

## COMPARISON BETWEEN 12-MINUTE WALK TEST AND 3-MINUTE STEP TEST IN NORMAL ADULTS

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### Abstract

**Background:** Cardiorespiratory endurance is a fundamental component of physical fitness. Compared with maximal exercise testing, sub-maximal testing has greater applicability to physical therapists. Field tests that evaluate the physical capacity are widely used in practice due to their ease of implementation, low cost & representativeness of daily activities. The purpose of this study was to compare 2 practical measures of functional endurance – 12 minute walk test (12MWT) & 3 minute step test (3MST) to determine their appropriateness for use as field tests in adults.

**Methodology:** 150 individuals between 18 to 25 yrs were divided into Group A performing 12 MWT & Group B performing 3MST randomly. After informed consent & departmental ethics approval this study was conducted. We documented the changes in blood pressure, heart rate responses and subjective exertion associated with the tests immediately post test, 1 minute after, 3 minute after so on till basal level was obtained.

**Results:** Both the tests produced significant changes in all outcomes. The average heart rate & perceived exertion were significantly higher after 3 MST than 12 MWT. The average heart rate in 3 MST was equal to 76.11% of the age related target heart rate.

**Conclusion:** The 12 MWT is less stressful physiologically & therefore 3 MST may be a better option for field-testing functional endurance in adults.

**Key Words:** Physical performance measure, Cardio-respiratory fitness, exercise testing, 12 MWT, 3 MST.

### INTRODUCTION

Physical performance measures are defined as clinician observed measures of physical function that assess a task classified as “activity” using the World health organization International classification of functioning, disability & health (ICF) model<sup>1</sup>. Physical function is evaluated directly by the clinician while an individual is performing the activity usually by timing, counting & distance measures<sup>2</sup>. Cardio-respiratory endurance is a fundamental component of physical fitness.

Only a rough estimate can be got from the patients' descriptions of their symptoms, which, although helpful in diagnosis, are inadequate for many purposes. An objective and more precise estimate is needed for a reliable judgment of the effects of treatment or for comparing one method of treatment with another, for assessing the patient's capacity for physical work during rehabilitation, for awarding compensation in industrial pulmonary disease, and for many types of survey investigation. For these purposes various

exercise-tolerance tests have been devised<sup>3</sup>. The individual response to exercise is an important clinical assessment tool because it provides a composite assessment of the respiratory, cardiac, and metabolic systems.

The current gold standard for assessing one's aerobic exercise response is the maximum incremental cardiopulmonary exercise test. However, most daily activities are performed at submaximal levels of exertion; thus, using submaximal functional tests would provide a more realistic simulation of one's physical capability<sup>4</sup>. Notable submaximal functional test, alternative to the measurement of maximal oxygen uptake has been identified. Functional tests are exercise tests that measure functional status or capacity, mainly the ability to undertake physically demanding activities of daily living<sup>5</sup>.

They are considered objective measures that provide a means to monitoring response to treatment<sup>6</sup>. Two such functional tests that are practicable in many settings are the Twelve minute walk test (12 MWT)

advocated by the American Thoracic Society & the YMCA Three minute step test (3 MST) included in the American College of Sports Medicine's guidelines for exercise testing & prescription<sup>7, 8</sup>.

Compared to traditional laboratory indexes of exercise capacity (cycle, treadmill, ergometry), walk & step tests require less technical expertise & equipment, making them inexpensive and easy to administer. More importantly, they employ an activity that individuals perform on a daily basis. Hence, these tests were compared to determine which of the 2 is the best to obtain target heart rate in adults.

**METHODOLOGY**

A departmental ethics approval was obtained before commencement of the study. Our study group includes 150 healthy adults (65 males & 85 females) between the age group of 18 to 25 years. Before recruitment, subjects with cardiorespiratory problems, such as asthma, bronchiectasis, congenital heart deficit, hypertension, exercise problems (neuromuscular & musculoskeletal diseases) were excluded from the study. An informed consent was obtained. These subjects were then randomly divided by coin toss method into Group A (12 MWT) and Group B (3 MST).

12 MWT: was conducted according to a standardized protocol<sup>8</sup>. The subjects were instructed to walk up & down an internal hallway covering as much as ground as they could in 12 minutes. The subjects were told that the purpose of this study was to see how far they could walk in 12 minutes & was self paced.

