Al-Rafidain Journal for Sports Sciences
https://rsprs.uomosul.edu.iq

A comparative study of the aerobic power of team and individual game players

Saman Maghdid Abdullah
Saman.abdullah@su.edu.krd
College of Physical Education and Sport Sciences
Salahaddin University-Erbil

Hashim Ahmed Sulaiman
dr.hashim@uomosul.edu.iq
College of Physical Education and Sport Sciences
University of Mosul

Article information

Article history:
Received:29/08/2023
Accepted:14/09/2023
Published online:15/04/2025

Keywords:
Step test, maximal oxygen consumption, multi-stage fitness test, indirect measurement.

Correspondence:
Saman Maghdid Abdullah
Saman.abdullah@su.edu.krd

Abstract

This study is a comparative analysis of aerobic capacity in team sport players versus individual sport athletes using indirect measurements.

A total of 28 players from team sports (football or basketball) in Erbil's government clubs were selected. These players, aged 18 to 24 years, had been competing at the club level for over three years. Additionally, 31 athletes from individual sports (tennis, fencing, long-distance running, and taekwondo) were selected. These athletes were aged 18 to 22 years and had participated in local championships.

The (VO2 max) values were determined using indirect measurement methods over three different days. On the first day, the Harvard Step Test, the Sharkey Step Test, the Queens College Step Test, and the YMCA Step Test were conducted. On the second day, the YoYo intermittent test was performed, while on the third day, multi-stage fitness tests were carried out. Various equations were used to determine the (VO2 max) values.

The results of this study revealed statistically significant differences in the means and standard deviations between team sport players and individual sport athletes. The results of the Harvard Step Test were (48.4214, ±5.72987) and (49.2484 ± 6.26104) for team sport players and individual sport athletes, respectively. The Sharkey Step Test results were (50.0286, ±5.82166) and (51.6323, ±7.50202), while the Queens College Step Test results were (49.7143, ±5.95860) and (49.7677, ±5.82508). The YMCA Step Test results were (49.8071, ±5.12069) and (50.7774, ±5.75411).

Meanwhile, the Yo-yo test results were (46.3071, ±6.09365) and (43.2274, ±3.75657), and finally, the MSFT test results were (46.7179, ±5.80320) and (42.9516, ±3.37934) for team sport players and individual sport athletes, respectively.

The findings indicate that the (VO2 max) values are higher in team sport players compared to individual sport athletes. This is because team sport players require greater aerobic capacity levels to sustain their performance.

DOI: (10.33899/rjss.2025.187298),

دراسة مقارنة للقدرة الهوائية للاعبي الألعاب الجماعية والفردية

سامان مغديد عبدالله
كلية التربية البدنية وعلوم الرياضة / جامعة صلاح الدين
Saman.abdullah@su.edu.krd
هاشم أحمد سليمان
كلية التربية البدنية وعلوم الرياضة / جامعة الموصل
dr.hashim@uomosul.edu.iq

تاريخ تسليم البحث (٢٠٢٣/٨/٢٩) تاريخ قبول النشر (٢٠٢٣/٩/١٤) تاريخ النشر (٢٠٢٥/٤/١٥)
DOI: (10.33899/rjss.2025.187298)

