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Thirty second chair stand performance is associated with six-minute walk test among postmenopausal women: inference from a cross-sectional study among women from India

Hina Vaish, Digvijay Sharma

School of Health Sciences, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India

Correspondence: Hina Vaish, School of Health Sciences, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India.

Tel.: +919450124758.

E-mail: hina22vaish@gmail.com, hinavaish@csjmu.ac.in

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Abstract

Menopause is an inevitable yet normal biological process in a woman's life. The menopausal process has been associated with a decline in muscle strength and functional capacity. Thus, the present study aimed to explore the association of the 30-Second Chair Stand Test (30s CST) with the 6-Minute Walk Test (6MWT) among postmenopausal women. Thirty-five postmenopausal women aged 40–55 years were included in this cross-sectional study by purposive sampling method. After initial screening and assessment 30s CST and 6MWT were recorded as per standardised guidelines. The mean and Standard Deviation (SD) for all continuous variables was calculated. Correlations were estimated using Pearson's coefficient of correlation. A two-tailed p-value <0.05 was considered statistically significant. There exist a significant positive association of 30s CST values with 6MWT among postmenopausal women. Also, the Rate of Perceived Exertion (RPE) scores after the 6MWT were found to be significantly correlated with RPE scores after 30s CST. In conclusion, there exists a significant

positive correlation of 30s CST with 6MWT among postmenopausal women. The 30s CST could be used as an economical and quick physical function assessment measure among postmenopausal women in low-resource settings.

Introduction

The physiological impact of menopause on women's health has been deeply explored.[1] There are physiological changes due to menopause that could contribute directly to limitations in physical function.[2,3]

The 6-Minute Walk Test (6MWT) is a submaximal exercise test commonly used for evaluating physical functional capacity among disease states as well as healthy adults.[4-6] It is a practical and well-tolerated test, which is more reflective of daily life activities than cardiopulmonary exercise tests.[7]

Physiological impairments that arise with menopause may affect muscle power, strength and mass.[8] The sit-to-stand performance test is extensively used for assessing lower-extremity function, strength, and balance control.[9,10] The 30-Second Chair Stand Test (30s CST) is a time-based test and it evolved to overpower the floor effect of 5 or 10 repetitions sit-to-stand test.[9,10] This test has been performed in various health conditions like knee replacements, Chronic Obstructive Pulmonary Disease (COPD), rehabilitation programs, and healthy adults.[11-13]

The 30s CST evaluates the ability to stand up from a sitting position, which is an essential activity as walking in daily life.[14] The 30s CST has also been proposed as a reliable and valid indicator of lower body strength.[15,16] The 6MWT distance may be a good indicator of lower limb muscle strength.[17] 6MWT and 30s CST are considered tests of physical performance, it

is postulated that the 30s CST may be correlated with the 6MWT and therefore a useful alternative for assessing the functional capacity.[18]

The correlation between sit-to-stand test and 6MWT has been studied in COPD patients and young adults.[14,18] However, there is a scarcity of research concerning 6MWT and sit-to-stand tests among women, particularly concerning menopause. In order to address the research gap, the authors conducted the present study to explore the association of the 30s CST test with 6MWT in postmenopausal women. Secondarily, we studied the association of 30s CST and 6MWT with pulmonary function among postmenopausal women.

Materials and Methods

Study design

This is a cross-sectional study.

Ethical statement

The study was approved by the ethics committee of the institute with reference number CSJMU/R&D/1482/2023, registered in the Clinical Trial Registry of India (CTRI) with number CTRI/2023/10/058517 and was conducted in accordance with the Declaration of Helsinki (Revised 2013) and National Ethical Guidelines for Biomedical and Health Research involving human participants' guidelines laid by Indian Council of Medical Research (2017).

Eligibility criteria

Postmenopausal women were recruited from October 2023 to January 2024.

