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Research Study

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Intra-rater reliability of 6minute pegboard and ring test as a tool to assess upper limb endurance in healthy population between age group 40-70 years

^{*1}Nikita Chhajed, ²PrajaktaBidkar, ³Dr Shreya Dhake(PT)

^{*1}Intern, Deccan Education Society's Brijlal Jindal College of Physiotherapy, Fergusson college campus, Pune –411004, India

²MPT second year student (Cardiovascular and respiratory physiotherapy), Deccan Education Society's Brijlal Jindal College of Physiotherapy, Fergusson college campus, Pune – 411004, India

³Assistant Professor, Deccan Education Society's Brijlal Jindal College of Physiotherapy, Fergusson college campus, Pune – 411004, India

*Corresponding Author: Nikita Chhajed
Email id: nikitachhajed07@gmail.com

ABSTRACT

Background– An examination of muscle endurance is important in determining functional capacity. All daily living tasks – supported or unsupported require some degree of muscle and cardiopulmonary endurance. 6 minute pegboard and ring test(6PBRT)have been developed to evaluate arm exercise capacity in individuals with chronic obstructive pulmonary disease. Various studies have used the 6PBRT as a way to evaluate upper limb endurance in various conditions like COPD, asthma, etc.

Purpose of the study–To establish the intra-rater reliability of 6 minute pegboard and ring test as a tool for assessing upper limb endurance in healthy population between age group 40-70 years.

Method – A 6 minute pegboard and ring test tool was made according to guidelines of American Thoracic Society. A cross sectional study was done which included 138 healthy adults (males and females) with mean age of 55.34 ± 8.02 years old. Subjects performed 6 minute pegboard and ring tests twice on same day, with 30 minutes rest in between. Number of rings moved during first test (T1) and after 2nd test (T2) were recorded and compared to find out intra-rater reliability of the tool which was made.

Result–In each age group males and females taken were also equal i.e. 40-49yrs - 23 males and 23 females, 50-59yrs - 23 males 23 females and 60-70 yrs 23 males 23 females. There was no sample loss in the study. Cronbach's alpha or coefficient alpha which is most common test score reliability coefficient came out to be 0.99. Average number of rings moved before were 296.95 and after 30 minutes were 302.24.

Conclusion – Study concludes that 6 minute pegboard and ring test, tool which was made for assessing upper limb endurance has excellent reliability.

Clinical implications – The tool can be used in clinical setup for assessing the upper limb endurance, for prognosis and to train upper limb endurance in healthy individuals as well as many other conditions.

Keywords: endurance, upper limb, tool, reliability, chronic obstructive pulmonary disease.

INTRODUCTION

Muscle endurance is “the ability to sustain forces repeatedly or to generate forces over a period of time”.¹ An examination of muscle endurance is important to determine functional capacity. Maintenance of balance and proper alignment of the body segments requires sustained control(endurance) by postural muscles.² All daily living activities - supported or unsupported extensively contribute in performing both simple as well as complex tasks such as brushing teeth, bathing, combing hairs, kitchen work, etc. In fact, almost all daily living tasks require some degree of both- muscle and cardiopulmonary endurance.³

Fatigue is an overwhelming sense of exhaustion and decreased capacity for physical and mental work at the usual level. Fatigue can be the result of excessive activity caused by an accumulation of metabolic waste products (e.g. Lactic acid), malnutrition (i.e. deficiency of nutrients), cardiorespiratory disturbances (i.e. inadequate oxygen and nutrients to the tissues), emotional stress and other factors.² Both simple and complex activities require the muscles namely trapezius, pectoralis minor, scalene and intercostal muscles to participate in positioning the arm. These muscles also function as accessory muscles of respiration. Therefore elevation of arm increases the load on these muscles and they are unable to perform dual task resulting in arm fatigue and a feeling of dyspnea in healthy individuals as well as in individuals with COPD.

It is observed that even healthy individuals develop fatigue when performing unsupported upper limb activities for prolonged time. Reliability refers to how consistently a method measures something. If the same result can be consistently achieved by using the same methods under the same circumstances, the measurement is considered reliable. Reliability of an assessment tool is the extent to which it consistently and accurately measures learning.

