

Original Article

Comparison of Rockport one-mile walk test and McArdle step test for the prediction of VO_2 max

ABSTRACT

Background: There are various field tests to predict VO_2 max. The Rockport one-mile walk test and McArdle step test are among them, which are easy to administer and give good result. The purpose of this study was to see the differences in the result of VO_2 max predicted by Rockport one-mile walk test and McArdle step test in the adult North Indian population.

Methodology: A total of sixty college/university students from North India, between the age group of 18 and 25 years, were divided into two equal groups of thirty each. Group A performed Rockport one-mile walk test and Group B performed McArdle step test.

Results and Analysis: The mean age (years), height (cm), weight (kg), and VO_2 max (ml/kg/min) of Group A were 19.73 (± 1.34), 172.37 (± 8.52), 63.23 (± 11.01), and 55.47 (± 3.73), respectively, whereas the mean age (years), height (cm), weight (kg), and VO_2 max (ml/kg/min) of Group B were 19.30 (± 1.02), 174.17 (± 7.56), 70.03 (± 7.11), and 53.12 (± 9.37), respectively. T-test applied between both groups, and there is no statistically significant difference found in age (0.164), height (0.392), weight (0.006), and VO_2 max (0.206) between both groups.

Conclusion: This study has concluded that there is no difference between the Rockport one-mile walk test and McArdle step test for the prediction of VO_2 max. Hence, we can use any of the tests, either Rockport one-mile walk or McArdle step test, for calculating VO_2 max in any individuals.

Keywords: McArdle step test, Rockport 1 mile walk test, VO_2 max

ملخص

الخلفية: هناك العديد من الاختبارات الميدانية للتنبؤ بالمعدل الأقصى لاستهلاك الأكسجين، من بينها اختبار روكبورت لمشي مسافة ميل واحد واختبار خطوة ماك آرل، والتي يسهل إدارتها وتعطي نتيجة جيدة، حيث كان الغرض من هذه الدراسة هو معرفة الاختلافات في نتيجة المعدل الأقصى لاستهلاك الأكسجين التي تنبأ بها اختبار روكبورت لمشي مسافة ميل واحد واختبار خطوة ماك آرل في السكان البالغين في شمال الهند.

المنهجية: تم تقسيم ما مجموعه ستين طالبًا جامعيًا / من خريجي الكليات بشمال الهند، ضمن الفئة العمرية بين 18 و 25 عامًا، إلى مجموعتين متساويتين كل منهما مكون من ثلاثين طالبًا. أجرت المجموعة أ اختبار روكبورت لمشي مسافة ميل واحد من وأجرت المجموعة ب اختبار خطوة ماك آرل.

النتائج والتحليل: متوسط العمر (بالسنوات)، الطول (سم)، الوزن (كجم)، والمعدل الأقصى لاستهلاك الأكسجين (مل/كجم/دقيقة) للمجموعة أ كان 19,73 ($\pm 1,34$)، 172,37 ($\pm 8,52$)، 63,23 ($\pm 11,01$) و 55,47 ($\pm 3,73$) على التوالي، في حين أن متوسط العمر (بالسنوات) والطول (سم) والوزن (كجم) والمعدل الأقصى لاستهلاك الأكسجين (مل/كجم/دقيقة) للمجموعة ب كان 19,30 ($\pm 1,02$)، 174,17 ($\pm 7,56$)، 70,03 ($\pm 7,11$) و 53,12 ($\pm 9,37$) على التوالي. تم تطبيق اختبار تي بين المجموعتين، ولم يوجد فروق إحصائية ملحوظة في العمر (0,164)، الطول (0,392)، الوزن (0,006)، والمعدل الأقصى لاستهلاك الأكسجين (0,206) بين المجموعتين.

الخلاصة: خلصت هذه الدراسة إلى أنه لا يوجد فرق بين اختبار روكبورت لمشي مسافة ميل واحد واختبار خطوة ماك آرل للتنبؤ بالمعدل الأقصى لاستهلاك الأكسجين. وبالتالي، يمكننا استخدام أي من الاختبارين، إما اختبار روكبورت لمشي مسافة ميل واحد واختبار خطوة ماك آرل، لحساب المعدل الأقصى لاستهلاك الأكسجين لدى أي فرد.