الملخص

هذه الدراسة عبارة عن دراسة مقارنة للقدرة الهوائية للاعبي الألعاب الفرقية ولاعبي الألعاب الفردية باستخدام القياسات غير المباشرة. تم اختيار ٢٨ لاعبًا من فرق (كرة القدم أو كرة السلة) في أندية حكومة أربيل، الذين تتراوح أعمارهم بين ١٨ إلى ٢٤ عامًا، والذين يلعبون لأكثر من ثلاث سنوات على مستوى الأندية. وكما تم اختيار ٣١ لاعباً من الالعاب الفردية (التنس، المبارزة، عدائي المسافات الطويلة والتايكوندو)، التي تتراوح أعمارهم بين ١٨ إلى ٢٢ سنة، ومشاركون في البطولات المحلية. تم تحديد قيم (**VO2 max**) باستخدام طرق غير مباشرة على مدى ثلاثة أيام مختلفة. في اليوم الأول، تم إجراء اختبار خطوة هارفارد، واختبار خطوة شاركي، واختبار خطوة كلية كوينز، و اختبار(**YMCA**)، في اليوم الثاني تم أجراء اختبار اليويو المتقطع وفي اليوم الثالث اختبارات اللياقة البدنية متعددة المراحل. لتحديد قيم (**VO2 max**) تم استخدام معادلات متعددة. أظهرت النتائج هذه الدراسة بوجود فروق ذات دلالة إحصائية في المتوسطات والانحرافات المعيارية بين لاعبي الألعاب الفريق ولاعبي الالعاب الفردية. وكانت نتائج اختبار هارفارد للخطوات (٤٨.٤٢١٤، ±٥.٧٢٩٨٧) و (٤٩.٢٤٨٤ ± ٦.٢٦١٠٤) للاعبي الالعاب الفرقية ولاعبي الالعاب والفردية على التوالي. واختبار الشاركي للخطوة كانت (٥٠.٠٢٨٦، ±٥.٨٢١٦٦) **(51.6323, ±7.50202**، واختبار كلية كوينز للخطوة كانت (٤٩.٧١٤٣، ±٥.٩٥٨٦٠)،(**49.7677, ±5.82508**)، واختبار (**YMCA**) للخطوة كانت (٤٩.٨٠٧١، ±٥.١٢٠٦٩) **(50.7774, ±5.75411,** في حين نتائج اختبار (**YoYo**) كانت (٤٦.٣٠٧١، ±٦.٠٩٣٦٥) و **(43.2274, ±3.75657)** ، واخيرا نتائج اختبار (**MSFT**) كانت (٤٦.٧١٧٩، ±٥.٨٠٣٢٠) **(42.9516, ±3.37934)** للاعبي الالعاب الفرقية ولاعبي الالعاب الفردية على التوالي. أن نتائج هذه الدراسة تشير الى المستوى أعلى للقيم (**VO2 max**) للاعبي الالعاب الفرقية بمقارنة مع لاعبي الالعاب الفردية وذلك لان لاعبي الالعاب الفرقية يحتاجون الى مستويات أعلى للقدرة الهوائية.

الكلمات المفتاحية : اختبار المقعد (الخطوة)، الحد الأقصى لاستهلاك الأكسجين، اختبار اللياقة البدنية متعدد المراحل، القياس غير المباشر.

Introduction

One of the important predictors of success in sports is physical fitness. This comprises numerous different capacities, of which aerobic capacity is considered a major component (1). Aerobic capacity is the ability to transport energy for the continuous performance of a specific movement for an extended period of time. The best indicator of aerobic capacity is VO_2 max, which describes maximal oxygen consumption by players and athletes. The method used to measure the VO_2 max value is classified as a direct measurement method in the laboratory and an indirect measurement method in field tests [1].

Direct measurement of VO_2 maximal requires progressive loading when analyzing oxygen supply and carbon dioxide excretion, along with an assessment of heart rate at each stage of the test (2).

In contrast, when measuring VO_2 max by indirect methods, the variable is determined by the equation scoring method, based on the determination of time or distance; i.e. using a multi-stage fitness test, a Yo-Yo, 12 min, and a bench test (3).

The difference with indirect measurement is that the test uses equation method for calculation. This prediction is based on heart rate due to movement, intensity and volume of movements performed over a given period of time, as well as fatigue index (4). The predictive test calculation assumes a linear relationship between heart rate or power output and oxygen consumption during physical activity (5). The advantage of the indirect method is that it uses simple equipment and can be easily performed with a larger number of participants in a shorter period of time (6).

At the same time, testing VO_2 max with direct measurement has several advantages, including greater accuracy, more measurable analytical component metrics, and maximum testing results, since the test is more efficient. Adjust for temperature, humidity and altitude and use a heart rate monitor. However, the direct measurement method is expensive, requires skilled personnel, takes longer to process, and is performed in a limited laboratory (9).

Thus, the aim of this study is to compare the aerobic power of team players and players of individual sports using indirect measurements.

