Sportif Bakış Spor ve Eğitim Bilimleri Dergisi
E-ISSN : 2148-905X
Year: 2026, Volume: 13, Issue: 1, pp.: 129-138

The Effects of Strength Training on Physical Performance and Selected Biochemical Parameters in Kickboxers

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DOI: 10.70736/spjses.336		**Research Article**
Received:	*Accepted:*	*Published*:
29.01.2026	11.03.2026	15.03.2026

Abstract

Kickboxing is a sports branch that is popular in combat sports and is important in tecnic-tactic during the competition, the proficiency of the motor skills of the athletes, as well as the strength and flexibility of these motor skills to establish superiority against the opponent. Aim of this study, 8-week maximal strength exercises were carried out to determine the effects of amateur kickboxers on strength and flexibility motor skills, as well as the changes in blood parameters. Our study included 24 athletes actively participating in sports in Kayseri province. The experimental group consisted of 12 male athletes with an average age of 19.1±0.88, while the control group consisted of 12 male athletes with an average age of 19.57±0.48. In the 8-week period, strength exercises were applied to the experimental group 2 days a week in addition to the branch training, and no strength training program was planned for the control group, and they continued their existing branch training. Pre-test and post-test measurements were taken from the athletes Body weight (BW), body mass index (BMI), hand and leg strength, flexibility, total cholesterol (TC), low-density lipoprotein (LDL), high-density lipoprotein (HDL), glucose and Triglyceride (TG) measurements were taken. At the end of the study, it was found that there was a significant difference in BW, BMI, hand and leg strength, flexibility, TK and LDL measurements in the experimental group, while there was a significant difference only in LDL values in the control group ($p<.05$). In conclusion, an examination of the results of our study revealed that maximal strength exercises have an effect on maximal lifting force values and blood glucose, LDL, and cholesterol levels in kickboxers.

Keywords: Athletic performance, blood parameters, kickboxers, strength, training

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INTRODUCTION

Kickboxing it is stated that its origins were common in America in the 1960s and similar forms date back to 2000 years ago in east and West Asia Kickboxing is a sports branch in which two athletes fight in the ring within 2 minutes and 3 rounds and aim to win by hitting the person opposite in the strongest way in the hand, leg, elbow and knee regions. The categories of this branch are called muay thai, European and American style kickboxing, Chinese san shou and french savate and differ in various rules (Piepiora et al., 2022). In addition to various skills in Kickboxing, it is emphasized that tactics applied correctly are important for success (Buse, 2009; Silva et al., 2011). In amateur and professional competitions, the importance of physical condition, mental state, technical and tactical competition is emphasized (Negrea et al., 2019). In another expression, it is stated that a strong anaerobic capacity is required, and that the lower and upper extremities must display a strong performance in attack and defense (Ouergui et al., 2014; Ouergui et al., 2016).

In this sport branches, which can cause serious injuries as a result of blows to the head and risky areas during the preparation period and the competition period, may encounter some bad situations in their physical and mental health in the later stages of their lives (Gartland et al., 2001; Zazryn et al., 2003). Strength in sports is defined as the ability of the muscle to overcome a resistance as a result of stretching and relaxation, and it is stated that it depends on the biomechanical feature of the movement and the extent of contraction of the muscles involved (Bompa, 2007). Force; It is evaluated in 3 classes as static, dynamic and amortized. Flexibility is defined as the ability of the joints to move in the widest possible range. Flexibility is an important motor skill in achieving results in individual or team sports (Ramsay, 2015).

The examination of the effect of performance on the hormonal, biochemical and physiological status kickbox branches showed that the plasma levels of growth hormone, testosterone, cortisol, glucose, and some of biochemical parametres were raised after a simulated kickboxing match and training period (Ouergui et al., 2016). According to a statement, fight sport branches effect blood parameters, heart rate and lactate level (Benekeet et al., 2004). It has been statement that blood parameters influence the type and HITT of the exercise, while exercise practice also effects biochemical parameters (Karadağ et al., 2018).

