Journal of Sport Science Technology and Physical Activities
ISSN : 1112-4032
eISSN 2543-3776
Vol: 19 / N°: 1 (June 2022), p : 16-24

Comparison of maximal anaerobic power between athletes from different sports (Karate, handball, and cycling)

[1] SADOUKI Kamel , [2]ABDELMALEK Mohammed, [3] ZERRAT Derradji.
[1,2] Laboratory of biological sciences applied to sport, ES/STS, Dely Ibrahim, Algiers,
[3]University of Boumerdes, [1] sadouki_kamel@yahoo.fr , [2] inesmine1012@live.fr ,
[3] dr.zerrat@yahoo.com

ARTICLE INFORMATION
ORIGINAL RESEARCH PAPER
RECEIVED : 13/01/2022
ACCEPTED : 14/04/2022
PUBLISHED: 01/06/2022

KEYWORDS :
KARATE
HANDBALL
CYCLING
MAXIMAL ANAEROBIC POWER

Auteur correspondant :
SADOUKI Kamel
Emai : sadouki_kamel@yahoo.fr

ABSTRACT

OUR STUDY AIMS TO DETERMINE IF THERE IS A DIFFERENCE IN MAXIMAL ANAEROBIC POWER BETWEEN KARATEKAS, HANDBALL PLAYERS, AND CYCLISTS, USING THE FORCE-VELOCITY TEST ON AN ELECTROMAGNETIC HOME TRAINER. FIFTY (50) SENIOR MALE ATHLETES, FROM THREE DIFFERENT SPORTS; AMONG THEM, NINETEEN (19) KARATEKAS, THIRTEEN (13) HANDBALL PLAYERS, AND EIGHTEEN (18) CYCLISTS PARTICIPATED IN THIS STUDY. THESE ATHLETES UNDERWENT ANTHROPOMETRIC MEASUREMENTS AND A FORCE-VELOCITY TEST ON AN AXIOM STATIONARY ERGOMETER, WHICH INVOLVED TWO 6-SECOND ACCELERATIONS, INTERSPERSED WITH AT LEAST 5 MINUTES OF ACTIVE RECOVERY. THE PURPOSE OF THE TEST IS THE MEASUREMENT OF PEAK POWER USING A POWERTAP G3 HUB POWER METER. ALL STATISTICAL ANALYSES WERE PERFORMED USING SPSS VERSION 22.0 FOR WINDOWS. COMPARISONS BETWEEN THE THREE GROUPS OF ATHLETES WERE MADE USING ANALYSES OF VARIANCE (ANOVA). INTERGROUP COMPARISON WAS PERFORMED USING THE TUKEY POST HOC TEST. INTERGROUP ANALYSIS SHOWED THAT HANDBALL PLAYERS ARE HEAVIER AND TALLER THAN KARATEKAS AND CYCLISTS. THE MAXIMAL ANAEROBIC POWER IN THE ABSOLUTE VALUE OBTAINED BY THE HANDBALL PLAYERS WAS HIGHER THAN THAT FOUND IN THE KARATEKAS AND ALMOST SIMILAR TO THAT RECORDED BY THE HANDBALL PLAYERS.

1. Introduction

Anaerobic power is important for all types of sports activities such as karate, handball, and cycling. Explosive actions, such as jumping, accelerating, changing direction, or throwing an object or opponent, are crucial contributors to performance (Scharer et al., 2019). These actions depend on the ability to generate muscular force at high speeds and in short time durations (Gross et al., 2017).

Handball is a high-intensity body contact sport that emphasizes running, jumping, sprinting, throwing, hitting, blocking, and pushing (Gorostiaga et al., 2005). It is a complex intermittent game, which requires players to have a high level of aerobic and anaerobic fitness (Gaurav and Singh, 2014; Chadi and Bachir, 2019). High anaerobic power in the lower limbs is of great importance in this discipline as it plays a great role in performance (Özkan, 2011).