Methodology

The present study was a comparative study, for which approval was obtained from the college of physical education and sports science at Salahaddin University-Erbil.

Selection criteria: The participants were 28 players of team sports (i.e., football players and basketball players) from Erbil government clubs, aged 18 to 22 years, who have been playing regularly for more than three years, and have played tournaments at club level; and thirty-one players of individual sports (i.e., tennis, fencing, long-distance running and Taekwondo) aged 18 to 22 years, who regularly participate in tournaments.

Procedure: All participants were informed about the nature of the study and the detailed procedures were clear. Written consent was obtained from all participants. Subjects were asked to report to the test 3 hours after their last meal. They were asked not to engage in any vigorous exercise for 48 hours before the test. They are also required to wear comfortable clothing.

The following measurements were taken in the indoor center at a college of physical education and sport science.

- Body weight: measured by standard weighing scales; and
- Standard Height: taken by measuring tape.

Table (1) Anthropometric measurement of team game players

Variables	Mean	Median	Standard Deviation	Skewness
Hieght (cm)	171.85	173	4.53	-0.255
Weight (kg)	71.01	71	5.67	0.772
Age (year)	22.78	23	2.34	-0.506

Table (2) Anthropometric measurement of individual game players

Variables	Mean	Median	Standard Deviation	Skewness
Hieght (cm)	172.73	172.00	4.35	0.432
Weight (kg)	69.37	70.50	4.49	-0.464
Age (year)	21.27	21.00	2.63	0.436

VO_2 max (Aerobic capacity) was determined applying the following indirect measurement tests:

- Harvard Step Test
- Sharkey Step Test

- Queens College Step Test
- YMCA Step Test
- Yo-Yo intermittent Test
- Multi-stage fitness tests was used to predict maximal aerobic

First day: The Harvard Step test

The participants were asked to step up and down on the platform at a rate of 30 steps per minute for 5 minutes or until exhaustion. Exhaustion means when the athlete can no longer sustain stepping rate for 15 seconds.

The participants immediately sat down on completion of the test, and the total number of heart beats were recorded between 1 and 1.5 minutes after completion, and then additional heart rate measures were taken at intervals between 2 to 2.5 minutes, and between 3 to 3.5 minutes.

First day: Sharkey Step Test

The participants were asked to step up and down on the step, leading with either leg. The metronome was set at 90 beats per minute, to represent a step rate of 22.5 steps per minute. After a five-minute walk, the subjects sat up and measured their heart rate. Heart rate was recorded 15 seconds after the end of the test, and counting stopped 15 seconds later, 30 seconds after exercise.

First day: YMCA 3-minute Step Test

After instructing participants to alternate walking, they began walking up with their second foot (2nd beat), down with one foot (3rd beat), and down with the other (4th beat). Participants were able to practice the steps. Metronome, set at 96 beats per minute. Participants walk up and down the platform at the specified speed for a total of 3 minutes. Participants immediately stopped at the end of the test and sat still. After 5 seconds, the heart rate is recorded for one minute.

Second day: The Yo-Yo Intermittent Test measurement

All subjects start at or behind the midline and start running 20m according to the audio provided through the Sounds app. Participants turn and return to the starting point when signaled by a recorded beep. There is then an active recovery period (5 and 10 seconds for the endurance and recovery versions of the test, respectively) that alternates between each 20 meter sprint (out and back), during where the subject has to walk or run around the other cones and back. At the

starting point. A warning will be given if the participants do not complete the round within the time limit, the test will end after the second unsuccessful round.

Third day: The 20m multistage fitness test (MSFT)

In this test, the participant had to run between two 20m lines with the time indicated by a pre-recorded beep. For this reason it is called the "beep" or "beep" test.

Subjects begin this section by standing behind the first row, facing the other row. The initial speed is moderate. Subject continues running between the two lines and turns back on the signal signaled by the recorded beep. A beep sound indicates increased speed, after levels and beeps get closer together. Subject will wait until a beep sounds some time later. In the event that at some point the line is still not reached, a beep is heard, the subject will receive a warning and must continue running towards the line, then turn around and attempt to catch up with the other two beeps. '. Subject receives a warning when it fails to reach the line (within 2 meters) for the first time and ends after the second warning.

