REPETITIVE SPRINT OR CALISTHENICS TRAINING: WHICH IS MORE SUCCESSFUL FOR ATHLETIC PERFORMANCE?

Cengiz Ölmez[1], İbrahim Orkun Akcan[2]

[1]Physical Education and Sport Department, Sport Sciences Faculty, Trabzon University, Turkey
[2]Physical Education and Sport Department, School of Physical Education and Sports, Erzincan University, Turkey

DOI. 10.51371/issn.1840-2976.2021.15.2.5 Original scientific paper

Abstract

This study aims to compare the effects of repetitive sprint and calisthenics training methods on athletic performance improvement. The study was carried out with the voluntary participation of 20 international level kickboxers. Athletes were randomly assigned into two groups as Repetitive Sprint Training Group (RSTG) (n=10; age: 20, 20±1,32 years) and Calisthenics Training Group (CTG) (n=10; age: 21,20±1,23 years). Athletes participated in the training of their groups for six weeks, three times a week, every other day. The effects of training methods on the performance improvement of athletes were examined by measurements and tests performed at the pre-test (T1), interim-test (T2), and post-test (T3) stages. Athletes' height, body composition (body weight, body mass index, body fat mass), aerobic endurance (VO2max), peak anaerobic power, and isometric leg (knee, flexion-extension) strength values (60º/sec- 90º/sec) has been examined. At the end of the study, the data were analyzed at a 95% significance level. The results of the study revealed that the repetitive sprint and calisthenics training methods were effective on body composition, aerobic endurance, anaerobic power, and isokinetic strength parameters ($p1<0.05$), but the effect level was similar in both training methods ($p2>0.05$). Repetitive sprint and calisthenics training methods are both effective in regulating the body composition of athletes and accelerating aerobic endurance, power, and strength progress, but when designed at similar training intensity, both methods have similar effects.

Keywords: *Isokinetic strength, power, body composition, sprint training, calisthenics training*

Introduction

Numerous training methods have been designed to achieve the physical and motor conditions required to achieve success in sports. As in all sports, athletes must always be strong and resilient in martial arts (Chiu et al., 2007; Matsushigue et al., 2009; Pieter, 2009; Yüksek & Ölmez, 2020). This necessity drives trainers and athletes to think over choosing the training that best suits their purpose. This situation can be particularly confusing concerning the development of aerobic and anaerobic features. For this reason, this study compared the effects of calisthenics and repetitive sprint training, two commonly used high-intensity training methods, on athletic performance.

The word calisthenics is derived from two Greek words, "Kàlos" meaning beauty, and "Sthénos" meaning power. Although Calisthenics was originally developed in the United States as a series of bodyweight exercises used to improve the overall fitness level of girls, later on, it has evolved into a training culture aimed at improving health and fitness using body weight (Beecher, 1856; Mark, 1957; Otzen, 1988). The purpose of this training method is to improve strength and endurance without the need for any special equipment and places. In calisthenics training, bodyweight is used as resistance; since the exercise intensity can be regulated, it can be used in many different areas, from military training to general health improvement (Basso-Vanelli et al., 2016; Gist et al., 2015; Greulich et al., 2014; Harman et al., 2008).

Another type of training in which body weight is used as a training load is running. Among the runs, sprints are the type with the highest intensity. Bishop et al. (2011), reported that repetitive sprints (≥10 s) require performance at the highest possible power and speed. Repetitive sprint training is associated with strength, speed, repetitive-sprint ability, and endurance components and is recommended for performance improvement (Eniseler et al., 2017; Fernandez-Fernandez et al., 2012; Taylor et al., 2015).

This study aims to examine the effects of repetitive sprint and calisthenics training on the development of body composition, aerobic endurance, anaerobic power, and isokinetic strength related to athletic performance. The study compared the effects of two popular training methods on athletic performance and recommendations were made to sports scientists and trainers.

Methods

Experimental Approach to the Problem

In the study, pre-test, interim-test, and post-test were applied to both groups with two-week intervals (Figure 1). At the end of the study, the changes in the development of the Repetitive Sprint Training Group (RSTG) and Calisthenics Training Group (CTG) were compared within the group (change over time) and between the groups (RSTG x CTG).