Physiological changes occur acutely and chronically in individuals who train (Fox, 1999). Cholesterol is a substance in the blood that is similar to insoluble fat under normal conditions. When combined with cholesterol and protein, it turns into lipoprotein. Types of lipoproteins; It is divided into low density (LDL), high density (HDL), VDL, IDL, chylomicron. Regular physical activities increase HDL and decrease LDL (Merteens & Holvoet, 2001). Strenght exercise can be effect some of bichemical blood parameters and increase level of blood parameters glucose, lactate, HDL, LDL etc. (Smilios et al., 2003). Exercise is effect hematologic and according to a statement type of exercise can influence biochemical blood parametres and body composition (Guyton & Hall, 1996). Triglyceride (TG) is a type of lipid found in the blood. High lipid levels in the blood indicate cardiovascular risk factors. TG, which is stored as an energy source in adipose tissue, can be used as an energy source in muscles and other tissues (Çetinkalp, 2017). Glucose is retained by the brain, skeletal

muscles, the rest by the kidney, internal organs, erythrocytes, and other tissues, and during exercise, glucose enters muscle cells (Steppel & Horton, 2008).

Aim of this study, it was conducted to determine the effect of strength exercises on strength, flexibility and blood parameters (Cholesterol, HDL, LDL, TG, Glucose) in male amateur kickboxers, It is believed that the results of our research will contribute to the organization and implementation of training programs for kickboxing coaches. Furthermore, in terms of its contribution to the literature, it will be beneficial for sports scientists working in the field of strength training, providing a reference for their research.

H_1: There were differences between the experimental and control groups in body composition, strength performance, and flexibility measurements as a result of strength training.

H_2: There were differences between the experimental and control groups in some selected blood parameters as a result of strength training.

METHOD

Research Model

The study was designed as a pre-test and post-test with experimental and control groups. Twenty-four athletes actively participating in kickboxing in Kayseri province were included in our study. In this research, power analysis was performed using G*Power 3.1 program to determine the sample size. In the analysis, t test (paired samples t-test) was selected for the dependent groups as the statistical test. The effect magnitude was determined as d=.60, which is considered to be moderate according to Cohen's classification. Significance level was taken as α=.05 and statistical strength (1-β)=.80. As a result of a priori power analysis, it was determined that the minimum sample size required in the study should be 24 participants. The experimental group consisted of 12 male athletes with an average age of 19.1±.88, and the control group consisted of 12 male athletes with an average age of 19.57±.48. In our study, over an 8-week period, the experimental group received strength training twice a week (Tuesday-Thursday), in addition to their regular training, with one day of rest between training sessions and training times of 3:00 PM. Prior to the administration of the physical measurement tests, athletes were adjusted to a standardized relative intensity of 65% maximum heart rate at the cardiovascular stage for the warm-up protocol. For the protocol-specific activity prior Before these training sessions, necessary active warm-up exercises were performed to prevent injuries and prepare for the load, and nutritional status was optimized before the training program. The control group did not receive any strength training program and continued with their existing regular training. Informed consent forms were completed by the participating athletes, and necessary permissions were obtained from their families and club management.

Research Group

Experimental group in our study; 12 non-elite kickboxers with an average age (19.18±.876 years) and an average height (176.18±3.842cm) participated on a voluntary basis. Before the research, the participants were informed and the study started. The control group consists of

12 male athletes with an average age (19.57±.485 years) and an average height (179.54±2.761).

Data Collection Tools

Physical performance measurements (height, body weight, BMI): For the height measurement of the participants in the study, Vestel Vfit brand smart scales were used for body weight and BMI measurements, a height meter fixed to the wall with a measurement accuracy of 0.1

Bench Press: In the measurements, the maximum load that the participants can lift on the Decathlon brand weight bench was calculated and 2 applications were requested, and the highest value was recorded with kilogramme (Pijnappels & Burg, 2007).

Right and Left Hand Grip: Yissone brand device was used for hand grip strength measurements, and the highest grade was recorded in kg at the end of 2 repetitions (Verstrate et al., 2007).

Leg Press: In our research, was used for leg strength measurements 'diesel evog' brand legg press weight device, after two repetitions and the best value was recorded with kilogramme (Pijnappels & Burg, 2007).

Flexibility Measurement: Athletes performed 2 trials on a flat surface using a flexibility bench, and the best grade was recorded in santimeter (Verstrate et al., 2007).