Asymptomatic postmenopausal females aged 40–55 years with stable vitals were included depending on their menstrual history. The menstrual bleeding pattern was classified based on a series of questions.[2,19] Participants with the absence of any acute disease during the six weeks

preceding the study were included. Participants with any health problem or use of medication associated with musculoskeletal, neuromuscular, cardiovascular system or use of medications that might interfere with the ability to perform physical exercise, use of walking aids, sensory deficits, blood pressure >139/89 mm of Hg, Body Mass Index (BMI) <18.5 kg/m^2 and >29.9 kg/m^2, resting heart rate ≥100 bpm, past or current smokers, history of any surgery in last one year, females who have delivered a baby in two-year years or less, having had a double oophorectomy, women with hysterectomy, women with use of hormone replacement therapy, involved in sports or athletic activity were excluded.

Sample size estimation

The sample size for this study was calculated by using the G power software version 3.1.97, where the level of significance was set as 5% at 90% power of study with coefficient of determination considered as 0.311.[14] The minimum required sample size was 29. Considering an attrition rate of 20%, the total required sample size was 35. The sample was selected from among individuals accompanying patients in the outpatient department, staff, and those visiting the institute and from nearby community dwellings.

Procedure

The participants who fulfilled the selection criteria of the study and were willing to participate were selected. All the participants provided the written informed consent regarding the study. Body weight (in kg) was measured with a weighing machine. Body height (in meters) was recorded and body mass index (BMI = weight/$height^2$) was calculated.

The individuals were explained about the test procedures in the language that was best understood by them (Hindi/English). The demographic details, history, and basic information

of the test were well explained to the participants for a better understanding of the procedure and to ensure its proper form.

The 30-Second Chair Stand Test procedure

The test was conducted following the procedure as outlined in previous reports.[15] The 30s CST was administrated using the chair without arms.[15,16] The chair was stabilized against the wall to ensure stability and to prevent the chair from moving during the performance. As instructed, likewise the test began with participants sitting on the middle of the chair with their back in an upright position and feet approximately shoulder-width apart. The test commenced upon the assessor instructing the participant to rise from the chair keeping the body erect after the go command in the language best understood by them (Hindi/English) on their own preferred speed with arms folding across their chest, then retaining back to the initial sitting position. The participants were encouraged to achieve as many full stands and sits as possible within a time of 30 seconds. The participants were given the instruction to be fully seated after each stand. The Rate of Perceived Exertion (RPE) (modified Borg rating of perceived exertion) was documented before and after the test.

The correctly performed stands were considered and the values of the test were noted. All tests were conducted by the same assessor.

The 6-Minute Walk Test procedure

The 6MWT was conducted according to a standardized protocol in a 30-meter indoor level corridor with marks at every 1 m intervals.[20,21] Standard encouragements was given every minute in the local language.[20] The participants sat in a chair located near the starting position for at least 10 minutes before the test. During this time, RPE, heart rate, oxyhemoglobin saturation, and systolic and diastolic blood pressures were recorded. The participants were

asked to walk as far down the corridor as they could at their own pace for the allotted six minutes. Participants were allowed to stop if they developed any symptoms such as dyspnea, leg cramps, dizziness, or chest pain, but were encouraged to continue walking as soon as possible. At the end of the 6 minutes, each participant's heart rate, systolic and diastolic blood pressures, oxygen saturation, and RPE were measured along with the distance covered in the allotted 6 minutes (6MWD).

Pulmonary function assessment

The pulmonary function test was measured by using RMS Helios 401- computerized spirometer as per standardized guidelines.[22] Before performing the test, all the participants were allowed to take a rest period to prevent measurement error. Participants performed the test for three times to obtain the best value. Measurement of Forced Expiratory Volume in One Second (FEV_1), Forced Vital Capacity (FVC), and ratio of FEV_1 and FVC (FEV_1/FVC), were recorded.

Statistical analysis

Statistical analyses were performed using SPSS software, version 16 (Statistical Package for the Social Sciences Inc., Chicago, IL, USA). Data was normally distributed and presented as the mean and Standard Deviation (SD) for all continuous variables. Correlations were estimated using Pearson's coefficient of correlation. A two-tailed p-value < 0.05 was considered statistically significant.

Results

All the participants completed the test and there were no dropouts. The study flowchart is shown in Figure 1.

The characteristics of the participants are shown in Table 1. The mean age at menopause for the postmenopausal women was 47.68 ± 2.77 years. The baseline characteristics of the participants are mentioned in Table 1.