Secondly, karate is one of the most popular martial arts practiced in the world, where competitions consist of two equally important karate disciplines: Kumite and kata competitions. In addition, the movements contain sudden accelerations, changes in direction, and sudden, fast, explosive attacks (Soykan et al., 2011). During short, high-intensity attacks, the anaerobic system provides the necessary energy (Benosmane, 2019; Mansouri, 2021), while during low-intensity movements and rest periods, the aerobic system provides the necessary energy (Franchini et al., 2015).

Finally, cycling is a weight-bearing sport in which the lower body is primarily active. Road cycling requires the cyclist to have an aerobic potential for prolonged efforts and an anaerobic potential for breakaways, climbs, and sprints, Reilly et al. (1990).

In recent years mechanical power has become the best parameter to evaluate the explosive strength of the lower limbs in athletes of different sports (Lammari et al, 2009), especially with the use of power sensors capable of recording the instantaneous power (Sadouki, 2020).

Various field and laboratory tests are used to measure the physiological qualities of athletes in the sports mentioned above. Two of the main methods of assessing maximal anaerobic power that has been studied in the past are various forms of vertical jump tests and bicycle tests (the Wingate test and the strength-speed test) (Khiat, 2004; Khiat, 2014; Driss & Vandewalle, 2013).

Several studies have compared anaerobic power between different sports (individual sports, team sports, and combat sports), using the Wingate test

(Kumar and Bhat, 2014; Suna et al., 2016; Bayrakdaroglu and Can, 2018). However, the Wingate test's peak power underestimated the maximal anaerobic power in powerful subjects.

Following this, a question arises:

Using the strength test, is there a difference in maximal anaerobic power between karate players, handball players, and cyclists?

2. Method and Materials

In our study, we opted for the descriptive method, adapted to the nature of the problem and the variables of our study. The independent variable is the different sports (karate, handball, and cycling), while the dependent variable is the maximum anaerobic power measured using the force-velocity test.

2.1. Participants

The sample of our study is composed of fifty (50) senior male athletes, from three different sports; among them, nineteen (19) karatekas, thirteen (13) handball players, and eighteen (18) cyclists. The karatekas are athletes of a national and international level, participating in two specialties namely kata and Kumite. The handball players are from C.R.baraki, a first division club. As for the cyclists, they are athletes belonging to specialized clubs affiliated with cycling leagues in Algeria, who participate in national and international competitions. The selection of our sample was random. The characteristics of the sample are reported in table n°01.

Table 1 : Participant characteristics (mean (M)±standard deviation (SD))

Croup	Age (years)	Years of practice (ans)	Weight (kg)	Height (cm)
Total (n=50)	24,08±4,59	12,94±5,65	76,59±10,88	179,17±7,18
Karate (n=19)	25,05±5,03	15,21±4,81	73,32±8,22	174,89±7,22
Handball (n=13)	24,61±5,11	14,77±6,67	89,15±9,26	185,85±3,41
Cycling (n=18)	22,67±3,50	9,22±3,62	70,97±6,58	178,86±5,55

2.2. Materials

Height was measured using an anthropometer and weight was taken using a Yunmai electronic scale. The force-velocity test was designed for the evaluation of maximum power using a Powertap G3 hub power meter and an electromagnetic home-trainer (see more details in design and procedure).

2.3. Design and Procedure

The assessment was done in the pre-competitive period. The weight and height were taken just before the force-velocity test. The handball players were evaluated at the Omni sports hall of the municipality of Baraki, the Karatekas at the fighting sports hall of Baraki and the level of the higher school of science and technology of sport (ES/STS) and the cyclists at the higher school of science and technology of sport (ES/STS).

2.3.1. Force-velocity test on an axiom stationary ergometer

The athlete uses a bike, equipped with the Powertap, which was connected to the Realaxiom home trainer (Elite, Fontaniva, Italy). The home-trainer is a computerized ergometer with electromagnetic braking, fixing the rear wheel in the home-trainer support by the spindle with the rear wheel quick lock (Bertucci et al., 2012). The mechanical power is measured with a Powertap G3 hub power meter located at the rear wheel hub of the bike, with an accuracy of 1.5% (Bertucci et al., 2005). The test starts with a 15-minute warm-up at medium intensity (100 watts).