Blood Analysis: Before blood sampling from the experimental group, appropriate information was provided, and necessary hygiene rules were observed to reduce the risk of infection. 5 cc blood samples were taken from both groups on the first day before the training program began and on the last day after the training programs, ensuring the patient was fully rested and comfortable. Blood measurements were taken from the inside of the right arm (with a tourniquet applied 10-15 cm from the top). The collected blood samples were analyzed in an authorized laboratory and transferred to the E-pulse application by a specialist healthcare professional.

Table 1. Training schedule

Type of Exercise	Weeks	Intensity	Repetition	Rest of time (min)
Leg Extension	**1st, 2nd, 3rd**	85%	5	3
Squat		85%	5	3
Bench Press		85%	5	3
Dumbell Curling		85%	5	3
Leg Extension	**4th, 5th, 6th**	90%	3	2
Squat		90%	3	2
Bench Press		90%	3	2
Dumbell Curling		90%	3	2
Leg Extension	**7th, 8th**	95%	2	1
Squat		95%	2	1
Bench Press		95%	2	1
Dumbell Curling		95%	2	1

Data Analysis

SPSS 22 program was used in the analysis of the findings in the study. In the study, Descriptive statistics (mean±standard deviation) were used tosummarize the demographic characteristics and physical performance parameters of the participants. To examine the

normality of the data distributions, Shapiro-Wilk test was applied. As the data were found to be normally distributed, parametric tests were used for further analyses. For the comparison of pre-test and post-test results within the same group, paired samples t-tests were conductedIn blood measurements, it was found that the data did not show normal distribution and Wilcoxon Signed Rank test was used that is data, which is one of the non-parametric tests. The significance level was set between p<.01-.05.

FINDINGS

Table 2. Body composition, strength and flexibility measurements of the experimental group

Variable	Test	Min.	Max.	Mean	SD.	t	p
Body Weight^{cm}	Pre-test	67.55	79.60	73.59	3.387	3.689	**.004***
	Post-test	65.61	80.80	72.51	4.424		
BMI$^{kg/m2}$	Pre-test	22.15	25.92	23.71	1.163	3.752	**.004***
	Post-test	21.74	25.41	23.36	1.222		
Bench Press^{kg}	Pre-test	72.50	92.50	78.95	5.795	-4.400	**.001***
	Post-test	75.00	97.50	83.40	2.397		
Right Hand Grıp^{kg}	Pre-test	32.0	40.51	39.27	3.926	3.597	**.005***
	Post-test	34.0	41.68	41.27	3.663		
Left Hand Grıp^{kg}	Pre-test	30.0	38.0	34.27	2.327	5.221	**.000***
	Post-test	31.0	41.0	36.63	2.618		
Leg Press^{kg}	Pre-test	115.0	172.5	143.86	20.065	7.402	**.000***
	Post-test	117.5	175.0	148.40	20.616		
Flexibility^{cm}	Pre-test	31.20	38.20	35.01	1.823	2.254	**.048***
	Post-test	32.90	41.90	36.15	1.932		

*p<.05, BMI=Body Mass Index, (Experimental Group, n=12)

When the data in Table 2 were examined, it was determined that there were significant changes in favor of the experimental group in body weight (cm), BMI (kg/m2), bench press (kg), right and left hand grip strength, leg press (kg), and flexibility (cm) performance measurements (p<.05).

Table 3. Measurement of blood parameters (experimental group)

Variable	Test	Min.	Max.	Mean	SD.	t	p
Cholesterol$^{mg/dL}$ **(Total)**	Pre-test	80	145	113.54	.874	-2.324	**.020***
	Post-test	79	141	108.27	7.716		
HDL$^{mg/dL}$	Pre-test	74	119	102.90	12.707	-1.612	.107
	Post-test	77	124	105.63	12.524		
LDL$^{mg/dL}$	Pre-test	69	91	78.63	6.622	-2.117	**.034***
	Post-test	69	89	76.36	5.766		
Triglyceride$^{mg/dL}$	Pre-test	91	135	111.81	13.991	-.402	.687
	Post-test	93	148	110.45	17.136		
Glucose$^{mg/dL}$	Pre-test	71	98	85.00	8.625	-1.619	**.024***
	Post-test	70	93	83.18	8.340		

*p<.05, HDL=High Density Lipoprotein, LDL=Low Density Lipoprotein, (Experimental Group n=12)

Examine data of Table 3, it was found that there was a significant change in cholesterol$^{mg/dL}$, LDL$^{mg/dL}$ and Triglyceride measurements in the blood measurements of the experimental group (p<.05). There are no significant change was found in HDL$^{mg/dL}$ and Glucose$^{mg/dL}$ measurements (p>.05).