الكلمات الرئيسية: اختبار روكبورت لمشي مسافة ميل واحد، اختبار خطوة ماك آرل، المعدل الأقصى لاستهلاك الأكسجين

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INTRODUCTION

VO₂ max is also considered as cardiorespiratory fitness, which is a vital component of health-related physical fitness since its more elevated level sustains the capacity to continue moderate-to-high-intensity practice for delayed timeframes, whereas lower levels raise the danger of different ailment conditions, for example, coronary supply route sickness, hypertension, stroke, corpulence, and Type 2 diabetes.^[1] Cardiorespiratory endurance exercises help the body to turn out to be increasingly productive and better ready to adapt to physical difficulties.^[2] The VO₂ max is measured in ml/kg/min. The average VO₂ max values range from 45 ml/kg/min for a sedentary 35-year-old male to 55 ml/kg/min for an average 35-year-old male runner and 65 ml/kg/min for a locally competitive male runners. The elite runners may have a VO₂ max value of 70–85 ml/kg/min. Women's VO₂ max level is about 10% lower than men because of difference in physiological characteristics.^[3,4] If there is a high VO₂ max, the heart has the ability to pump a large amount of blood with every beat, and the circulatory system can efficiently deliver that blood to the working muscles.^[4,5] Training improves the ability to sustain a high percentage of maximal heart rate for long periods of time, heart's stroke volume, the size and number of mitochondria in the muscles, the density of capillaries, and the proportion of blood sent to working muscles.^[6] We can measure VO₂ max with different techniques either performed in the laboratory or in the field. Laboratory tests are much accurate and have higher validity than the field test. However, the tests performed for VO₂ max in the laboratory are much more expensive and cannot be performed for everyday practice. On the other hand, the field test is cheaper and can be performed on a daily basis.^[7] Commonly used exercise testing methods include field tests, treadmill tests, cycle ergometry tests, and step tests. There are various field tests available to measure VO₂ max effectively,^[8] in which the Rockport one-mile walk test and McArdle step test are also being used. Rockport one-mile walk test is used to calculate VO₂ max, for both men and women, of poor fitness who are not able to complete a similar distance run test,^[9] whereas McArdle step test is a useful test for clients with higher levels of aerobic fitness.^[10] Since the target population for both tests is different, hence the measurement result of both tests may have any differences also. There is a paucity of researches which reported differences in the result of both these tests if applied on a normal healthy individual. Therefore, the purpose of this study was to investigate the differences in the result of VO₂ max predicted by the Rockport one-mile walk test and McArdle step test in the adult North Indian population.

METHODOLOGY

Ethical clearance was obtained from the Institutional Ethics Committee of Galgotias University, Greater Noida. A total of sixty college/University students between the age group of 18 and 25 years without any recent medical or surgical condition who are devoid of taking any substance abuse or psychotherapy were randomly selected in this study. All participants first filled the Physical Activity Readiness Questionnaire and then submitted a written informed consent form for their voluntary participation. Then, all these sixty participants were divided randomly into two equal groups. Group A consists of thirty participants who performed VO₂ max test using Rockport one-mile walk test, and Group B consists of thirty participants who performed VO₂ max test using McArdle step test.

The selected participants were asked to present on a prescribed date and time. Only ten people were asked to report at a particular date and time. The participants were asked to report at least 30 min before the testing and asked not to ingest any food or caffeine within 3 h of testing. The entire test was performed either in the morning or evening session. The environment temperature for both field tests was maintained at 25°C.

Rockport one-mile walk test

This test is being used to measure VO₂ max.

Equipment required:

- One-mile track
- Stopwatch
- Pulse oximeter.

The participants walked as fast as possible for one mile. After walking one mile, immediately the pulse rate was measured.

Scoring: VO₂ max can be calculated by the formula:

- For females: $VO_2 \text{ max} = 139.168 - (0.388 \times \text{age}) - (0.077 \times \text{weight in lb}) - (3.265 \times \text{walk time in minutes}) - (0.156 \times \text{heart rate})$
- For males: $VO_2 \text{ max} = 139.168 - (0.388 \times \text{age}) - (0.077 \times \text{weight in lb}) - (3.265 \times \text{walk time in minutes}) - (0.156 \times \text{heart rate}) + 6.318$.

McArdle step test

This test used to measure exercising heart rate from which VO₂ max can be estimated. This test is useful for clients who are aerobic fitness of a higher level.

Equipment required:

- Step of 16.25 inch (41.3 cm)
- Stopwatch
- Metronome.

Procedure

The participants stepped up and down on the platform at a rate of 22 steps per minute for females and at 24 steps per minute for males. The participants performed to step using a four-step cadence, “up-up-down-down” for 3 min. The participants stopped immediately on completion of the test, and the heartbeats had been counted from 5 to 20 s of recovery.