Statistics

Data is reported as mean ± SD. Before using parametric statistical tests, the assumption of normality was verified, and data was found to be normally distributed.

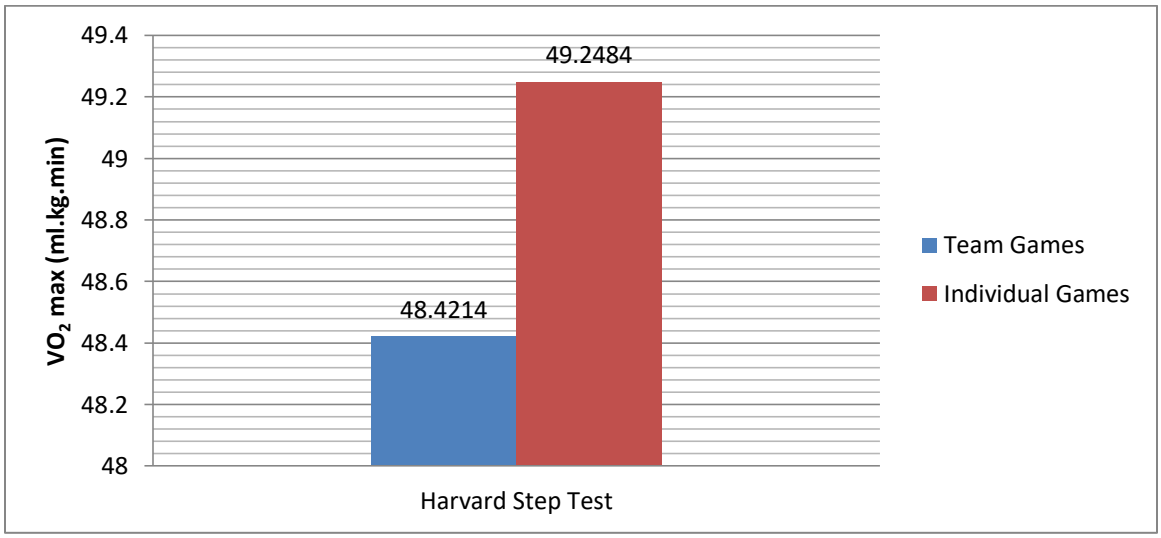
Independent *t* sample tests were applied to compare the different VO_2 max values between team sports and individual sports.

Results

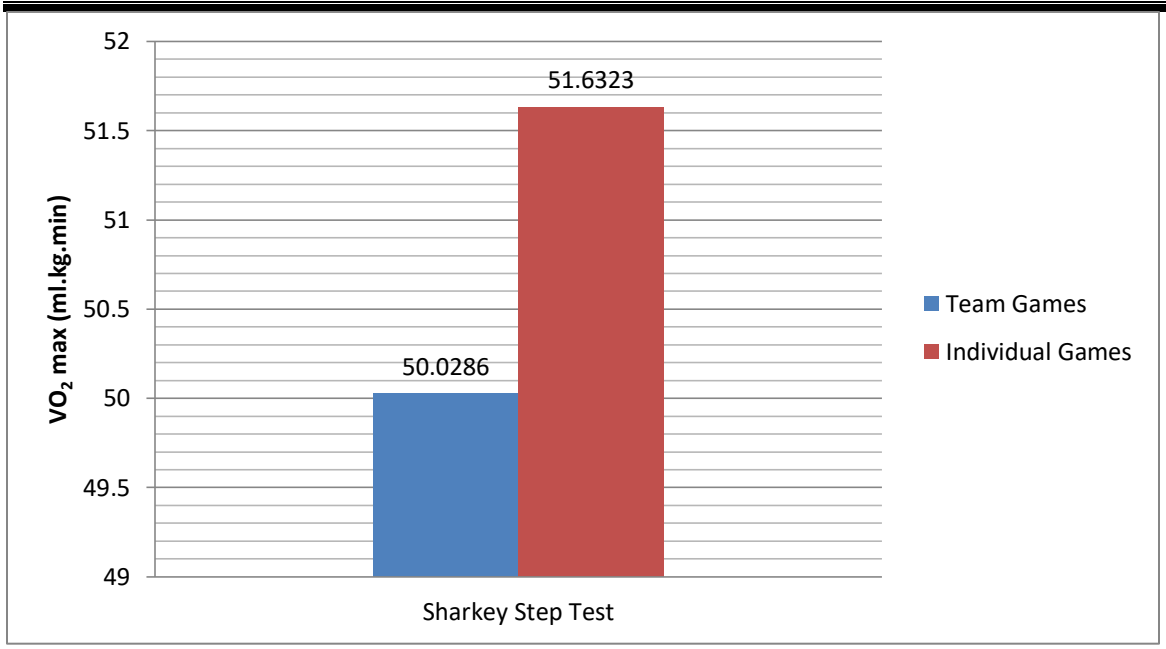
Table (3) Comparison of VO_2 max between team players and individual game players