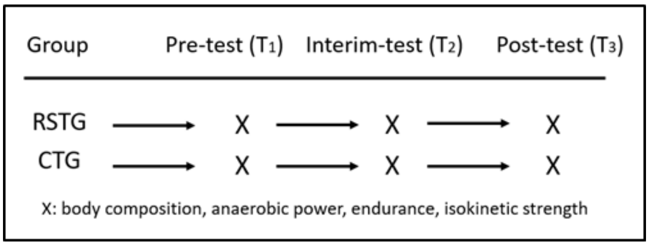

Figure 1: The implementation of the study

Participants

The study was conducted with 20 randomly selected international level kickbox athletes who volunteered to participate in the study, 10 in the Repetitive sprint training group ($\bar{x}$age: 20,20±1,32 years) and 10 in the calisthenics group ($\bar{x}$age: 21,20±1,23 years). All athletes were informed about the study design and were explained about the possible benefits and risks of the research. After expression, all athletes were given a written informed consent from which was prepared according to the Declaration of Helsinki. The study was conducted in compliance with the ethical principles of the European Convention and the Helsinki Declaration (ethics principles regarding human experimentation). It was confirmed by the Bioethics Commission of the Gazi University (no: 91610558-302.08.01).

Procedures

Athletes were divided into two groups as calisthenics training group (CTG) and repetitive sprint training group (RSTG). Athletes participated in the training of their groups for six weeks, three times a week, and every other day. Table 1 shows the specifics of the training programs.

Calisthenics Training: Calisthenics training is designed according to the Tabata Protocol. This training protocol consists of a total of 4 sets of 8 moves each, with the principle of 20-second intervals performed at maximum effort and 10-second stages of rest. It is stated that high-intensity interval training at an appropriate level improves anaerobic and aerobic energy systems (Tabata et al., 1996). In the CTG program, sprint, crunches, burpees, plank, mountain climbing, squats, jumping jacks, and bicycle crunches were applied respectively for each session of six weeks of training. The sets of the 6-week training program were determined as 4x8 for the 1st and 2nd weeks, 5x8 for the 3rd and 4th weeks, and 6x8 for the 5th and 6th weeks, with 1-minute rest between sets.

Repetitive Sprint Training: Repetitive sprint is defined as the ability to apply Repetitive sprints with minimum recovery time or presenting the best mean sprint performance of successive sprints (Bishop et al., 2011). Both straight-line repetitive sprints and multi-directional repetitive sprints are frequently used to increase physical capacity in many sports branches (Buchheit et al., 2012; Koral et al., 2018). The athletes did the training as four sets in the first two weeks, five sets in the 3rd and 4th weeks, and six sets in the last two weeks, with each set of 30 seconds max (all-out effort) loading. A Four-minute rest period was given between each set.

The repetitive sprint training sessions were held on a 25-meter-long straight running field with 5-meter-spaced marker lines (Figure 2). The instructions were to travel the greatest distance possible in 30 seconds, making trips of 5, 10, 15 m, etc. During the 4-minute recovery period, the athletes walked back to the start line where they waited for the following repetitions (Koral et al., 2018).

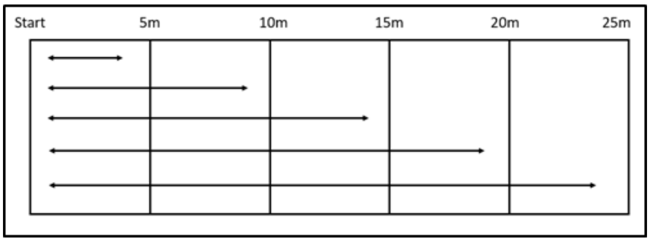

Figure 2. Repeated sprint training

Measurement and Tests

Body Composition Measurements: To determine the body composition of the athletes, their height, body weight, body mass index, and body fat mass values were determined.

The height of the athletes was measured with a Holtain brand (UK) stadiometer, while body mass index, and total body fat measurements were performed using the foot-to-foot bioelectrical impedance analysis (Tanta Body Composition Analyzer) at 10.00 AM.

Anaerobic Power measurements: The anaerobic power performances of the athletes were determined by Wingate cycle ergometer (Monark Peak Bike 894-E). The athletes were warmed up for 5 minutes at 60-80 rpm before the test. After the warm-up, the saddle, handlebar, and seat height were adjusted for each athlete. The seat height was adjusted as the knee angle was 175º in flexion position, while the athlete's foot was on the pedal with the pedal in its lowest position. Before the test, 7.5% of the body weight of the athletes was equally placed on the weight baskets. When the athletes were ready, the test was started. The athletes were asked to show maximum performance for 30 seconds. After the test started, when the pedaling force reached 150 rpm, the weight baskets automatically dropped and the athletes pedaled at maximal speed against the resistance in the weight baskets (Bar-Or, 1987; Inbar et al., 1996).