An estimation of VO_2 max is then calculated from the test results, using the following formula (McArdle *et al.*, 1972).

- For men: $\text{VO}_2 \text{ max (ml/kg/min)} = 111.33 - (0.42 \times \text{heart rate [bpm]})$
- For women: $\text{VO}_2 \text{ max (ml/kg/min)} = 65.81 - (0.1847 \times \text{heart rate [bpm]})$.

Statistical analysis

Mean and standard deviation were used to prepare descriptive statistics. Unpaired *t*-test was used to determine the differences between both the groups among all the variables. All these statistical analyses were done on SPSS v 16, IBM, Chicago, IL, USA.

RESULTS AND ANALYSIS

The mean age (years), height (cm), weight (kg), and VO_2 max (ml/kg/min) of Group A and Group B are shown in Table 1.

Student's *t*-test applied between both groups, and there was no statistically significant difference found in age (0.164), height (0.392), and VO_2 max (0.206) between both groups, as shown in Table 2.

DISCUSSION

This study was done to determine the comparison between Rockport one-mile walk test and McArdle step test, which shows no statistically significant difference in the VO_2 max.

Therefore, we can say that both of these tests can alternatively be used for the prediction of VO_2 max as both are showing similar findings of VO_2 max.

Table 1: Descriptive statistics of Group A and Group B

	Group A		Group B	
	<i>n</i>	Mean $\pm$ SD	<i>n</i>	Mean $\pm$ SD
Age (years)	30	19.73 $\pm$ 1.34	30	19.30 $\pm$ 1.02
Height (cm)	30	172.37 $\pm$ 8.52	30	174.17 $\pm$ 7.56
Weight (kg)	30	63.2333 $\pm$ 11.01	30	70.03 $\pm$ 7.11
VO_2 max (ml/kg/min)	30	55.4767 $\pm$ 3.73	30	53.12 $\pm$ 9.37

SD=Standard deviation

Rockport one-mile walk test is the simplest test that can be performed by any individual of any age groups. A previous study suggested that the Rockport one-mile walk test has been used for measuring VO_2 max from a one-fourth-mile walk to the traditional distance of one-mile for accuracy as a steady-state field test.^[11] However, it was noted previously that the participants who participated in this study did only the normal walking technique and did not include the aerobic walking technique for their validity investigation, which accepts the results based on the relationship between heart rate and VO_2 in predicting maximal oxygen consumption. Furthermore, there appears to be no learning effect for the Rockport one-mile walk test as the result of eliminating the maximal pace of the original Rock port one-mile walk test. The findings^[12,13] indicated that acceptable test–retest reliability of the Rockport one-mile walk test was a function of practice and learning how to pace oneself at a maximal pace throughout the entire one-mile walk, which seems logical to assume that a shorter version of the Rockport one-mile walk test could also be developed to elicit an acceptable steady-state for predicting VO_2 max when compared to other similar field tests.

In a study on the validity of McArdle step test in comparison with ergometer bicycle test for measuring maximum oxygen consumption (VO_2 max), there was no statistically significant difference was found in the results of both the tests. As per the result, it was proposed that McArdle step test can be used for measuring maximum oxygen consumption (VO_2 max).^[14] In another study, Satipati *et al.*^[15] examined the validity of step test for estimating maximum oxygen consumption (VO_2 max) of the female student. They concluded that the step test can be used to estimate the maximum oxygen uptake. Buckley *et al.*^[16] evaluated the validity and reliability of the step test for estimating the maximum oxygen uptake (VO_2 max) and suggested that there are no statistically significant differences of VO_2 max between both the groups.

CONCLUSION

This study has revealed that there is no difference between the Rockport one-mile walk test and McArdle step test for the prediction of VO_2 max. Hence, we can use any of the tests, either the Rockport one-mile or McArdle step test for calculating VO_2 max in any individual.

It can also be concluded that if any individual who is not able to perform McArdle step test can perform Rockport one-mile walk test for calculating VO_2 max, as both the tests give similar results.

Table 2: Student's t-test between Group A and Group B

	t	Significant (two-tailed)	Mean difference	Stared error difference	95% confidence interval of the difference	
					Lower	Upper
Age (years)	1.410	0.164	0.43333	0.30732	-0.18183	1.04850
Height (cm)	-0.862	0.392	1.79	2.07	-5.95	2.37
Weight (kg)	-2.84	0.006	-6.8	2.39	-11.59	-2.01
VO ₂ max (ml/kg/min)	1.279	0.206	2.35567	1.84153	-1.33056	6.04190

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Conflicts of interest

There are no conflicts of interest.

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