Variables	Team Games		Individual Games		t-value	*p*
	Mean	Std. Deviation	Mean	Std. Deviation		
Harvard Step Test	48.4214	5.72987	49.2484	6.26104	-.527	.600
Sharkey Step Test	50.0286	5.82166	51.6323	7.50202	-.910	.367
Queens College Step Test	49.7143	5.95860	49.7677	5.82508	-.035	.972
YMCA Bench Step Test	49.8071	5.12069	50.7774	5.75411	-.681	.498
Yo-Yo intermittent test	46.3071	6.09365	43.2274	3.75657	2.307	.026
Multi-Stage Fitness Test (MSFT)	46.7179	5.80320	42.9516	3.37934	3.005	.004

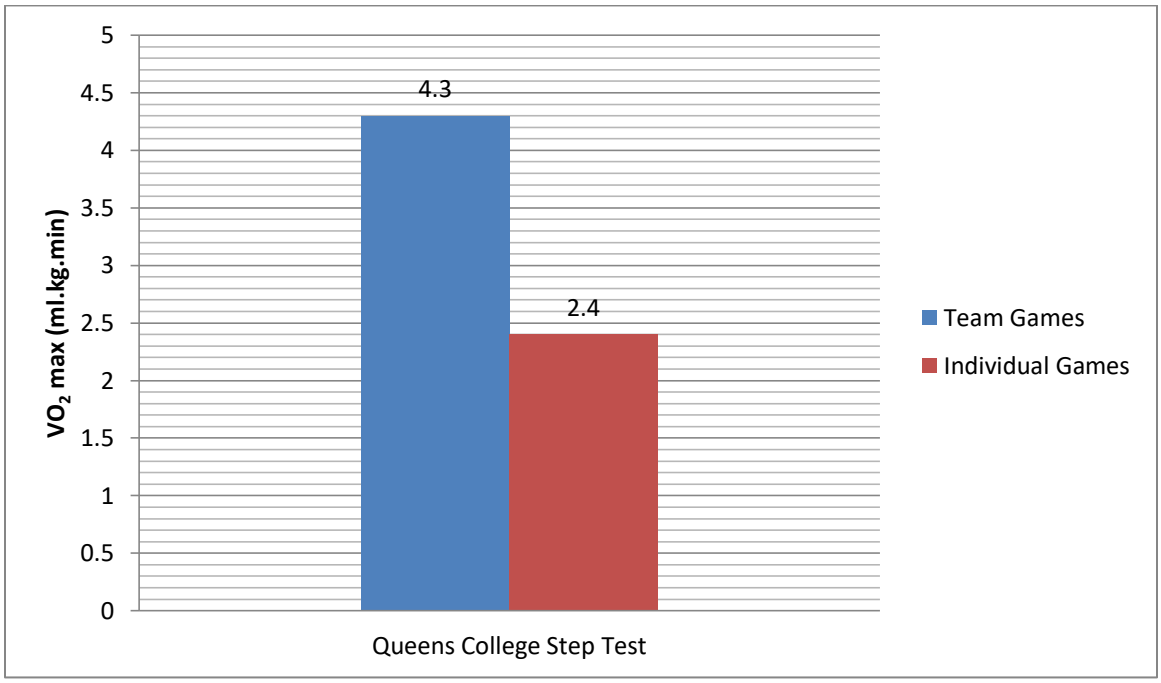
- Mean and Standard Deviation for both team players and individual sports players
- P value set at <0.05