The subject sat at rest in a chair, located near the starting position for 10 minutes before commencement of the test. During this period resting pulse rate, blood pressure and respiratory rate were recorded as basal values. A single investigator who used a mechanical lap counter to record the number of laps completed, and an electronic timer with an alarm that sounded after 12 minutes performed the test.

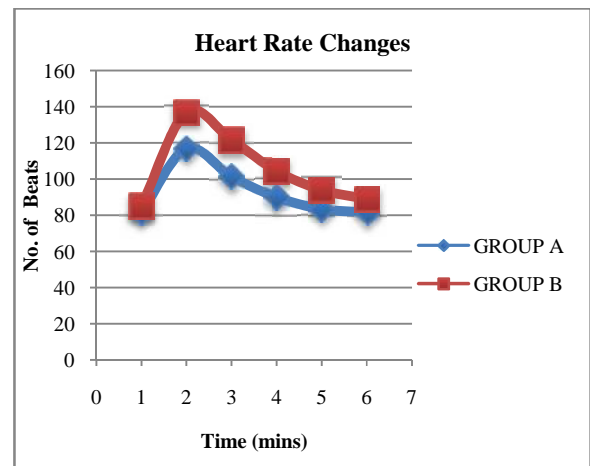
3 MST: was conducted according to the YMCA protocol<sup>7</sup>. A 12-inch tall step was used along with an electronic timer with an alarm set to 3 minutes. The subject was asked to step up and down the step at a regular pace (96 steps per minute). The basal parameters were noted prior to commencement of the study.

During the test standardized words of

encouragement were used (You are doing very well, cover as much as distance as you can, continue at the same pace etc.) The rates of perceived exertion during both the tests were recorded using the modified Borg's scale. Further, the changes in the basal parameters were also recorded immediately post the test, after 1 min, 3 min, 5 min, and 7 min till they leveled back.

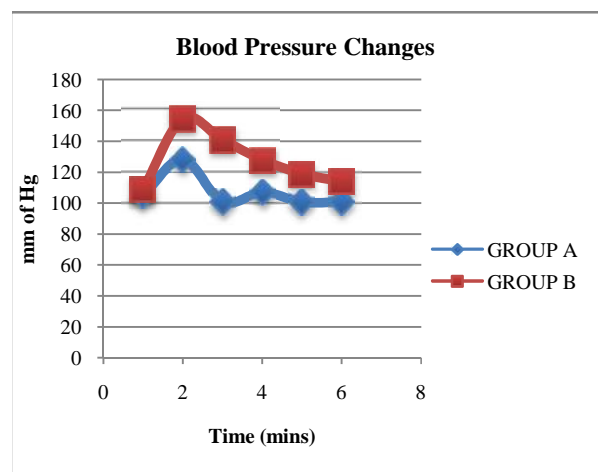
**RESULTS**

During the study, a very positive response was noted among the subjects. All of them were very excited & willingly participated in the test. Analysis was conducted using SPSS version 15.0. The 2 tests were compared using Pearson's correlation. As illustrated in the graphs below, the responses obtained for 3 MST was more intense than that of 12 MWT.



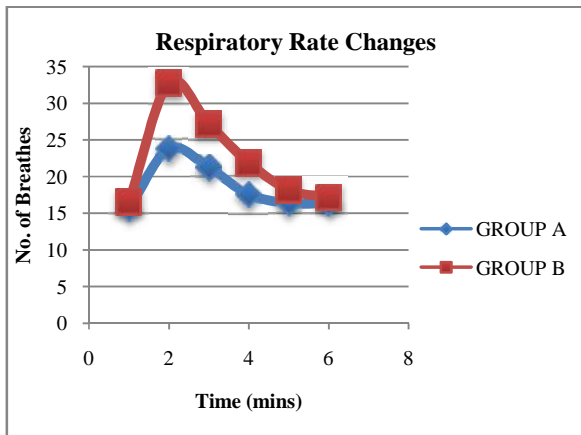
**Graph 1** Comparison between heart rate changes after 12 MWT & 3 MST