None of the participants stopped during the 6MWT and 30s CST. The mean ± SD 6MWD was 457.63 ± 28.42 m and number of stands in the 30s CST were 14.54 ± 2.02.

There was a significant positive correlation of 30s CST with 6MWD among postmenopausal women ($r = 0.605$, $p = 0.0001$) as shown in Figure 2.

The RPE scores after the 6MWT was found to be significantly correlated with RPE scores after 30s CST ($r = 0.47$, $p = 0.004$)

There was a significant negative correlation of age with 30s CST and 6MWD. Also, there exists a positive correlation of FEV_1/FVC ratio with 30s CST and 6MWD among postmenopausal women shown in Table 3.

Discussion

The number of studies measuring physical function status among postmenopausal women increased rapidly over the past years. It reflects raised awareness about physical function status during menopausal. In clinical practice, physical function status can be measured by several methods. The 6MWT is one of the most reliable, standardized, easy to perform tests. Recently a significant amount of research has been performed to explore simpler tests like sit-to-stand test, to measure exercise capacity.[14,18] Our results show that 6MWT distance and the number of stands during 30s CST were significantly correlated with each other. Also, the rate of perceived exertion after the test significantly correlated with each other.

It has been proposed that sit-to-stand is better tolerated and produces less hemodynamic stress compared to the 6MWT and has been proposed as a reliable and practical test that could be used for to assess functional status quickly without much equipment and space.[14,18]

Influence of menopause on 6-Minute Walk Distance

The 6MWD walked by women in the present study was less than the distance documented by researchers in Indian females.[5, 23]

Menopause significantly influences the 6MWD in participants. It has been proposed that menopause is related to a decline in estrogen that, decreases bone mass density, muscle mass, and strength.[3] The decline in muscle mass and strength may directly influence the 6MWD.

Influence of menopause on 30-Second Chair Stand Test

The 30s CST values in the present study were 14.54 ± 2.02 stands and in a previous study on postmenopausal women with a mean age of 55.6 ± 5.0 years was 13.1 ± 3.3 stands.[1] The 30s CST scores were greater than the values reported from the Indian sample of women aged > 60 year (10 ± 2.9 stands) possibly due to the elder age group in the study of Sheoran & Vaish.[13] Researchers have used the sit to stand movement as an indicator of lower limb strength.[15,16] Menopause is related to a decline in muscle mass and strength.[3]

Association of 30-Second Chair Stand Test with 6-Minute Walk Test

The correlations of 30s CST values had a significant association with 6MWD values in the present study in agreement with findings of reports from previous studies on young adults.[18] The correlation in the present study was also moderate (r = 0.605) as in previous studies.[18,24] There has been report of significant relationship between 60s sit to stand test performance and the 6MWT in healthy controls (r = 0.54) over the age of 60; significant relationship between 30s CST performance and the 6MWT (r = 0.611) in young adults.[18,24] This indicates that as the sit-to-stand test performance decreases, it impacts functional capacity, in agreement with previous studies.[4,18,24]

The RPE scores after the 6MWT were found to be significantly correlated with RPE scores after 30s CST (r = 0.47) in agreement with previous reports.[14,18] The correlations in the present study were better than as reported in the young adults.[18] It has been proposed that the physical demand of the 30s CST,[14,18] are like the 6MWT and this strengthens the hypothesis that the sit-to-stand tests and the 6MWT are consistent with one another regarding the functional capacity assessment.[18]

Association of pulmonary function with 6-Minute Walk Distance and 30-Second Chair Stand Test

The significant positive association of FEV_1/FVC with 6MWD among postmenopausal women indicates that the decline in pulmonary function is associated with a decline in function capacity after menopause. There is evidence that a decline in pulmonary function among postmenopausal women in India tends to develop obstructive pattern of ventilatory limitation.[25] Also, there exists a positive significant correlation of FEV_1/FVC with 30s CST among postmenopausal women. There is evidence that 30s CST performance is independently associated with forced vital capacity, maximum inspiratory pressure, and maximum expiratory pressure among older adults.[26] It can be proposed that measurement of respiratory function might be useful to assess physical health status and prevent deterioration of respiratory function in postmenopausal women.