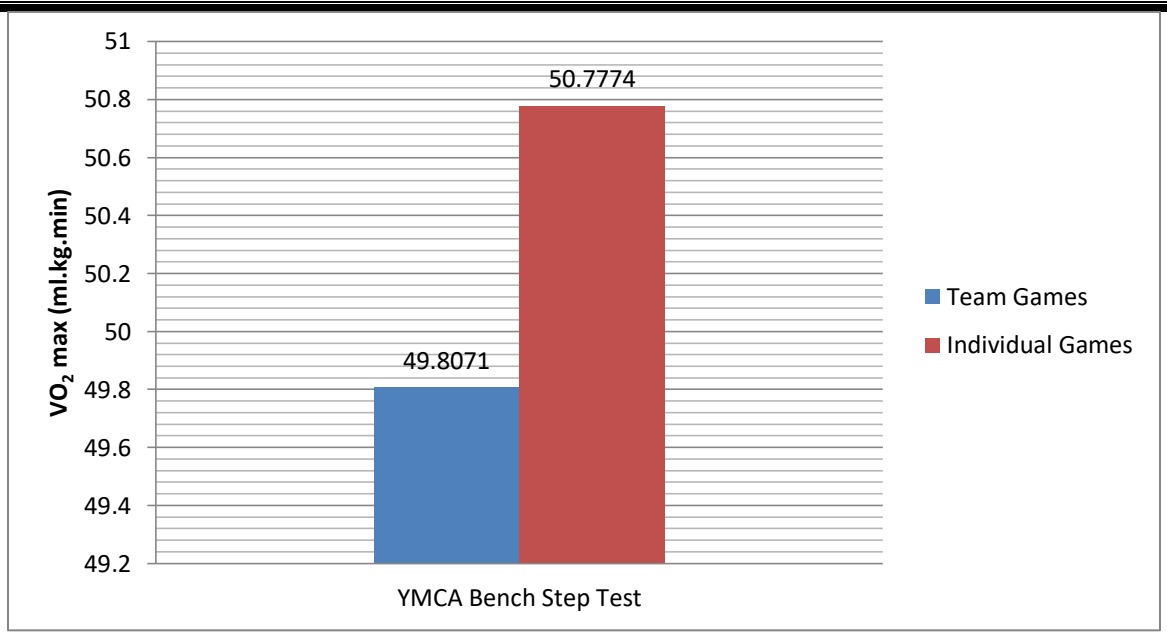
Graph: 1 Comparison of VO_2 max values on the Harvard step test between team players and individual game players.



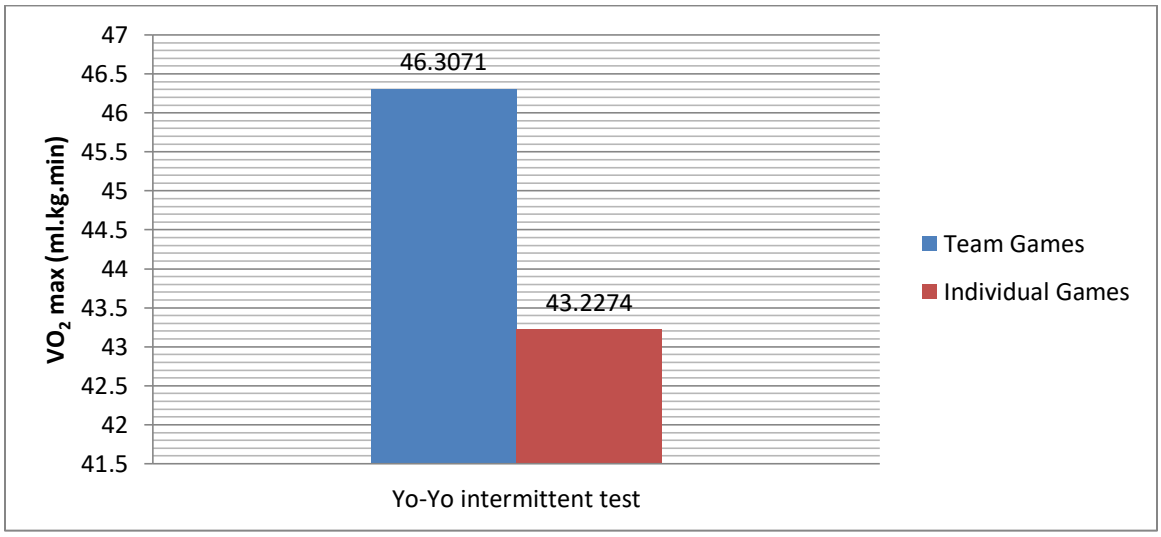
Graph: 2 Comparison of VO_2 max values from the Sharkey step test between team players and individual game players.