Endurance Measurements: The multistage shuttle run test was used to assess the aerobic power and capacity of the athletes. An indoor area was chosen so that the running test is not affected by the weather conditions. The test was terminated for the athletes who could not reach the target line twice in a row and the VO2max was calculated (Léger et al., 1988).

Isokinetic Strength Measurements: The isokinetic strength performances of the athletes were examined using the Biodex S4 isokinetic force dynamometer (Biodex Medical System Inc, Shirley, NY, USA). The athletes were asked to use their dominant legs during measurement and to hold the handles on both sides of the device. The athletes were not allowed to lean forward and hold their breath during the measurement. The weight of the extremity to be measured and the lever arm was calculated for each athlete. The torque was determined by calculating the effect of gravity using computer software. The knee extension and flexion tests were performed with 5 maximal contractions at two different angular velocities (60o/sec and 90o/sec). Athletes were asked to make 5 trials before each measurement. The athletes were allowed to passive rest for 90 seconds between each test. The peak torque values of the athletes were determined in the measurements.

Statistical Analysis

The normality and homogeneity were controlled before the analysis using the Shapiro-Wilk and Levene test. The Paired Samples T-Test and rate of change (RC %) was used within the groups, while the Independent Samples T-Test was used between the groups. All data were presented as mean, standard deviation, minimum and maximum (range) values. SPSS 25 was used for statistical analysis and the level of significance was set at p<0,05.

Table 1. CTG and RSTG training program

Weeks	Group	Training frequency	Set point	Duration	Load
1	CTG	3	4	20 sec. load 10 sec. rest	All Out - Effort
	RSTG	3	4	30 sec. Repetitive sprint 240 sec. rest	All Out - Effort
2	CTG	3	4	20 sec. load 10 sec. rest	All Out – Effort
	RSTG	3	4	30 sec. Repetitive sprint 240 sec. rest	All Out – Effort
3	CTG	3	5	20 sec. load 10 sec. rest	All Out – Effort
	RSTG	3	5	30 sec. Repetitive sprint 240 sec. rest	All Out – Effort
4	CTG	3	5	20 sec. load 10 sec. rest	All Out – Effort
	RSTG	3	5	30 sec. Repetitive sprint 240 sec. rest	All Out – Effort
5	CTG	3	6	20 sec. load 10 sec. rest	All Out – Effort
	RSTG	3	6	30 sec. Repetitive sprint 240 sec. rest	All Out – Effort
6	CTG	3	6	20 sec. load 10 sec. rest	All Out – Effort
	RSTG	3	6	30 sec. Repetitive sprint 240 sec. rest	All Out - Effort

CTG: Calisthenics training group; RSTG: Repetitive sprint training group

Results

Body mass index, VO2max levels, anaerobic power, and isokinetic strength performances of the athletes were examined. It was found that there were significant changes in the body composition of the athletes in both groups ($p1<0,05$). However, it was determined that the difference between the groups was not statistically significant and both types of training had a similar effect on athletes ($p2>0,05$) (Figure 3).