Inference: Heart rates achieved after 3 MST were higher compared to 12 MWT



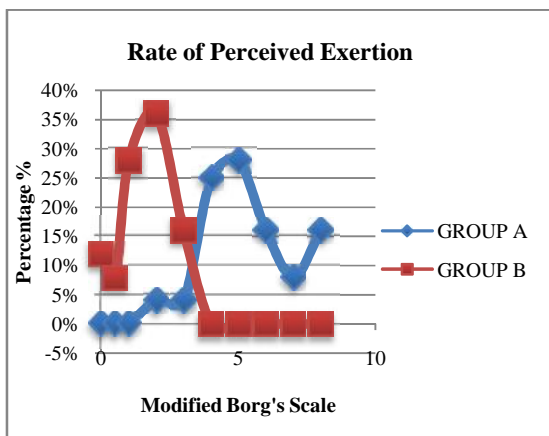
**Graph 2** Comparison between blood pressure changes after 12 MWT & 3 MST

Inference: Changes in Blood pressure after 3 MST were higher compared to 12 MWT



**Graph 3** Comparison between respiratory rate changes after 12 MWT & 3 MST

Inference: Changes in Respiratory rates were higher during 3 MST



**Graph 4** Comparison between respiratory rate changes after 12 MWT & 3 MST

Inference: Exertion felt by the subjects was greater during 3 MST

## DISCUSSION

Field tests are typically administered as a means of evaluating functional status, monitoring treatment effectiveness and establishing prognosis. The measurement of functional status & capacity has become an integral component of evaluating the impact of an intervention in patients with cardiorespiratory disease. Both 12 MWT & 3 MST are increasingly being used in routine clinical practice because it provides useful information on the daily physical performance of healthy individuals<sup>9</sup>. The reliability, validity & responsiveness for both the tests are well established<sup>(10, 11, 12, 13, 14)</sup>. Nevertheless, the comparability of individuals' physiological responses to both these tests is not clear. We, therefore, undertook this study to compare responses of individuals & thereby determine their appropriateness for use as field tests.

The advantage of the step test over the walk test is

its portability, which facilitates its use in any environment. The pace is dictated by auditory stimuli, which favors isolated analyses (same no. of steps / minute) with re-evaluation of individuals after intervention<sup>15</sup>.

We could observe that all subjects in the study completed the test properly, without pausing in between.

Designing cardiorespiratory training program requires the ability to calculate, monitor and manipulate the training intensities. Heart rate is the most reliable measurement to use. The most commonly used formula to find maximum heart rate ( $HR_{max}$ ) is 220 minus age. Based on this the cardiorespiratory workout is spaced into 3 zones

- Zone one: uses approximately 65 – 75 % of  $HR_{max}$ . This initial zone trains the body to maximize its potential.
- Zone two: uses 80 -85% of  $HR_{max}$ . This zone involves higher intensity of exercises requiring aerobic power and leads to increase burning of fats. This increases the aerobic capacity & anaerobic threshold of an individual.
- Zone three: is a true high intensity workout involving 90% of  $HR_{max}$ . It is an overload where an individual exercises on for 30-60 seconds.

A target HR is formulated into the HR training zones for developing cardiorespiratory fitness/field tests<sup>16</sup>. When comparing the results of the physiological variables assessed in both tests, difference in the heart rate before & after the test would represent the effort levels individual subjects exerted during the test. As shown in Graph 1, 3 MST required more energy to perform than 12 MWT.

For the 12 MWT the mean maximum heart rate obtained was equal to 69.9% of the target heart rate whereas for the 3 MST the value was equal to 80.11% of the target heart rate. This shows that the step test places more demands on the heart. Similar results were observed with blood pressure & pulse rate changes as depicted in graph 2 & 3. As the 3 MST places increased load on the heart, the rate of exertion was also greater during the test compared to 12 MWT as depicted in graph 4. Hence, we conclude that, the 3 MST is better suited as a field test for assessing the functional capacity of subjects of this age group.

## CONCLUSION

The 12 MWT and 3 MST are recommended as functional field tests that are used in the assessment of cardiorespiratory capacity. Though the 12 MWT is easy to administer and better tolerated, the 3 MST provides optimal workload on the cardiorespiratory system. 3 MST is therefore a valuable measure of exercise tolerance in the adult population.

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