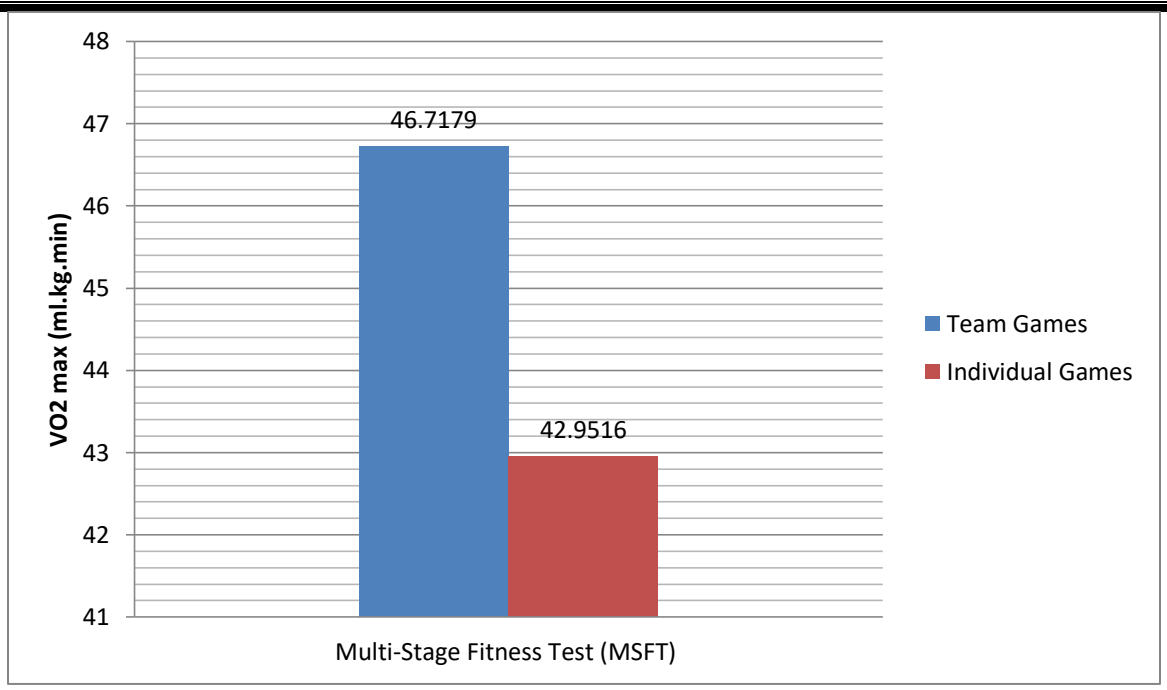
Graph: 3 Comparison of VO_2 max values from the Queens College step test between team players and individual game players.



Graph: 4 Comparison of VO_2 max values from the YMCA Bench step test between team players and individual game players.



Graph: 5 Comparison of VO_2 max value from Yo-Yo intermittent test between team games and individual games.



Graph: 6 Comparison of VO_2 max value from Multi-stage fitness test between team games and individual games.