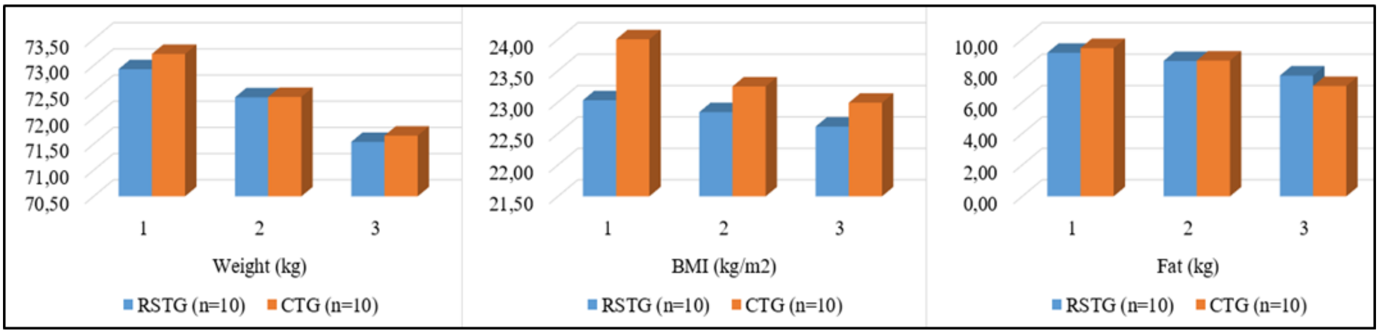

Figure 3. Changes in RSTG and CTG body compositions

As a result of the athletes' anaerobic power performances examination, it was found that the athletes of both groups showed improvement during the study (p1<0.05). However, this improvement was at a similar level (p2> 0.05) in both groups (Figure 4).

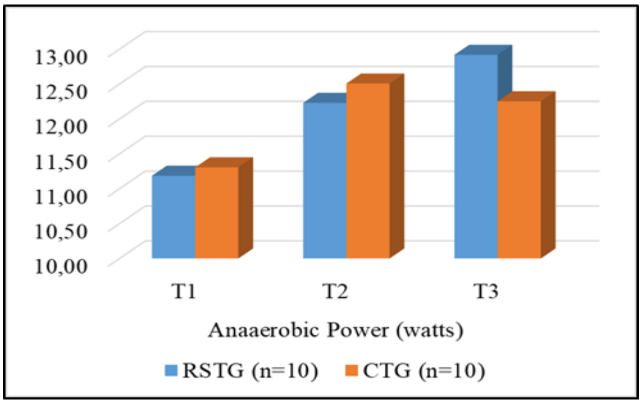

Figure 4. Changes in RSTG and CTG anaerobic power performances

In the examination of the endurance performances of the athletes, it was determined that the athletes of both groups showed improvement during the study. In the comparison between the groups, it was determined that there was no difference between the 1st and 2nd measurement results; However, the difference between the 3rd measurement results was statistically significant in favor of RSTG (p2<0,05) (Figure 5).

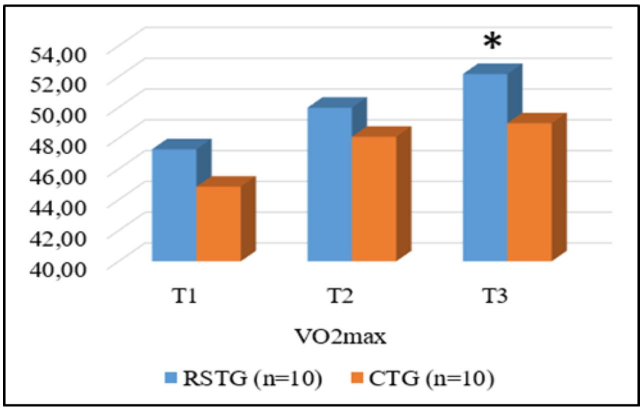

Figure 5. Changes in RSTG and CTG VO2max performances

As a result of the examinations, it was determined that the improvement in the isokinetic (60º/sec and 90º/sec) extension strength performance of RSTG athletes was not significant (p1>0.05), while the improvement in the flexion strength performances was significant (p1<0.05). It was determined that the CTG athletes' improvement in the flexion and extension strength performances at an angular velocity of 60º/sec was not significant (p1> 0.05), while the difference between the 1st and 2nd measurements results at an angular velocity of 90º/sec was significant (p1 <0,05). In the analysis of intergroup differences, it was found that the differences were not statistically significant, and both training methods had a similar effect on the athletes (p2> 0.05) (Figure 6).