After 5 minutes of recovery, the cyclist performed three (3) maximum 6-second saddle sprints with braking force (simulating a 7% grade), with the following gear ratios: 1st sprint (52/19), 2nd sprint (52/17), 3rd sprint (52/15), interspersed with at least 5 minutes of low-intensity active recovery. Data were recorded on a Garmin Fenix 3 watch and processed using Garmin connect software, Grappe (2012).

2.4. Statistical Analysis

Descriptive statistics (mean and standard deviation (SD)) were calculated for all variables. Comparisons between the three groups of athletes were made using analyses of variance (ANOVA). Intergroup comparison was performed using the Tukey post hoc test. All data analyses were performed using SPSS Statistics version 22.0 (IBM Corp., Armonk, NY, USA), and the significance level was set at 5%.

3. Results

Somatic variables, maximal anaerobic power are reported in tables n°01 and 02 in mean values ± standard deviation.

Table n°02: Somatic variables and maximal anaerobic power of tested athletes

Croup	**Weight (Kg)**	**Height (Cm)**	**MAP (W)**	**MAP (W/Kg)**
Total (n=50)	76,59±10,88	179,17±7,18	1074,72±144,85	14,19±2,09
Karate (n=19)	73,32±8,22	174,89±7,22	1005,68±168,21	13,75±1,94
Handball (n=13)	89,15±9,26	185,85±3,41	1104±98,63	12,47±1,35
Cycling (n=18)	70,97±6,58	178,86±5,55	1126,44±121,79	15,90±1,33
F	22,258	13,63	4,01	18,68
P<	**0,001**	**0,001**	**0,05**	**0,001**

MAP: maximal anaerobic power

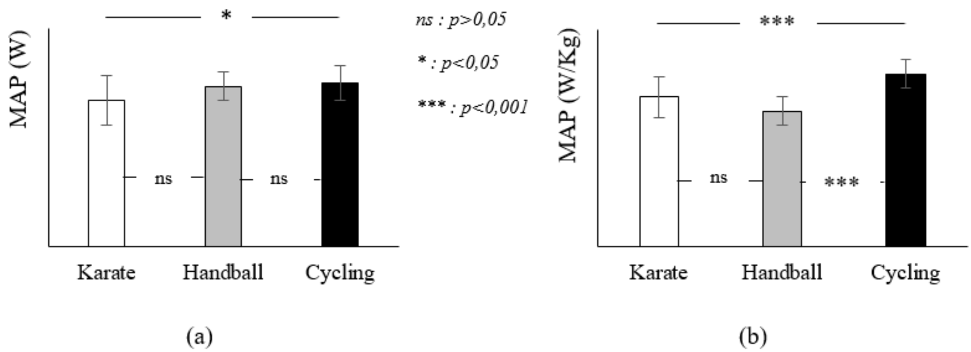
The analysis of variance showed (Table n°02) that the sports groups differed in weight (F=22.258; p<0,001), height (F=13.63; p<0,001), maximum power in absolute value (F=4.01; p <0,05) and maximum power in relative value (F=18.68; p <0,001).

Table n° 03: Results of statistical comparisons between groups with the posthoc test (Tukey)

Groupes	**Weight (Kg)**	**Height (cm)**	**MAP (W)**	**MAP (W/Kg)**
Kar-H.B	0,001	0,001	Ns	Ns
Kar-Cyc	Ns	Ns	0,05	0,001
H.B-Cyc	0,001	0,01	Ns	0,001

Kar: Karate, H.B: Handball, Cyc: Cycling, NS: no significant, MAP: maximal anaerobic power

Intergroup analysis showed (Table 03) that handball players are heavier than karatekas (p<0,001) and cyclists (p<0,001). Similarly, they are taller than karate players (p<0,001) and cyclists (p<0,01). For their part, cyclists are lighter and taller than karatekas (p>0,05). The maximum power in the absolute value (Figure n°01 (a)) obtained by cyclists was significantly higher than that found in karatekas (p<0,05). The high values of the maximum power in the relative value (Figure n°01 (b)) obtained by the cyclists differed from the results obtained by the karatekas (p<0,001) and the handball players (p<0,05).



