Universal Journal of Educational Research 6(9): 1938-1941, 2018 http://www.hrpub.org
DOI: 10.13189/ujer.2018.060912

Analysis of Difference between the VO_2max Values in Field and Laboratory Tests

Süleyman Gönülateş

Faculty of Sport Sciences, Pamukkale University, Turkey

Abstract Purpose of this study is to determine whether there is a difference between the VO_2max values in field and laboratory test. 96 students, studying at the Sports Academy of Sports Sciences and Technology of the Pamukkale University, have participated to the study on voluntary basis. While during the field test, the 12-minutes Cooper test has been utilized, as determinant in the laboratory test the Bruce Treadmill test has been used. The data obtained in result of the applied tests were calculated using formula advised for the test. For the statistical analysis of the data, the IBM SPSS (Statistical Package for Social Sciences) 21.0 pack program has been used. In order to define the data distributions, an Identify in Statistics has been performed. For the comparison of two variables on the same group, the Paired Sample t-test has been used. Results have been submitted as average (X) and standard deviation (SS). The value P<0,05 has been found to be significant. Consequently, a statistically significant difference has been determined between the Field test (Cooper) and Laboratory test (Bruce). And this shows that the VO_2max value in the applications of the laboratory environment is higher than the VO_2max value in the applications of the field test.

Keywords Bruce, Cooper, VO_2max

1. Introduction

One of the most important physiological indicators of endurance, Maximal Oxygen Consumption (VO_2max), refers to the use of O_2, which reaches a certain maximal level and cannot be further increased by the increase in active muscle mass incorporated into the exhaust [1,2]. It is the maximum amount of oxygen that can be used by a person who participates in large muscle groups and exercises with increasing intensity [3]. It can also be defined as the amount of oxygen the body can use in a minute during maximal intense exercises (L/dk) [4].

The Bruce protocol is a treadmill test protocol that allows the athlete to reach the VO_2max in a short period of time with the tilt and speed increasing together. It is known that VO_2max tests should not be continued for more than 8-12 minutes and that the duration of the test period may not reach the VO_2max of the athletes due to regional fatigue [5, 6]. For this reason, the Bruce protocol is considered to be very useful and suitable for detecting true VO_2max [7, 8].

Cooper 12 min test which was developed by Kenneth Cooper from the original Balke [9], is a 15 minute running test. The Cooper test is available in 12 min and 1.5 mile versions. The athlete tries to run the longest distance he can get in 12 minutes. The assistant takes the nearest 100 m note. The correlation between VO_2max and 12 min run-walk distance was reported as r = 0.90 [10, 11, 12].

The aim of this study is to determine whether there is a difference in VO_2max values between field and laboratory tests.

2. Materials and Methods

Subjects

A total of 96 students, 45 females and 51 males attending Pamukkale University Sports Sciences and Technology School of Sports, voluntarily participated in the study. The students participating in the study were given explanations about the test to be done by giving information about the research. Athletes participating in the study were signed by reading the informed consent form. When the age was determined, the body length was measured in cm and the body weight was measured in electronic scale and recorded in kg. The cooper test runs the longest distance the athlete can take in 12 minutes. The assistant takes the nearest 100 m note. Correlation between VO_2max and 12 min running-walk distance is reported as r = 0.90. The equation used to determine aerobic power in the Cooper test is as follows:

VO_2max: Distance traveled (m) -504,9) / 44,73

Exercise Protocol

The implementation of the Bruce protocol was carried out automatically using the Cosmed T 150 (Germany) treadmill, running from the band's memory. The test was carried out at a speed of 2.7 km / h, starting at 10% slope and increasing at a speed and slope every three minutes. The test was continued until the athlete could not continue the test continuation [13]. VO_2max of the athletes and the formula used for men and women active and sedanter in the calculation part of the Bruce Treadmill application (treadmill test) were calculated indirectly.