Measuring reliability of a tool or any measurement is of utmost importance as we can be confident that repeated or equivalent assessments will provide results which are consistent.

There are four general classes of reliability estimates, each of which estimates reliability in different way. They are:

- Inter-rater or Inter-observer reliability – Used to assess the degree to which different raters/observers give consistent estimates of the same phenomenon.
- Test-Retest reliability –Used to assess the consistency of measure from one time to another. Mostly the rater is same.
- Parallel – forms reliability – Used to assess the consistency of the results of two tests constructed in the same way from the same content domain.

- Internal consistency reliability – Used to assess the consistency of results across items within a test.

Over the years, to quantify the impairment of unsupported upper limb function various tests like supported upper limb exercise test (SULEX), grocery shelving test (GST), the unsupported upper limb exercise test (UULEX) have been developed. But all these tests are time consuming tests.

One of the tests which mimics activities of daily living is the six minute pegboard and ring test (6PBRT). The 6 minute pegboard and ring test (6PBRT) is a simple, inexpensive test that helps to evaluate both arm function and endurance. It is a time limited test (6 minutes). Considering the feasibility and time 6 minute pegboard and ring test is better and can be performed easily.

The 6PBRT was developed to evaluate arm exercise capacity in patients with COPD. Various studies have used the 6PBRT as a way to evaluate individuals with COPD, or as a way to compare them with healthy individuals or to find out the normative values of 6PBRT in healthy individuals. The 6PBRT is a method of assessing upper limb endurance that has been validated and reproducible not only for individuals with COPD but also for healthy adults in few research articles (9), (10).

NEED FOR THE STUDY

Activities of daily living that involve unsupported upper limbs leads to dyspnea and fatigue in individuals suffering from COPD. Even healthy individuals find prolonged upper limb activities difficult to be performed for longer time. 6 minute pegboard and ring test is used to assess upper limb endurance in various population. The 6PBRT is a reliable and valid test in COPD and asthma patients but its reliability in healthy individuals is not known. To perform 6 minute peg board and ring test, equipment was constructed according to the guidelines of American Thoracic Society. Hence the need to assess reliability of this instrument was felt. It is the first tool to assess upper limb muscle endurance. If found reliable, patients can be assessed using it.

Aim

To establish the intra-rater reliability of 6 minute pegboard and ring test in healthy population between age group 40-70 yrs.

Materials and methodology

Materials

Pegboard and rings, stop watch Ring- 50 gm each.

Study design

Type of study – Cross sectional

Sample size- 138

Study population – Healthy population

Inclusion criteria

1. Healthy population
2. Age 40-70 years
3. Males/ females

Exclusion criteria

1. Individuals with musculoskeletal impairments likely to interfere with the completion of the test like shoulder pathologies or upper limb recent fractures.
2. Neurological weakness - Patients having neurological problems, cognitive dysfunction.

Sampling technique – Convenience sampling.

Method

This was a prospective cross-sectional study of a convenience sample of healthy adults recruited according to the age group needed within the community. Initially demographic data of the participant was taken, the data included name of the participant, age of the participant and gender of the participant. Consent was obtained from an

individual. Subjects were selected according to the inclusion and exclusion criteria. The test procedure and purpose of the study was explained in the language patient understands. The participant was seated on chair on front of a wooden board on which there were four pegs (two upper and two lower) and 10 rings hanging on each of the lower pegs. The lower pegs were positioned at shoulder height of the participants and upper pegs 20 cm above the lower pegs. Participants were instructed to move as many rings as possible from lower to upper pegs and vice versa during a 6 minute period. Participant started the test as the stop watch started. Number of rings moved in a 6 minute period were calculated. The participant performed two 6PBRT's, the second being performed at an interval of 30 minutes. During the test if participant needed to rest he/she was allowed to rest. If a participant needed to rest, he/she was instructed to resume the test as soon as possible as the stopwatch was not stopped. Standardized phrases of encouragement were offered every minute during the test. The outcome of 6PBRT was the number of rings moved by the end of the test.