Table 4. Body composition, strength and flexibility measurements of the control group

Variable	Test	Min.	Max.	Mean	SD.	t	p
Body Weight^{cm}	Pre-test	55.1	81.9	63.75	3.378	-2.784	.425
	Post-test	50.4	83.2	61.84	2.985		
BMI$^{kg/m2}$	Pre-test	17.5	24.3	22.7	1.933	-2.275	.125
	Post-test	17.1	23.9	22.4	1.128		
Bench Press^{kg}	Pre-test	73.5	89.5	77.5	6.854	-1.874	.652
	Post-test	74.2	93.4	77.9	5.865		
Right Hand Grıp^{kg}	Pre-test	28.0	48.0	31.5	5.814	-5.541	.184
	Post-test	24.0	48.0	27.6	4.985		
Left Hang Grıp^{kg}	Pre-test	29.0	47.0	3.4	5.245	-6.378	.632
	Post-test	25.0	47.0	34.9	5.189		
Leg Press^{kg}	Pre-test	121.5	168.5	139.4	18.454	-5.951	.057
	Post-test	123.1	170.1	147.8	17.112		
Flexibility^{cm}	Pre-test	30.40	39.80	33.90	1.452	-1.781	.291
	Post-test	34.54	43.70	37.40	.980		

*p<.05, BMI= Body Mass Index, (Control Group, n=12)

Examining of Table 4 (control group n=12), there are no significant change was found in body weight^{kg}, BMI$^{kg/m2}$, bench press^{kg}, right and left hand grip strength, leg press^{kg} and flexibility^{cm} measurements (p>.05).

Table 5. Blood analysis results of control group

Variable	Test	Min.	Max.	Mean	SD.	t	p
Cholesterol$^{mg/Dl}$ **(Total)**	Ön-test	88	137	109.47	1.852	-2.755	.174
	Son-test	86	137	105.75	5.619		
HDL$^{mg/dL}$	Ön-test	73	119	104.12	9.111	1.721	.635
	Son-test	81	123	105.63	8.154		
LDL$^{mg/dL}$	Ön-test	79	119	79.97	7.136	-.951	**.005***
	Son-test	75	123	75.69	7.145		
Triglyceride$^{mg/dL}$	Ön-test	92	115	105.13	9.759	2.354	.064
	Son-test	95	113	101.45	14.002		
Glucose$^{mg/dL}$	Ön-test	68	86	75.36	5.853	1.085	.328
	Son-test	68	89	81.91	5.409		

*p<.05, HDL=High Density Lipoprotein, LDL=Low Density Lipoprotein, (Control Group n=12)

In the this results; it was found that there was a significant difference in cholesterol$^{mg/dL}$, HDL$^{mg/dL}$, Triglyceride$^{mg/dL}$, and Glucose$^{mg/dL}$ values (p>.05) but there is only significant different LDL$^{mg/dL}$ measurements (p<.05).

DISCUSSION AND CONCLUSION

In this study, which was conducted to determine the effect of 8-week strength exercises applied to amateur kickboxers on upper and lower extremity maximal load lifting values, flexibility and blood parameters, the findings were discussed by similiar reviewing the literature.

In the findings in Table 2, it was founded that there was a significant change (p<.05) in the experimental group (n=12) parameters of VA, BMI, upper extremity arm and hand grip strength, and lower extremity measurements. In the control group (Table 4, n=12), although there was a change, there was no significant difference (p>.05). In a study on Turkish kickboxing national team athletes, it was determined that there was a significant difference in body weight measurements.