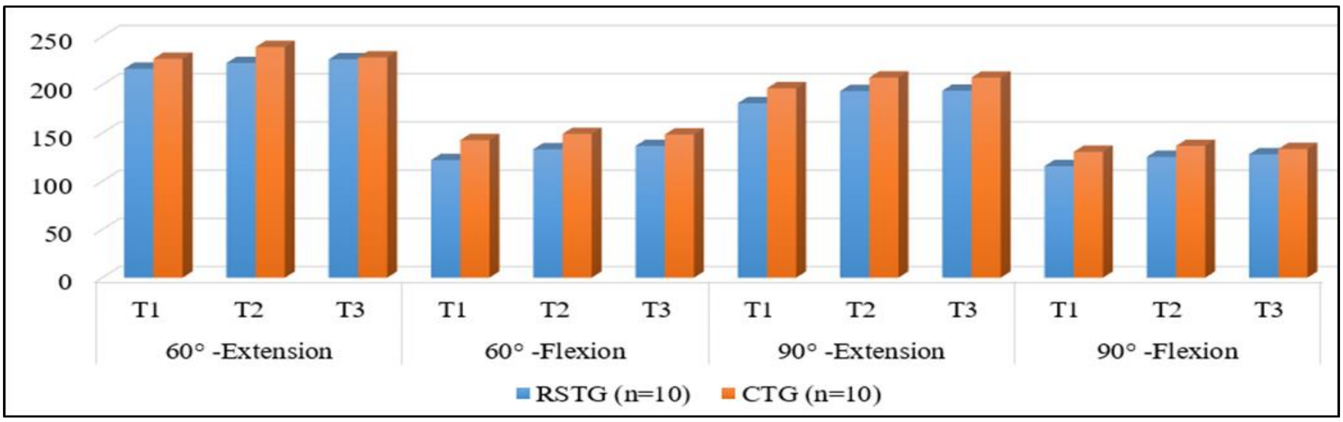

Figure 6. Changes in RSTG and CTG isokinetic force performances

Discussion

This study aims to compare the effects of repetitive sprint and calisthenics training on body composition, aerobic endurance, anaerobic power, and isokinetic strength development. The study results revealed that both the repetitive sprint and calisthenics training, with similar intensity, were effective both in short-term, two-week intervals and in a relatively long period of six weeks. However, the intergroup comparison findings revealed that repetitive sprint and calisthenics training in the short (2 weeks) and medium-term (6 weeks) had a similar effect on athlete development. Previous studies support our findings. Thomas et al. (2017), reported that calisthenics training is an effective and economical training method for body composition and strength development. Similarly, Gist et al. (2015), reported that calisthenics training is an effective training method for maintaining fitness even in short-term and low-intensity. It was noted that a comprehensive program including calisthenics and high-intensity exercises would be very suitable for maintaining fitness in moderately trained individuals who do not have access to equipment (Gist et al., 2015). Harman et al. (2008), reported that two different calisthenics-based military training methods, the new Standardized Physical Training (SPT) program, and the Weight-Based Training (WBT) experiment program, can provide similar significant improvements in military physical performance in a relatively short (8-week) training.

Studies show that repetitive sprint training provides physical, physiological, and motor skills developments, as in calisthenics training. Campa et al. (2019), reported that repetitive sprint training is effective in reducing body fat and increasing motor skills performance. Similarly, Brocherie et al. (2014), reported that athletes' strength qualities and repetitive sprint performances are related to high muscle mass and low body fat. On the other hand, the in-group isokinetic strength analysis results showed that the flexion force exhibited at an angular velocity of 60º/ sec and 90º/sec was more regular and higher in RSTG athletes. Previous studies have reported positive effects of repetitive sprint training or running-based exercise programs on lower extremity flexor and extensor strength in various sports branches. Eniseler et al. (2012), reported that basic daily soccer training and weekly competitions may cause changes in knee strength at high angular velocities. Newman et al. (2004), on the other hand, reported that there is a high level of correlation between isokinetic knee strength and sprint performance; but there may be different variables affecting repetitive sprint performance. Nunes et al. (2016), stated that isokinetic knee strength is positively associated with sprint and repetitive sprint performance. Özgünen et al. (2021), reported that, after 8-week training, the peak moment, work, and power values of the dominant and non-dominant legs for both extensor and flexor muscle groups significantly improved at various angular velocities.

In our study, it was determined that RSTG and CTG athletes' VO2max levels make progress in 6 weeks. Also, intergroup comparisons showed that the progress was higher in RSTG athletes. However, previous studies have shown that while repetitive sprint and calisthenics training positively affect anaerobic-based characteristics, they did not cause significant progress in aerobic characteristics (Attene et al., 2015; Gist et al., 2015; Nunes et al., 2016). This result may be caused due to the differences in athletes' branches or the differences in their training programs. It was determined that there are limited studies conducted with kickboxers. In this respect, our study will make a significant contribution to the literature.

Conclusion

In conclusion, 6-week repetitive sprint and calisthenics training are effective in regulating body composition, increasing aerobic endurance, and accelerating the development of lower extremity power and strength of elite kickboxers, and the effects of both types of training are similar. Based on the results obtained from the study and previous studies, it can be stated that although repetitive sprint and calisthenics training are different training methods, when they are designed with similar scope and intensity, they show similar effects in 6-8 weeks. The long-term effects of these training methods may be different; more research is required on the long-term effects of these training methods.

