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# TO MEASURE LOWER BODY STRENGTH IN INDIAN POPULATION USING CHAIR STAND TEST.

Physiology

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## ABSTRACT

The thirty second chair stand test has been used as a measure of lower body fitness in older adults from 60 – 90 years, healthy or unhealthy. This study aims at establishing the reliability and validity of this technique as a measure of lower body strength in an Indian population in individuals of age groups 20 to 59 years.

**OBJECTIVES:** To evaluate the thirty second chair stand test (CST) as a measure of lower body strength in an Indian population.

**METHODOLOGY:** A prospective case study was done from June 2017 to June 2018 in the department of Physical medicine and rehabilitation in 100 subjects of the ages of 20 to 59 years. For the 30 – second CST, individuals were required to stand up from a standard chair to a fully extended standing position as many times as possible with their arms folded across their chest. The number of completed repetitions achieved in 30 seconds was recorded. Test retest reliability was evaluated by performing this test on two separate occasions 1 week apart. Intra – class variations was analyzed across age and gender.

**FINDINGS:** Intraclass reliability R ranged from 0.98 to 0.99 – with a majority of values being 0.99 indicating that the tests have good relative reliability across trials. ANOVA results revealed no significant changes from scores from day 1 testing to day 2 retesting, thus indicating that the tests also have absolute reliability across trials. The scores were found to decline across age and are lower for older age group (40 – 59) as compared to younger (20-39). The scores were found to be lower for females as compared to males.

**CONCLUSIONS:** The results of this study indicate that the THIRTY SECOND CHAIR STAND TEST is a reliable test to measure lower body strength. We assessed construct validity across age and gender and a positive trend was found. Hence it is a valid test.

## KEYWORDS

Fitness testing, Thirty second chair stand test, Lower body strength, Indian population

## INTRODUCTION

In the World Health Organization statistics for India, for the year 2011, Non-Communicable Diseases (NCDs) were estimated to account for 53% of all deaths. In the 2008 estimated prevalence of metabolic risk factors, raised blood pressure, raised blood glucose, overweight, obesity and cholesterol ranked high in the list with overweight and obesity making up 12.9% of the total. Among the behavioral risk factors, physical inactivity overtook smoking with a prevalence of 14%.[1]

In the face of these and more such sobering statistics, national and international organizations have launched public health programs to curtail obesity. Some of the mantras being chanted world over now are, "fitness", "health", "wellbeing" and "physical activity".

"Physical activity," "exercise," and "physical fitness" are terms that describe different concepts. However, they are often confused with one another, and the terms are sometimes used interchangeably. "Physical activity" is defined as any bodily movement produced by skeletal muscles that result in energy expenditure. The energy expenditure can be measured in kilocalories. Physical activity in daily life can be categorized into occupational, sports, conditioning, household, or other activities. "Exercise" is a subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective the improvement or maintenance of physical fitness. "Physical fitness" is a set of attributes that are either health- or skill-related. The degree to which people have these attributes can be measured with specific tests.[2]

Fitness tests include testing measures of functional strength, aerobic endurance, dynamic balance and agility, and flexibility. This study focuses on a test for functional muscle strength. Traditional protocols for assessing fitness include tests like treadmill and cycle ergometer tests, bench step tests, isokinetic muscle testing etc. Most of these require extensive and expensive instrumentation and/or extensive training for test technicians and are, therefore, not feasible for use in the clinical or community setting. The 30-SECOND CHAIR STAND TEST was thus "designed specifically for use in clinical or field settings and, particularly, to be capable of providing continuous scale measurements across the wide range of ability levels typically found in the community-residing older adult population".[3]

The 30-second chair stand test was then further developed, validated and normative scores published for American adults in the age groups of 60 – 94. It has since then been incorporated by the National Centre for Injury Prevention and Control (USA) under the Centre for Disease Control and Prevention (CDC) as part of their STEADI (Stopping Elderly Accidents, Deaths and Injuries) program.[4]

In population based European study, sex- and age-stratified reference values for the CST for a European adult population up to the age of 79 years was determined. Age, sex, smoking status, BMI and level of perspiration during physical activity together predicted test performance moderately. CST results for men were generally higher (on average 3 more repetitions) than for women. In both men and women, there was a constant decline of performance across age groups.[5]

In an Indian cross sectional study, 723 participants of ≥60 years without any morbidity, from AIIMS, New Delhi was done and the Cut-off for thirty second chair stand test in 60-65 years, 66-70 years and >70 years for male were 10, 9 and 8 and for females was 8, 8 and 7 repetitions, respectively.[6] This normative data is useful to clinicians and researchers as Indian reference values are less as compared to western data.[4,5,6]