In their study, Kızılca and Okut (2025) observed significant improvements in back strength (t=-2.336; p= 0.044) and dominant hand grip strength (t=-2.877; p= 0.018) in the experimental group and these improvements supported the post-test results. Beilke et al., (2013) found that there was an improvement in the strength performance data of the participants after the 8-week exercise program applied. Ambrozy et al., (2022) found that there was a significant difference in strength performance measurements of lower and upper extremity strength exercises in kickboxers (p<.05). In the same study, similar results were taken obtained with our study in flexibility measurements.

Soykan et al., (2011) did not find that there was a significant difference between the leg strength measurements of the participants in their study (p>.05). Akman and Orhan (2020) found a difference in leg strength measurements in taekwondo players in their study (p<.05). Wirth et al., (2015), similar results were obtained with our current study between measurements (p<.05). İpek and Korkmaz (2022) found that there was a significant difference in flexibility and strength measurements in their study on muay-tai athletes (p<.05).

There are studies in the literature with similar and different results. It is valid that the planned strength exercise protocol has a positive effect on the lifting performance of the athletes. The findings in the control group support this statement. However, it is thought that factors such as the training protocol of the sample group, the sports history and the level of competition (local, national, international etc.), the competition period may be effective in the difference in the mists obtained.

In the findings in Table 3, as a result of the blood analyzes of the athletes in the experimental group, it was found that there was a significant change in total Cholesterol, LDL and Glucose measurements, while there was a difference in only LDL measurements in the control group (p<.05). Jówko et al., (2017) ın their study, they found that there was a significant difference in triglyceride, LDL, HDL values. Melnik et al., (2022) found significant changes in cholesterol and HDL measurements (p<.05), but no significant change was found in LDL values (p>.05). In the smilar study, in which an 8-week exercise protocol was applied with the participation of taekwondo players, similar findings were obtained in the measurements of Cholesterol, LDL, TG (p<.05) with our current study (Sung et al., 2017). Lobigs et al., (2018), it was found that there was a significant difference in LDL measurements (p<.05). In a study conducted on combat athletes, it was found that there was no significant change (p>.05) in the LDL values of the participants after the exercise program (Reljiç et al., 2016). It is thought that diets for match periodic weight reduction in athletes can affect changes in blood parameters.

As a result, it is seen that there is an increase in the maximum strength lift averages of the planned strength exercise protocol applied to kickboxers participating in the competitions as amateurs. It is thought that when these features are combined with technical training in athletes, their performance in competitions may increase. It is thought that the change in blood values after the strength exercise program in the experimental group is due to the effect of exercise on the human organism, and the difference in LDL values in the control group may be due to the effect of exercise on these values. In addition, it is thought that body weight control is an important element in this branch, and food consumption, especially in the pre-

competition period, is effective in the differentiation of blood values. It is believed that the results of our research will contribute to the organization and implementation of training programs for kickboxing coaches. Furthermore, in terms of its contribution to the literature, it will be beneficial for sports scientists working in the field of strength training, providing a reference for their research. More detailed studies with different working groups and a larger number of subjects are recommended.

Recommendations

End of the this study, all of the results commend only this group (male n=12) and can be practice similiar others studies. In addition, this qualitative research can be obtained from other research methods to obtain more in-depth results. Nutritional habits should be controlled during the period when maximal strength exercises are applied in amateur sports. Especially during the pre-tournament preparation period, blood measurements should be made and analyzed with the help of experts. Trainers should have knowledge in evaluating these parameters and it is recommended to renew their training and nutritional status according to the performance status of the athletes.

REFERENCES

Akman, O. & Orhan, Ö. (2020). Genç milli taekwondocuların bacak kuvveti ile çeviklik değerleri arasındaki ilişkinin incelenmesi. *International Social Mentality and Researcher Thinkers Journal, 6*(32), 927-935. http://dx.doi.org/10.31576/smryj.543

Ambroży, T., Rydzik, Ł., Kwiatkowski, A., Spieszny, M., Ambroży, D., Rejman, A., & Czarny, W. (2022). Effect of crossfit training on physical fitness of kickboxers. *International Journal of Environmental Research And Public Health, 19*(8), 4526. https://doi.org/10.3390/ijerph19084526

Beilke, C., Hetzel, L., Kreft, B., Pan, L., & Schroeder, J. (2012). Crossfit training ımprovements in sport performance and body composition in young healthy adults. Department of Kinesiology, University of Wisconsin-Eau Claire.