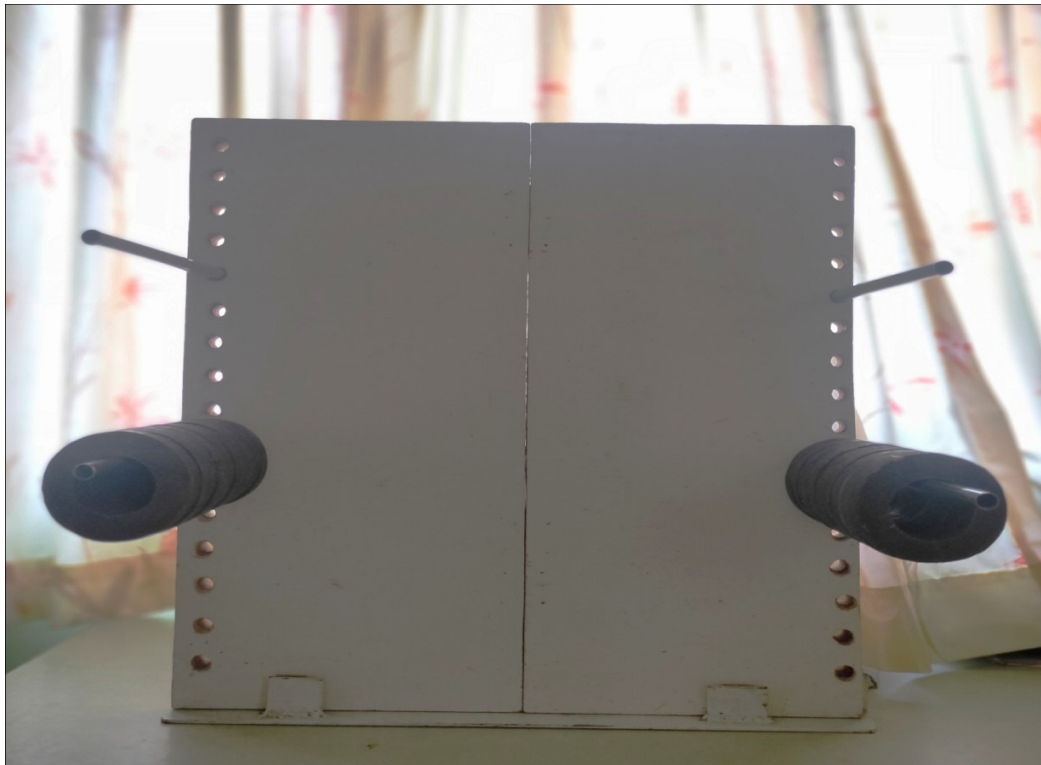


Figure 1. Instrument constructed for 6 minute peg board and ring test.



Figure 2. The participant performing 6 minute pegboard and ring test.

Data analysis and results

Data was analyzed using SPSS software and Cronbach's alpha or coefficient alpha which is the most common test score reliability coefficient was determined.

Table 3.2 : The Alpha Cronbach Value (Konting et al., 2009)

Alpha Cronbach Value	Interpretation
0.91-1.00	Excellent
0.81-0.90	Good
0.71-0.80	Good and Acceptable
0.61-0.70	Acceptable
0.01-0.60	Non acceptable

Figure 3. Alpha Cronbach value and its interpretation

RESULTS

Each age group consisted of equal number of males and females. Age group was from 40-49yrs, 50-59yrs, and 60-70yrs consisting of 23 males & 23 females. There was no sample loss. The mean age