Discussion

Based on the results of this study it emerged that maximal oxygen uptake was recorded for both team game players and individual players; it was expressed for both in and relative units (ml/kg/min) based on expected value having considered the facts. Team game players, require an intermittent performance combining aerobic and anaerobic exercises(1).

The players on the team must have an efficient energy system to support them during a 90-minute football match at its maximum. When comparing relative values, no statistically significant differences emerged between team game players and individual players in the four-period test. However, there was a significant difference between team game players and individual game players in the multi-step and 20 m Yo-Yo fitness test. This is due to the timing and characteristics of these tests.

Team sports require every athlete on the field to have extraordinary aerobic capacity (10). Aerobic capacity is an indicator of the functional capacity of all the athlete's physical systems involved in oxygen transport and energy metabolism. Low level of aerobic capacity will limit a player's ability to maintain high level of aerobic fitness during matches and competitions. Athletic performance will be negatively affected by fatigue, especially towards the end of the game (10). A high level of aerobic fitness is essential for success in all team and individual sports. Therefore, determining VO2 max is very important.

Our results show statistically significant differences in mean and standard deviations between the team sports and individual sports players. Our results show the highest VO_2 max values were noted for team sports, which require a higher degree of endurance than individual sports.

This indicates that the training associated with each sport has led to physiological changes in the athletes.

Conclusion

Investigation into maximal oxygen uptake provides relevant data on both team and individual players. It can indicate the potential effects on planning and training, and may be useful for the early selection of players. Consequently, improving players' VO_2 max values will necessarily improve results.

References

1. Ranković, Goran, Vlada Mutavdžić, Dragan Toskić, Adem Preljević, Miodrag Kocić, Gorana Nedin-Ranković, and Nikola Damjanović: Aerobic capacity as an indicator in different kinds of sports, Bosnian journal of basic medical sciences 10, no. 1 (2010): 44.
2. Santtila, Matti, Keijo Häkkinen, Kai Pihlainen, and Heikki Kyröläinen: Comparison between direct and predicted maximal oxygen uptake measurement during cycling, Military medicine 178, no. 2 (2013): 234-238.
3. Gönülateş, Süleyman: Analysis of difference between the VO 2 max values in field and laboratory tests, Universal Journal of Educational Research (2018).
4. Kavcic, Iztok, Radoje Milic, Morteza Jourkesh, Sergej M. Ostojic, and Mehmet Zeki Ozkol: Comparative study of measured and predicted VO2max during a multi-stage fitness test with junior soccer players, Kinesiology 44, no. 1. (2012): 18-23.
5. Vandersmissen, G. J. M., R. A. J. R. Verhoogen, A. F. M. Van Cauwenbergh, and Lode Godderis: Determinants of maximal oxygen uptake (VO2 max) in fire fighter testing, Applied ergonomics 45, no. 4 (2014): 1063-1066.
6. Beltz, Nicholas M., Ann L. Gibson, Jeffrey M. Janot, Len Kravitz, Christine M. Mermier, and Lance C. Dalleck: Graded exercise testing protocols for the determination of VO 2 max: historical perspectives, progress, and future considerations, Journal of sports medicine 2016 (2016).
7. J. A. Grant, A. M. Y. N. Joseph, and P. D. Camp, "˙ VO2 max : A Comparison of 7 The Prediction of V Indirect Tests of Aerobic Power, no.04 October, 2017.

8. Chamari, K., Y. Hachana, F. Kaouech, R. Jeddi, I. Moussa-Chamari, and U. Wisløff: Endurance training and testing with the ball in young elite soccer players, British journal of sports medicine 39, no. 1 (2005): 24-28.
9. Reilly, Tom, Jens Bangsbo, and Adele Franks: Anthropometric and physiological predispositions for elite soccer, Journal of sports sciences 18, no. 9 (2000): 669-683.
10. Casajús, José Antonio: Seasonal variation in fitness variables in professional soccer players, Journal of sports medicine and physical fitness 41, no. 4 (2001): 463-469.

https://www.topendsports.com/testing/tests/yo-yo-intermittent.htm