Men; Equation 2.5: VO_2max = 14.76 - (1.379. times. T) + (0.451. times. T2) - (0.012. times. T3)
r = .98 SEE = 3.35 ml / kg / min [14].
Women; Equation 2.6: VO_2max = 4.38 x T -3.90
r = .91 SEE = 2.7 ml / kg / min [15].
(T = test end time)

Table 1. Bruce Exercise Protocol

Step	Time(min)	Speed (km/h)	Slope (%)
1	0	2,74	10
2	3	4,02	12
3	6	5,47	14
4	9	6,76	16
5	12	8,05	18
6	15	8,85	20
7	18	9,65	22
8	21	10,46	24
9	24	11,26	26
10	27	12,07	28

Statistical Analysis

IBM SPSS (Statistical Package for the Social Sciences) 22.0 package program was used to analyze the data. Descriptive Statistics were used to determine the distributions of the data. The t-test (Paired Samples t-test) was used to compare two variables on the same group. The results are presented as mean (X) and standard deviation (SD). A value of P <0.05 was considered significant.

3. Results

Table 2. Descriptive Statistics on Determining Distributions of Data

	N	Min.	Max.	X	SD
Age	96	18	30	21,81	2,268
Height	96	157	198	170,85	7,580
Weight	96	44	92	62,55	9,723
Gender	96	1	2	1,53	,502
Cooper VO_2max	96	21	58	42,78	8,932
Bruce VO_2max	96	35	70	53,91	10,012
Valid N (listwise)	96				

To determine whether there is any difference in the VO_2max values between the field and laboratory tests, the averages of the data obtained in the study were determined and whether there was a statistical difference between the variables was determined. When Table 2 was examined, Cooper VO_2max value was found to be 42,78 and Bruce VO_2max value was found to be 53,91 (p <0.05), while the mean age of the 96 students was 21,81, the mean height was 170,85 and the weight average was 62,55.

When Table 3 is examined, the significant value is seen as "000" in the comparison between the variables. This indicates a statistically significant difference. That is, there is a significant difference between Cooper VO_2max value and Bruce VO_2max value (p <0.05).

Table 3. Comparison between Variables

	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	p
Cooper VO_2max Bruce VO_2max	-11,127	6,597	,673	-12,464	-9,791	-16,528	95	,000

4. Conclusions

As a result of the literature searches made for the purpose of our work, we have supported our work and found many researches that resulted in the opposite direction. Some of those: Michael et al. [16] compared ASU and Bruce protocols in their study. There was no significant difference between the VO_2max values obtained by estimation and measurement from both tests in the study of 32 age 21.09 ± 2.52 years age group. However, between the two tests, there was a statistically significant difference between the measured VO_2max values ($p < 0.04$). Jana et al. [17], 18 college players aged 19-23 participated in the study and found a significant relationship between the 9-minute running test and VO_2max ($p < 0.05$). MacNaughton et al. [18] compared 15-minute running test with 5-minute running test. The study was found to be more effective in predicting the VO_2max of the 15-minute running test for all age groups. Froelicher et al. [19] compared the Balke Protocol with the Bruce Protocol. 34 sedans with a mean of 36.9 years and 45 athletes with an average of 32 years applied the Balke protocol, 32 sedanter subjects with an average age of 38.2 and 45 athletes with an average age of 34.2 applied the Bruce protocol. In another study conducted by Aydoğmus et al. [20], 20 m shuttle running test was applied before and after training. An increase in the VO_2max values of the badminton athletes after the shuttle running test, which is an important field test in VO_2max prediction, has been found. Arslanoglu [21] used a 20 m shuttle run instead of cooper to measure aerobic capacity while studying physical profiles of wrestlers. The same authors observed that the Yo-Yo intermittent test performance was significantly correlated with the time to exhaustion and VO_2max values at the treadmill test, which led to the assumption that the treadmill exercise tests do not underestimate aerobic performance [22]. The fact that the field tests used to require less cost to laboratory tests and that there is no need for advanced hardware may be the reason for preference in these studies.

In conclusion, a statistically significant difference was found between the field test (Cooper) and the laboratory test (Bruce). This shows that the VO_2max value in applications performed in the laboratory environment is higher than the VO_2max value in field applications. It is believed that the results are due to the fact that the VO_2max value is higher in the laboratory environment and the environmental factors that may affect performance are more minimal.

REFERENCES

[1] Astrand, P. O. & Rodahl, K. (1986a). Textbook of Work Physiology. 3rd ed. New York: McGraw-Hill Book Company.

[2] Fox EL, Bowers RW, Foss ML. (1988). "The physiological basis of physical education and athletics". 4th ed., USA; Saunders College Publishing.

[3] Joyner, M. J. (1993). Physiological limiting factors and distance running: influence of gender and age on record performances. Exercise and sport sciences reviews, 21(1), 103-134.