In individual age group-

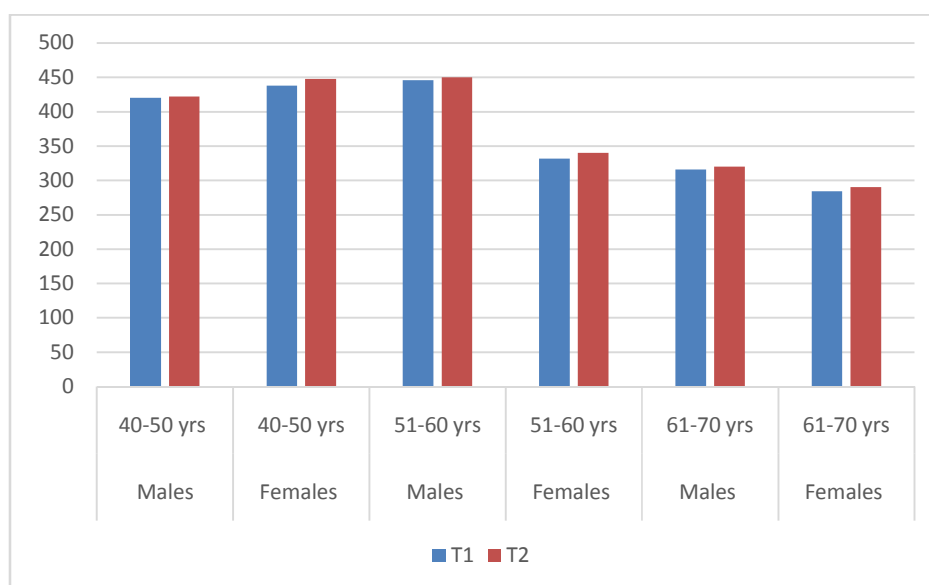
of study population was 55.34 ± 8.02 yrs. Average number of rings moved in test 1 were 296.95 and test 2 were 302.24.

Table 1. Number of rings moved by males of each age group.

Males- Age grp.	40-49 yrs	50-59 yrs	60-70 yrs
Test 1(T1)	377.13 ± 20.01	342.18 ± 36.43	247.74 ± 37.50
Test2 (T2)	383.04 ± 19.82	348.18 ± 35.71	252 ± 37.78

Table 2. Number of rings moved by females of each age group

Females - Age grp.	40-49 yrs	50-59 yrs	60-70 yrs
Test 1 (T1)	336.97 ± 45.94	277.39 ± 32.05	228.35 ± 31.58
Test 2 (T2)	342.17 ± 47.37	283 ± 33.20	233.82 ± 31.84



Graph1. Gender comparison for maximum rings moved in test 1(T1) in each age group.

According to the above results Cronbach's alpha came to be 0.99 which shows excellent reliability.

DISCUSSION

The 6PBRT is a simple, inexpensive test that helps to evaluate both arm function and endurance. This study aimed to investigate the intra-rater reliability of 6 minute pegboard and ring test as a tool for assessing upper limb endurance in which equipment was made according to the guidelines of American Thoracic Society.

There was only a little difference in the number of rings moved after an interval of 30 minutes, hence proving that the instrument has excellent reliability.

The number of rings moved after 30 minutes were comparatively higher in all individuals. This may be due to the population becoming aware of the test after performing once hence improving the performance (learning effect). Learning effect also called as practice effect – as participants complete

the measures after each condition, they may get better practice. Clear and concise instructions (test instructions) in the language the participant understands, no momentary distraction, group variability (no group of participant with homogenous ability), all these intrinsic as well as extrinsic factors resulted in increased reliability. The 6 minute pegboard and ring test (6PBRT) can also be used as a reliable test to evaluate functional arm exercise capacity in patients with asthma, pulmonary hypertension, etc.

The present study also demonstrated that only age was a determinant of performance on 6 minute pegboard and ring test in both genders, younger individuals performing better than older individuals. The number of rings moved was higher in younger participants - 40-50yrs (377.13 ± 20.01 by males and 336.97 ± 45.94 by females) than in older participants - 50-60yrs (342.18 ± 36.43 by males and 277.39 ± 32.05 by females) and 60-70yrs (247.74 ± 37.50 by males and 228.35 ± 31.58 by females). It is well established in literature that aging affects muscle mass, strength, endurance and motor coordination including in healthy, physically active individuals.

Also according to the authors 6 minute pegboard and ring test consists of small amplitude movements during which the individuals keep their shoulder flexed at 90° throughout the test.

Although 6 minute pegboard and ring test is less intense from cardio respiratory point of view, it requires greater motor coordination.

FUTURE SCOPE

Can be used to assess arm function both in healthy and diseased population in clinical practice. Can be used to find out normative values of number of rings moved in each age group and then compare with diseased population.

CONCLUSION

Study concludes that 6 minute pegboard and ring test is a reliable tool for assessing upper limb endurance in healthy population.

Clinical implications

This tool can be used in clinical setup for assessment and prognosis of upper limb endurance.

Conflicts of interest

None.

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