**Examples of use:**

- Outcome measures following hip/knee arthroplasty [7]
- Outcome measure following physical rehabilitation in hip/knee osteoarthritis [8,9,10]
- Outcomes following drug trials for osteoarthritis [11]
- Predictive studies in hip/knee osteoarthritis [12]
- Functional mobility measure across age and gender [13]
- Balance disorders [14]
- Performance batteries for physical function [15]

**Methods**

The aim and objective was to to assess and establish Test-Re-test reliability of the CST and to assess and establish construct validity of the CST by analyzing intra-class variations across age, gender and level of physical activity.

The study was carried out in the Department of Physical medicine and rehabilitation (PMR) from the time period of 1st June 2017 to 15th December 2018. It was an experimental study done among the people visiting this department across ages 20 – 59 years of both genders. Candidates were selected from among the attendants of patients visiting PMR OPD and staff and students of Christian Medical College and Hospital, Ludhiana, that decided to volunteer for this study. All candidates were screened by the modified American Heart Association/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire[16] for the presence of risk factors for various cardiovascular, pulmonary, renal, and metabolic diseases as well as other conditions (e.g., pregnancy and orthopedic injury) that require special attention. This screening protocol classified them into low, moderate or high risk according to the ACSM's guidelines for exercise testing.

## INCLUSION CRITERIA

1. Normal healthy subjects between the ages of 20 - 59
2. Low risk as per the screening protocol
3. Agreed to sign a statement of informed consent.

## EXCLUSION CRITERIA

1) Musculoskeletal limitations which would prohibit their performance on the tests, i.e.
a) limited their activities due to pain during the preceding 30 days before enrollment in the study
b) had neuromuscular disease
c) required another person or an assistive device to walk
d) had an injury or illness that affected their walking ability
e) had surgery in the past year requiring a recuperation period greater than 1 week
f) Reported fainting spells or frequent falls in the prior year.
2) Moderate and high risk as per the screening protocol
3) People lost to follow up.

The sample required for various population sizes for 90% confidence for 95% reliability with no failures in the sample sampling without replacement was 45. However for the purpose of this study, a sample size of 100 was chosen.

Following screening, a total of 100 subjects were selected of age groups 20-29, 30-39, 40-49 and 50-59 each separated into men and women. The groups were decided by proportionate sampling with reference to census 2011.

The groups that were analyzed for difference in scores were categorized according to:

1. Gender – 52 men and 48 women
2. Ages – 64 subjects of younger age group ( 20-39 yrs) and 36 subjects of older age group ( 40-59 yrs)
3. Physical activity levels

## PROCEDURE

All selected participants were given a protocol that contained an information sheet , an informed consent form[17] and a physical activity questionnaire[18]. Prior to all testing, participants performed an 8-minute warm-up and stretch routine emphasizing the lower body.

Equipment used were a chair with a straight back without arm rests (seat 17" high) and a stopwatch. The subject was instructed to sit in the middle of the chair and place their hands on the opposite shoulder crossed at the wrists. While keeping their feet on the floor and their back straight, they were asked to rise to a full standing position and then sit back down again. Each cycle of sitting and standing was considered as 1. The number of times the person did this in 30 seconds was recorded as their score.

The test-retest reliability of CST was determined by comparing the two scores and the construct validity was evaluated by demonstrating differences between ages, genders and levels of physical activity.

## STATISTICAL ANALYSIS

Frequencies, proportions, means, standard deviations were calculated. Chi square and t-test was done using SPSS version 21. Test-retest reliability was estimated by calculating the intraclass coefficient (R) using one-way analysis of variance (ANOVA) procedures appropriate for a single trial.

Construct validity of the chair-stand test was demonstrated by the test's ability to detect differences between age, gender and physical activity level groups.For the reliability study, participants performed the test on two different days, one week apart.

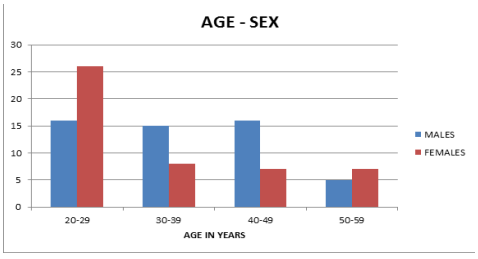
## RESULTS

The distribution among groups was decided by proportionate sampling with reference to census 2011.