References

Attene, G., Laffaye, G., Chaouachi, A., Pizzolato, F., Migliaccio, G. M., & Padulo, J. (2015). Repeated sprint ability in young basketball players: One vs. two changes of direction (Part 2). Journal of Sports Sciences, 33(15), 1553–1563. https://doi.org/10.1080/02640414.2014.996182

Bar-Or, O. (1987). The wingate anaerobic test an update on methodology, reliability and validity. Sports Medicine: An International Journal of Applied Medicine and Science in Sport and Exercise, 4(6), 381–394. https://doi.org/10.2165/00007256-198704060-00001

Basso-Vanelli, R. P., Pires di Lorenzo, V. A., Labadessa, I. G., Regueiro, E. M. G., Jamami, M., Gomes, E. L. F. D., & Costa, D. (2016). Effects of inspiratory muscle training and calisthenics-and-breathing exercises in COPD with and without respiratory muscle weakness. Respiratory Care, 61(1), 50–60. https://doi.org/10.4187/respcare.03947

Beecher, C. E. (1856). Physiology and calisthenics: for Schools and families. Harper & Brothers. https://books.google.com.tr/books/about/Physiology_and_Calisthenics.html?id=Y4Ahi9pw9XcC&redir_esc=y
Bishop, D., Girard, O., & Mendez-Villanueva, A. (2011). Repeated-sprint ability part II: recommendations for training. Sports Medicine, 41(9), 741–756. https://doi.org/10.2165/11590560-000000000-00000
Brocherie, F., Girard, O., Forchino, F., Al Haddad, H., Dos Santos, G. A., & Millet, G. P. (2014). Relationships between anthropometric measures and athletic performance, with special reference to repeated-sprint ability, in the Qatar national soccer team. Journal of Sports Sciences, 32(13), 1243–1254. https://doi.org/10.1080/02640414.2013.862840
Buchheit, M., Haydar, B., & Ahmaidi, S. (2012). Repeated sprints with directional changes: do angles matter? Journal of Sports Sciences, 30(6), 555–562. https://doi.org/10.1080/02640414.2012.658079
Campa, F., Semprini, G., Júdice, P. B., Messina, G., & Toselli, S. (2019). Anthropometry, physical and movement features, and repeated-sprint ability in soccer players. International Journal of Sports Medicine, 40(2), 100–109. https://doi.org/10.1055/a-0781-2473
Chiu, P.-H., Wang, H.-H., & Chen, Y.-C. (2007). Designing a measurement system for taekwondo training. Journal of Biomechanics, 40, S619. https://doi.org/10.1016/s0021-9290(07)70607-3
Eniseler, N., Şahan, Ç., Özcan, I., & Dinler, K. (2017). High-intensity small-sided games versus repeated sprint training in junior soccer players. Journal of Human Kinetics, 60(1), 101–111. https://doi.org/10.1515/hukin-2017-0104
Eniseler, N., Şahan, Ç., Vurgun, H., & Mavi, H. (2012). Isokinetic strength responses to season-long training and competition in Turkish elite soccer players. Journal of Human Kinetics, 31(1), 159–168. https://doi.org/10.2478/v10078-012-0017-5
Fernandez-Fernandez, J., Zimek, R., Wiewelhove, T., & Ferrauti, A. (2012). High-intensity interval training vs. repeated-sprint training in tennis. Journal of Strength and Conditioning Research, 26(1), 53–62. https://doi.org/10.1519/JSC.0b013e318220b4ff
Gist, N. H., Freese, E. C., Ryan, T. E., & Cureton, K. J. (2015). Effects of low-volume, high-intensity whole-body calisthenics on Army ROTC cadets. Military Medicine, 180(5), 492–498. https://doi.org/10.7205/MILMED-D-14-00277
Greulich, T., Kehr, K., Nell, C., Koepke, J., Haid, D., Koehler, U., Koehler, K., Filipovic, S., Kenn, K., Vogelmeier, C., & Koczulla, A. R. (2014). A randomized clinical trial to assess the influence of a three months training program (Gym-based individualized vs. Calisthenics-based non-invidualized) in COPD-patients. Respiratory Research, 15(1), 1–8. https://doi.org/10.1186/1465-9921-15-36