MAP: maximal anaerobic power

Figure n°01: evolution of the maximal anaerobic power in absolute (a) and relative (b) values.

4. Discussion

Intergroup analysis showed that handball players are heavier and taller than karatekas and cyclists. In handball, basic anthropometric characteristics (weight, height, and body mass index) are important for technical and tactical skills (Visnapuu and Jurimae, 2007), so stronger players with higher body mass have an advantage in this discipline, such as throwing the ball with power and speed (Gorostiaga et al, 2005). Cyclists are notably lighter than karatekas, which could be explained by the nature of the training based on a high percentage of aerobic training (Taubmann, 1994; Sadouki, 2018).

The maximal anaerobic power in the absolute value obtained by the handball players was higher than that found in the karatekas and almost similar to that recorded by the handball players. The advantage of the handball players over the karatekas could be the superiority in weight and height of the handball players and consequently a greater muscle mass, and longer lower limbs. These results support the previous speculation that leg lengthens sand muscle strength (Chamari et al, 2008) influencing explosive actions such as sprinting. Furthermore, the lower limb length is a real lever of strength on the pedals and on the other hand, muscle mass is a determining factor of strength, (Weineck, 2001).

The high values of maximal anaerobic power in the relative value obtained by cyclists differed from the results obtained by karatekas and handball players. This could be explained by the fact that cyclists have a lower weight compared to karate players and handball players.

5. Conclusion

The use of force-velocity test on electromagnetic home-trainer allowed us to compare the athletes of three different sports from the point of view of maximal anaerobic power. This comparison showed us an advantage of cyclists over handball players and Karatekas. This advantage in the absolute and the relative value was not important, remembering that the test represents a specific movement for cyclists, namely pedaling.

Some handball and Karatekas have recorded higher powers than some cyclists. These powers could encourage some handball and karate specialists to get into the saddle. And that's the case of several athletes who got into the saddle after distinguishing themselves in other disciplines, such as Primož Roglič (former ski jumper), Remco Evenepoel (former U16 international soccer player), Michael Woods (former middle-distance runner, gold medalist in the 1500 meters at the 2005 Pan American Junior Track and Field Championships) and rowers Kristen Faulkner and Hamish Bond (two-time Olympic champion, eight-time world champion).

References

1. Bayrakdaroğlu, S., Can, I. (2018). Anaerobic power, lower-body strength characteristic, and some kinetics and kinematics during loaded-squat jump movement in Turkish national boxers and kickboxers. Science of martial arts. 14, 153-159.
2. Benosmane, A.B. (2019). Continuous relative phases as a means of evaluating intersegmental coordination in karate. Journal of Sport Science Technology and Physical Activities, 16(2), 28-42.
3. Bertucci W, Duc S, Villerius V, Pernin JN, Grappe F.(2005). Validity and reproducibility of the Powertap mobile cycling power meter when compared with the SRM device. Int J Sports Med, 26, 868-873.
4. Bertucci, W.M., Betik, A.C., Duc, S., & Grappe, F. (2012). Gross Efficiency and Cycling Economy Are Higher in the Field as Compared with on an Axiom Stationary Ergometer. Journal of Applied Biomechanics, 28, 636-644.
5. Chadi, A., Bachir, H. (2019). Effect of plyometric training by using the interval circular training method on the development of explosive power of the lower limbs of handball players under 19 years. Journal of Sport Science Technology and Physical Activities, 16(2), 142-156.