**Table 1 Distribution by age and gender**

| | | GENDER | | Total | P value |
|---|---|---|---|---|---|
| | | Male | Female | | |
| Age Group | 20-29 | 16 (38.10%) | 26 (61.90%) | 42(100.00%) | 0.042 |
| | 30-39 | 15 (65.22%) | 8 (34.78%) | 23(100.00%) | |
| | 40-49 | 16 (69.57%) | 7 (30.43%) | 23(100.00%) | |
| | 50-59 | 5 (41.67%) | 7 (58.33%) | 12(100.00%) | |
| Total | | 52 (52.00%) | 48 (48.00%) | 100 (100.00%) | |

**Image 1 Distribution by age and gender (Table 1)**




## TESTS OF RELIABILITY

Intraclass reliability R ranged from 0.98 to 0.99 – with a majority of values being 0.99 indicating that the tests have good relative reliability across trials.

**Table 2 Test vs retest correlation**

| | Intraclass correlation | 95% Confidence Interval |
|---|---|---|
| Single measures | 0.9905 | 0.9859 to 0.9936 |
| Average measures | 0.9952 | 0.9929 to 0.9968 |

ANOVA results revealed no significant changes from scores from day 1 testing to day 2 retesting, thus indicating that the tests also have absolute reliability across trials.

**Table 3 Test vs retest scores**

| | Sample size | Mean ± SD | Median | Min-Max | Inter quartile Range |
|---|---|---|---|---|---|
| RETEST | 100 | 22.45 ± 7.61 | 21 | 8-47 | 17 - 28.500 |
| TEST | 100 | 22.23 ± 7.62 | 20.5 | 8-47 | 17 - 28 |

## TEST OF VALIDITY

The scores were found to decline across age and are lower for older age group as compared to younger.

**Table 4 Difference across age groups**

| | 20-39 | 40-59 | P value |
|---|---|---|---|
| Sample size | 65 | 35 | |
| Mean ± Stdev | 23.05 ± 8.03 | 20.71 ± 6.62 | |
| Median | 22 | 20 | |
| Min-Max | 11-47 | 8-35 | |
| Inter quartile Range | 17 – 29 | 17 - 24 | |

The scores were found to be lower for females as compared to males.

**Table 5 Difference across genders**

| | Male | Female | P value |
|---|---|---|---|
| Sample size | 52 | 48 | |
| Mean ± Stdev | 23.29 ± 7.02 | 21.08 ± 8.14 | |
| Median | 22 | 19.5 | |
| Min-Max | 12-41 | 8-47 | |
| Inter quartile Range | 18 - 29 | 15.500 - 25.500 | |

## DISCUSSION

The R values are above 0.90 (0.99) indicating that the test has a good relative reliability across trials with the first trial being the score on day 1 and trial 2 after a week. ANOVA results revealed no significant changes from scores from day 1 testing to day 2 retesting, thus indicating that the tests also have absolute reliability across trials.

The scores were found to decline with age and the scores were lower for older age group (mean 20) as compared to younger (mean 23). Further, they were lower for females (mean 21) as compared to males (mean 23). These results were in keeping with previous studies that showed decline with age and males performing better than females. In a study done in an older population among 7183 participants, scores of the CST also showed a decline with age and a better performance by males as compared by females[19]. This supports the construct or discriminant validity of the test in a younger population in the Indian setting.

In other published studies, content and criterion validity of the CST has been proven as mentioned below. A positive correlation was found with walking speed in frail older adults and the Stair Climb Test[20]. Further correlation with strength was found with the weight-adjusted leg-press test of lower extremity strength in both community dwelling older men and women[21].

Thus, results of this study corroborate that the CST is reliable and valid as a measure of lower body strength. Further, the CST appears to be a safe and socially acceptable assessment procedure for all age groups and population studies can be conducted to ascertain normative scores in Indians.

Also, more studies are recommended to investigate the reliability and validity of the CST with physically frail and disabled populations. This would thus be invaluable to the general practitioner in providing feedback for exercise prescription to help correct or reduce imbalances that may lead to mobility problems and potential injuries.

Furthermore, additional studies are needed to test the ability of the CST to detect change over time which could potentially provide practitioners an excellent outcome measure for assessing the benefits of therapeutic intervention.

The main drawback faced in this study was the method of sampling. Further studies preferably population studies with double blinded stratified random sampling are recommended for better results with more far reaching consequences, especially for establishing construct validity for physical activity.

The advantages of the CST are easy administration in the field or resource poor settings and a safe and socially acceptable assessment procedure for all age groups.

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