Association of anthropometric characteristics with 6-Minute Walk Distance and 30-Second Chair Stand Test

Age was found to be significantly negatively associated with 6MWD and 30s CST among postmenopausal women. The association is in agreement with the results from the Indian sample.[5,24]

The shorter distance walked as age increases can be explained by decreases in muscle mass, muscle strength, and maximum oxygen consumption as one ages.[27]

Age associated physiological changes, such as decreased nerve conduction velocity and increased passive tissue stiffness, also contribute to the decline in sit-to-stand test performance.[28]

The study had few limitations; a non-probability sample was taken though this has been a procedure of sample collection, but we had stringent inclusion and exclusion criteria. Induced/surgical menopausal women were not included. Hence, we proposed that future multicentre studies should be conducted including surgical menopausal women.

Conclusions

There exists a significant positive correlation of 30s CST test 6MWD among postmenopausal women. 30s CST could be used as an economical and quick physical function assessment measure among postmenopausal women in low-resource settings.

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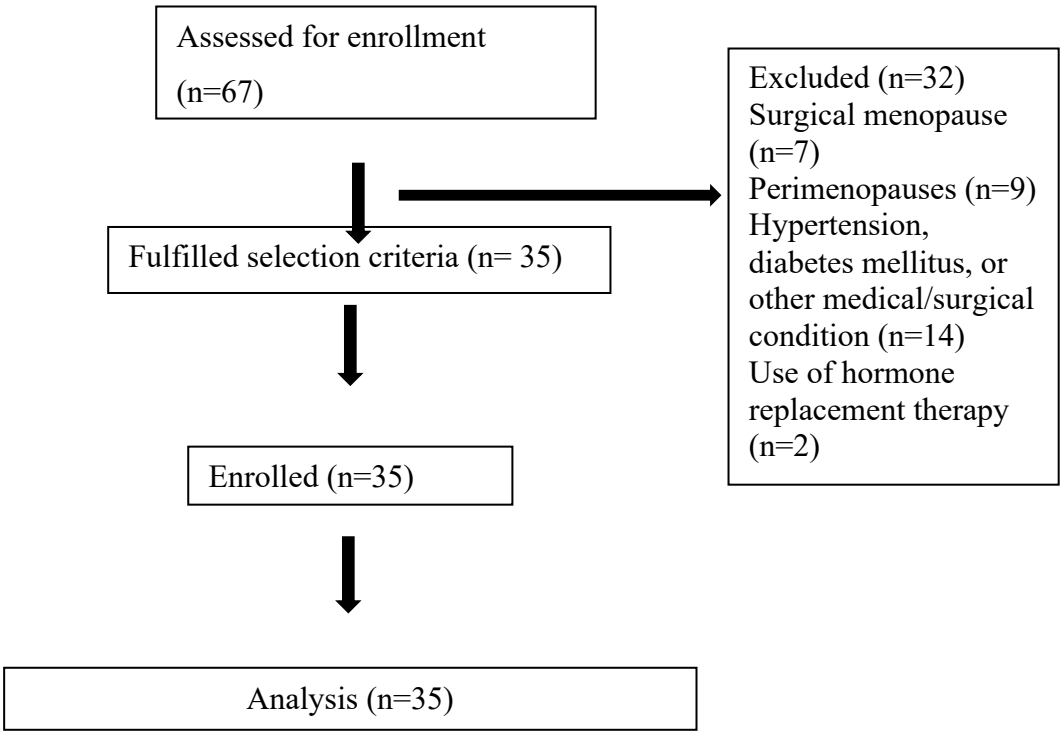

Figure 1. Study flowchart.