Beneke, R., Beyer, T., Jachner, C., Erasmus, J., & Hütler, M. (2004). Energetics of karate kumite. *European Journal of Applied Physiology, 92*(4), 518-523. https://doi.org/10.1007/s00421-004-1073-x

Bompa, T.O. (2007), Training theory and method. Sports Publishing House and Bookstore

Buse G. J. (2009) Kickboxing. In: Kordi R, Maffulli N, Wroble R., & Wallace W, (Eds.). *Combat Sports Medicine.* Springer (pp. 331-351).

Çetinkalp, Ş. (2017). Trigliserit nedir? Normal fizyolojideki yeri nedir? *Turk Kardiyol Dern Ars*, 45(1), 1-63. https://doi:10.5543/tkda.2017.77459

Fox, E. L., Bowers, R. W., & Foss, M. L. (1999) Beden eğitimi ve sporun fizyolojik temelleri. Cerit, M. (Çeviren). Bağırgan Yayınevi

Gartland, S., Malik, M. H. A., & Lovell, M. E. (2001). Injury and injury rates in muay thai kick boxing. *British Journal of Sports Medicine*, *35*(5), 308-313. http://dx.doi.org/10.1136/bjsm.35.5.308

Guyton M. D., & Hall J. E. (1996). *Tıbbi fizyoloji* (Çeviren Çavusoglu, H.), (9. Baskı), Yüce Yayınları, Alemdar Ofset.

İpek, İ., & Korkmaz, S. (2022). Farklı formlarda uygulanan yüksek şiddetli interval antrenmanın muay-thai sporcularının bazı fiziksel ve fizyolojik parametreleri üzerine etkisi. *ROL Spor Bilimleri Dergisi*, https://doi.org/10.29228/roljournal.62406

Jówko, E., Gierczuk, D., Cieśliński, I., Kotowska, J. (2017). Sod2 gene polymorphism and response of oxidative stress parameters in young wrestlers to a three-month training. *Free Radical Research*, *51*(5), 506-516. https://doi.org/10.1080/10715762.2017.1327716

Karadağ, M., Gür, E., Kargün, K., Savucu, Y., & Eskiyecek, G. (2018). Examination of changes in certain biochemical parameters before and after acute training in kick boxers. *Journal of Education and Training Studies, 6*(12), 235-238.

Kızılca, S., & Okut, S. (2025). The effect of a 4-week quick strength training program on body composition, strength, and jumping performance in kickboxers. *Journal of Education and Recreation Patterns (JERP), 6*(1), 113-125. https://doi.org/10.53016/jerp.v6i1.279

Lobigs, L. M., Sottas, P. E., Bourdon, P. C., Nikolovski, Z., El- Gingo, M., Varamenti, E., & Schumacher, Y. O. (2018). A step towards removing plasma volume variance from the athlete's biological passport: the use of biomarkers to describe vascular volumes from a simple blood test. *Drug Testing and Analysis, 10*(2), 294-300. https://doi.org/10.1002/dta.2219

Melnik, S. N., Belaya, L. A., Brel, Y. I., Konovalenko, V. P., & Haustova, E. S. (2022). Blood biochemical parameters in athletes of different types of sports. *Opera Medica et Physiologica*, *9*(2), 35-41.

Mertens, A. N. N., & Holvoet, P. (2001). Oxidized ldl and hdl: Antagonists in atherothrombosis. *The Faseb Journal*, 15(12), 2073-2084. https://doi.org/10.1096/fj.01-0273rev

Negrea, C., Leparda, A., Mirica, S. N., Domokos, M., Domokos, C., Bota, E., & Nagel, A. (2019). The training, nutrition and physical conditioning programme: A challenge for kickboxing athletes to achieve athletic greatness. *Timisoara Physical Education and Rehabilitation Journal*, *12*(22), 18-25. https://doi.org/10.2478/tperj-2019-0003

Ouergui, I., Davis, P., Houcine, N., Marzouki, H., Zaouali, M., Franchini, E., & Bouhlel, E. (2016). Hormonal, physiological, and physical performance during simulated kickboxing combat: Differences between winners and losers. *International Journal of Sports Physiology, Performance*, *11*(4). https://doi.org/10.1123/ijspp.2015-0052