6. Chamari, K., Chaouachi, A., Hambli, M., Kaouech, F., Wisløff, U., & Castagna, C. (2008). The five-jump test for distance is a field test to assess lower-limb explosive power in soccer players. J. Strength Cond. Res, 22, 944–950.
7. Driss, T.; Vandewalle, H. (2013). The measurement of maximal (anaerobic) power output on a cycle ergometer: A critical review. Biomed. Res. Int.
8. Franchini E, Ouergui I, Chaabene H. (2015). Physiological Characteristics of Karate Athletes and Karate-Specific Tasks. Karate Kumite: How to Optimize Performance. Edit by Chaabene H. Published by OMICS Group eBooks.
9. Gaurav, V., Singh, A. (2014). Study of physical characteristics of Indian handball players at a different level of competition. Turkish Journal of Sport and Exercise, 16(3),17-19.
10. Gorostiaga, E.M., Granados, C., Ibanez, J., Izquierdo, M. (2005). Differences in physical fitness and throwing velocity among elite and amateur male handball players. Int J Sports Med. 26:225-232.
11. Grappe, F. (2012). Power and performance in cycling. Training with power sensors. De Boeck Edition.
12. Gross, M.; Schellenberg, F.; Lüthi, G.; Baker, M.; Lorenzetti, S. (2017). Performance determinants and leg kinematics in the BMX supercross start. J. Sci. Cycl, 6, 3–12.
13. Khiat, B. (2004). Evolution of aerobic and anaerobic pathways during pubertal development in 114-year-old swimmers. Journal of Sport Science Technology and Physical Activities, 10, 38-44.
14. Khiat, B. (2014). Effect of pubertal maturation on the development of anaerobic power in 116-year-old Algerian college students. Journal of Sport Science Technology and Physical Activities, 11, 7-17. 27.
15. Kumar, R., Bhat, R.A. (2014). Comparative study of aerobic and anaerobic capacity between basketball and handball players. Ge-international journal of management research. 2, 286-292.
16. Lammari, F., Mimouni, N., Hannoun, D. (2009). Study of the asymmetries of the lower limb from anthropometric measurements and the ergo-jump test high-level Algerian athletes. Journal of Sport Science Technology and Physical Activities, 6, 45-58.
17. Mansouri, A. (2021). A comparative study of the intermittent long and short training and their effect on some physiological variables of karate wrestlers in the field oKumitete for the adult category. Journal of Sport Science Technology and Physical Activities, 18(3), 256-269.

18. Özkan A. (2011). Anaerobik Performans ve İzokinetik Kuvvet Değerlendirilmesinde Bacak Hacmi ve Kütlesinin Rolü. Ankara Üniversitesi, Sağlık Bilimleri Enstitüsü, Doktora Tezi. s: 2. Ankara.
19. Reilly, T., Secher, N., Snell, P., and Williams, C. (1990). Cycling in Physiology of sports. 1st edition. E and FNspon, London, 153-187.
20. Sadouki, k. (2018). Body composition and somatotype of road cyclists participating in stage races. Journal of Sport Science Technology and Physical Activities, 15(2), 59-72.
21. Sadouki, k. (2020). Anaerobic power performance and anthropometric parameters of the 1st an2nd-year male cycling riders in the U17 category. Journal of Sport Science Technology and Physical Activities, 17(2), 15-29.
22. Scharer, C.; Lehmann, T.; Naundorf, F.; Taube, W.; Hubner, K. The faster, the better? Relationships between run-up speed, the degree of difficulty (D-score), height, and length of a flight on vault in artistic gymnastics. PLoS ONE, 14 (3).
23. Soykan A, Ateş O, Güler M. (2011). Comparison of Leg Strength and Quickness of Under-21 Karate Elite Kata-Kumite Players]. İnternational Refereed Academic Social Science Journal], 1 (01):96–100.
24. Suna, G., beyleroğlu, M., Hazar, k. (2016). Comparison of aerobic, anaerobic power features basketball and handball team players'. Niğde University Journal of Physical Education And Sport Sciences. 10(3), 379-385.
25. Taubmann, W. (1994). Cycling Methodology Guide (F.A.C)
26. Visnapuu, M and Jurimae, T. (2007). Handgrip strength and hand dimensions in young handball and basketball players. J Strength Cond Res 21: 923–929.
27. Weineck, J. (2001). Training manual. Vigot Edition.