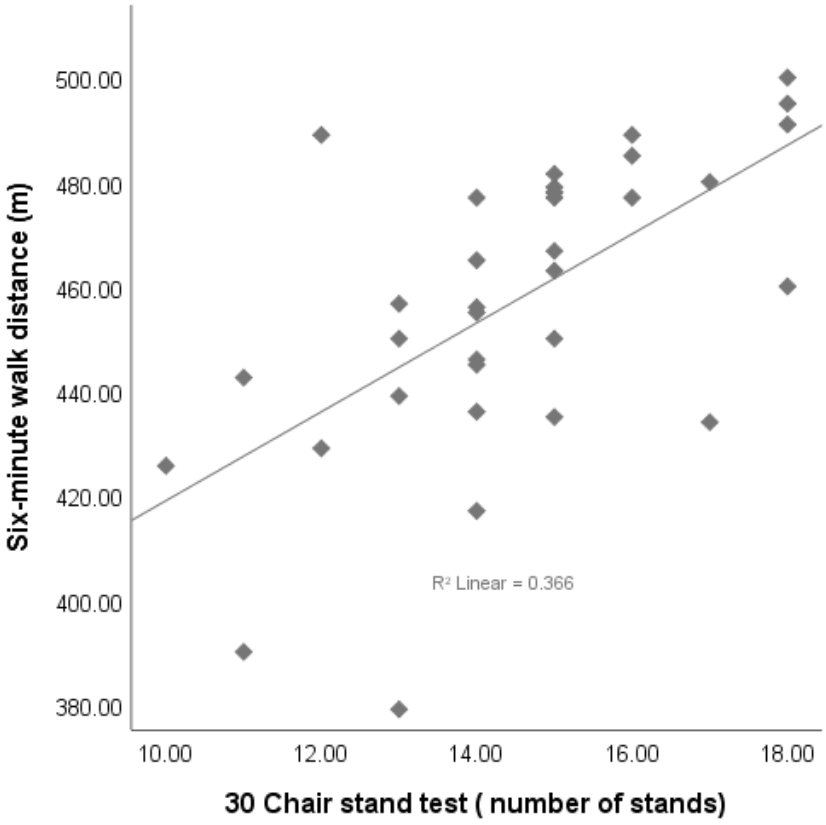

Figure 2. Correlation of 30-Second Chair Stand Test with 6-Minute Walk Distance.

Table 1. Baseline characteristics of the participants.

(n = 35)	**Mean ± SD**
Age (years)	50.11 ± 3.34
Height (m)	1.54 ± 0.091
Weight (kg)	60.19 ± 10.18
BMI (kg/m^2)	25.07 ± 3.25
FEV_1 (litres)	1.86 ± 0.25
FVC (litres)	2.43 ± 0.42
FEV_1/FVC %	77 ± 7.07

BMI, Body Mass Index; FVC, Forced Vital Capacity; FEV_1, Forced Expiratory Volume in One Second; SD, Standard Deviation

Table 2. The 30-Second Chair Stand Test and 6-Minute Walk Test results of the participants.

30 CST		**6MWT**	
Variable	**Mean ± SD (n = 35)**	**Variable**	**Mean ± SD (n = 35)**
30s CST (number of stands)	14.54 ± 2.02	6MWD (m)	457.63 ± 28.42
Baseline RPE	0.014 ± 0.08	Baseline RPE	0.014 ± 0.08
Posttest RPE	0.93 ± 0.59	Posttest RPE	1.73 ± 0.93

6MWT, 6-Minute Walk Test; 6MWD, 6-Minute Walk Distance; 30s CST, 30-Second Chair Stand Test; RPE, Rate of Perceived Exertion; SD, Standard Deviation

Table 3. Correlation of 30-Second Chair Stand Test and 6-Minute Walk Distance with anthropometric variables and pulmonary function.

n=35	6MWT		30 CST	
	r	p	r	p
Age (years)	-0.351	0.039*	-0.358	0.035*
Height (m)	0.053	0.763	0.018	0.918
Weight (kg)	-0.202	0.244	-0.054	0.758
BMI (kg/m^2)	-0.267	0.121	-0.025	0.887
FEV_1 (litres)	0.316	0.064	0.187	0.282
FVC (litres)	0.012	0.946	0.057	0.745
FEV_1/FVC %	0.467	0.005*	0.394	0.019*

*Significant at $p < 0.05$ (2-tailed)

BMI, Body Mass Index; 6MWT, 6-Minute Walk Test; 6MWD, 6-Minute Walk Distance; 30s CST, 30-Second Chair Stand Test; RPE, Rate of Perceived Exertion; SD, Standard Deviation

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