Harman, E. A., Gutekunst, D. J., Frykman, P. N., Nindl, B. C., Alemany, J. A., Mello, R. P., & Sharp, M. A. (2008). Effects of two different eight-week training programs on military physical performance. Journal of Strength and Conditioning Research, 22(2), 524–534. https://doi.org/10.1519/JSC.0b013e31816347b6
Inbar, O., Bar-Or, O., & Skinner, J. S. (1996). The wingate anaerobic test. Human Kinetics.
Koral, J., Oranchuk, D. J., Herrera, R., & Millet, G. Y. (2018). Six sessions of sprint interval training improves running performance in trained athletes. Journal of Strength and Conditioning Research, 32(3), 617–623. https://doi.org/10.1519/jsc.0000000000002286
Léger, L. A., Mercier, D., Gadoury, C., & Lambert, J. (1988). The multistage 20 metre shuttle run test for aerobic fitness. Journal of Sports Sciences, 6(2), 93–101. https://doi.org/10.1080/02640418808729800
Mark, M. V. (1957). A review of the use of the specific muscle calisthenics unit. Optometry and Vision Science, 34(12), 670–674.
Matsushigue, K. A., Hartmann, K., & Franchini, E. (2009). Taekwondo: Physiological Responses and Match Analysis. Journal of Strength and Conditioning Research, 23(4), 1112–1117. https://doi.org/10.1519/JSC.0b013e3181a3c597
Newman, M. A., Tarpenning, K. M., & Marino, F. E. (2004). Relationships between isokinetic knee strength, single-sprint performance, and repeated-sprint ability in football players. Journal of Strength and Conditioning Research, 18(4), 867–872. https://doi.org/10.1519/13843.1
Nunes, R., Buzzachera, C., Almeida, F., Da Silva, J., Flores, L., & Da Silva, S. (2016). Relationships between isokinetic muscle strength, measures of aerobic fitness, single sprint performance, and repeated-sprint ability in elite futsal players. Gazzetta Medica Italiana Archivio per Le Scienze Mediche, 175(5), 205–213.
Otzen, R. (1988). Recovering the past for the present: The history of Victorian Calisthenics. Lilith: A Feminist History Journal, 5, 96–112. https://search.informit.org/doi/abs/10.3316/ielapa.635040110056580
Özgünen, K., Özdemir, Ç., Adaş, Ü., Kilci, A., Boyraz, C., Eryilmaz, S. K., Günaşti, Ö., Askeri, N., & Kurdak, S. (2021). Effect of repeated sprint training on isokinetic strength parameters in youth soccer players. Isokinetics and Exercise Science, Preprint(Preprint), 1–9. https://doi.org/10.3233/ies-202231
Pieter, W. (2009). Taekwondo. In R. Kordi, N. Maffuli, R. Wroble, & Wallacei WA (Eds.), Combat Sports Medicine (pp. 263–286). Springer. https://doi.org/10.1007/978-1-84800-354-5
Tabata, I., Nishimura, K., Kouzaki, M., Hirai, Y., Ogita, F., Miyachi, M., & Yamamoto, K. (1996). Effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and VO(2max). Medicine and Science in Sports and Exercise, 28(10), 1327–1330. https://doi.org/10.1097/00005768-199610000-00018
Taylor, J., Macpherson, T., Spears, I., & Weston, M. (2015). The effects of repeated-sprint training on field-based fitness measures: a meta-Analysis of controlled and non-controlled trials. Sports Medicine, 45(6), 881–891. https://doi.org/10.1007/s40279-015-0324-9
Thomas, E., Bianco, A., Mancuso, E. P., Patti, A., Tabacchi, G., Paoli, A., Messina, G., & Palma, A. (2017). The effects of a calisthenics training intervention on posture, strength and body composition. Isokinetics and Exercise Science, 25(3), 215–222. https://doi.org/10.3233/IES-170001
Yüksek, S., & Ölmez, C. (2020). Development of Olmez & Yuksek taekwondo kyorugi performance evaluation scale. Research in Sports Science, 10(1), 1–6. https://doi.org/10.5152/rss.2020.20004

Corresponding information:

Received:28.05.2021.
Accepted:19.11.2021.
Correspondence to: Cengiz Ölmez
University: Trabzon University
Faculty: Sport Sciences Faculty
E-mail:cengolmez@gmail.com