[4] İpekoğlu G, Baynaz K, Mor A, Acar K, Arslanoğlu C, Arslanoğlu E. (2018). Examining Lactate Changes during High Intensity Spinning® Training. Universal Journal of Educational Research. 6(6), 1260-1263.

[5] Heyward, V. H. (1998). Advanced Fitness Assessment and Exercise Prescription. University of New Mexico. 4. Edition.

[6] Günay, M., Tamer, K., & Cicioğlu, İ. (2006) Sports Physiology and Performance Measurement. Gazi Publications. 1. Edition.

[7] İpekoğlu, G., & Balcı, Ş. S. (2016). Comparison between continuous and intermittent submaximal exercise at the intensity of maximal fat oxidation. Journal of Human Sciences, 13(3), 4604-4612.

[8] Pettersen, S. A., Fredriksen, P. M., & Ingjer, F. (2001). The correlation between peak oxygen uptake (VO_2peak) and running performance in children and adolescents. Aspects of different units. Scandinavian journal of medicine & science in sports, 11(4), 223-228.

[9] Balke, B. (1963). A simple field test for the assessment of physical fitness. Oklahoma City: Federal Aviation Agency. Civil Aeromedical Research ınstitute Report, 63-18.

[10] Cooper, K.H (1968). A means of assessing maximal oxygen intake. Journal of the American Medical Association 203:201-204.

[11] Cooper, K.H. (1980). Testing and developing cardiovascular fitness. In: Exercise, Science and Fitness. Movement Publications. 45-55.

[12] Castagna, C., Abt, G., & D'ottavio, S. (2005). Competitive-level differences in Yo-Yo intermittent recovery and twelve minute run test performance in soccer referees. Journal of Strength and Conditioning Research, 19(4), 805.

[13] Alemdaroğlu, U. (2008). Comparison of Field and Laboratory Tests Used in Determination of Aerobic Capacity. Pamukkale University Institute of Health Sciences, Department of Training and Movement Master Degree Thesis.

[14] Foster, C., Jackson, A. S., Pollock, M. L., Taylor, M. M., Hare, J., Sennett, S. M., Rod, J. L., Sarwar, M. & Schmidt, D. H. (1984). Generalized Equations for Predicting Functional Capacity from Treadmill Performance. American Heart Journal 107:1229-1234.

[15] Pollock, M. L., Bohannon, R. L., Cooper, K. H., Ayres, J. J., Ward, A., White, S. R., & Linnerud, A. C. (1976). A comparative analysis of four protocols for maximal treadmill stress testing. American heart journal, 92(1), 39-46.

[16] Michael, B. Spackman, James D. George, Todd R. Pennington, & Gilbert W. Oxygen uptake (VO_2 peak) and running performance in children and adolescents. Aspects of Different units, Scand. J Med Sci Sports, 11: 223-228.

[17] Jana, L. Arabas, Mary Margaret Elizabeth Peters Anderson, J. R. Arabas, C.D. Arabas, & J. L. Mayhew (1996). Estimation of VO_2max from 9-Minute Run Performance. IAHPERD Journal, 29(2).

[18] MacNaughton, L., Croft, R., Pennicott, J., & Long, T. (1990). The 5 and 15 minute runs as predictors of aerobic capacity in high school students. Journal of Sports Medicine Physical Fitness Mar. 30(1):24-28.

[19] Froelicher, V. F., Thompson, A. J., Noguera, I., Davis, G., Stewart, A. J., & Triebwasser, J. H. (1975). Prediction of maximal oxygen consumption: comparison of the Bruce and Balke treadmill protocols. Chest, 68(3), 331-336.

[20] Aydoğmuş M., Arslanoğlu, E., Özmen, T. (2014). Effect of Badminton Specific Training versus Badminton Match on Aerobic Fitness. The Online Journal of Recreation and Sport, 4(2), 12-15.

[21] Arslanoğlu, E. (2015). Physical profiles of Turkish young Greco-Roman wrestlers. Educational Research and Reviews 10(8), 1034.

[22] Metaxas, T. I., Koutlianos, N. A., Kouidi, E. J., and Deligiannis, A. P. (2005). Comparative study of field and laboratory tests for the evaluation of aerobic capacity in soccer players. The Journal of Strength & Conditioning Research, 19(1), 79-84.