Ouergui, I., Hssin, N., Haddad, M., Franchini, E., Behm, D. G., Wong, D. P., & Bouhlel, E. (2014). Time-motion analysis of elite male kickboxing competition. *The Journal Of Strength Conditioning Research*, *28*(12), 3537-3543. https://doi.org/10.1519/JSC.0000000000000579

Piepiora, P., Komarnicka, N., Gumienna, R., & Maśliński, J. (2022). Personality and gender of people training in kyokushin karate and kickboxing. ıdo movement for culture. *Journal of Martial Arts Anthropology*, *22*(1), 35-45. https://doi.org/10.14589/ido.22.1.6

Pijnappels, M., Van der Burg, J. C. E., Reeves, N. D., & van Dieën, J. H. (2008). Identification of elderly fallers by muscle strength measures. *European Journal of Applied Physiology, 102*, 585-592. https://doi.org/10.1007/s00421-007-0613-6

Ramsay, G. (2015). *The anatomy of stretching movements.* Rationale Books

Reljic, D., Feist, J., Jost, J., Kieser, M., & Friedmann-Bette, B. (2016). Rapid body mass loss affects erythropoiesis and hemolysis but does not impair aerobic performance in combat athletes. *Scandinavian Journal Of Medicine & Science İn Sports*, *26*(5), 507-517. https://doi.org/10.1111/sms.12485

Silva, J. J. R., Del Vecchio, F. B., Picanço, L. M., Takito, M. Y. & Franchini, E. (2011), Time-motion analysis in muay-thai and kick-boxing amateur matches. *Journal of Humansport And Exercise*, *6*(3), 490-496.

Smilios, I., Pilianidis, T., Karamouzis, M., & Tokmakidis, S. P. (2003). Hormonal responses after various resistance exercise protocols. *Medicine & Science in Sports & Exercise*, *35*(4), 644-654. https://doi.org/10.1249/01.MSS.0000058366.04460.5F

Soykan, A., Ateş, O., Güler, & Yılmaz, M. (2011). 21 yaş altı karate elit kata-kumite sporcularının bacak kuvveti ile çabukluklarının karşılaştırılması. *Uluslararası Hakemli Akademik Sosyal Bilimler Dergisi* 1(1), 96-100.

Steppel, J. H., & Horton, E. S., (2008). *Exercise in patients with diabetes mellitus.* Joslin's Diabetes Mellitus

Sung, Y. C., Liao, Y. H., Chen, C. Y., Chen, Y. L., & Chou, C. C. (2017). Acute changes in blood lipid profiles and metabolic risk factors in collegiate elite taekwondo athletes after short-term de-training: A prospective insight for athletic health management. *Lipids in Health And Disease, 16*(1), 1-10.

Verstraete, S. J., Cardon, G. M., De Clercq, D. L., & De Bourdeaudhuij, I. M. (2007). A comprehensive physical activity promotion programme at elementary school: The effects on physical activity, physical fitness and psychosocial correlates of physical activity. *Public Health Nutrition, 10*(5), 477–484. https://doi.org/10.1017/S1368980007223900

Wirth, K., Keiner, M., Szilvas, E., Hartmann, H., & Sander, A. (2015). Effects of eccentric strength training on different maximal strength and speed-strength parameters of the lower extremity. *The Journal Of Strength & Conditioning Research*, *29*(7), 1837-1845. http://dx.doi.org/10.1519/JSC.0000000000000528

Zazryn T. R., Finch C. F., & Mccrory, P. (2003). 16 year study of injuries to professional kick boxers in the state of victoria, Australia. *British Journal of Sports Medicine, 37(4), 321-324.* http://dx.doi.org/10.1136/bjsm.37.4.321

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Statement of Ethics Committee	
This research was conducted with the protocol decision dated 25/09/2024 and numbered 7612 of the Ethics Committee of Siirt University	
Statement of Conflict	
Researchers do not have any personal or financial conflicts of interest with other people and institutions related to the research.	
Statement of Support and Acknowledgment	
No contribution and/or support was received during the writing process of this study.	
Generative AI Use Statement	
An artificial intelligence tool was not used for data analysis, interpretation of results, or creation of scientific content.	