RESEARCH ARTICLE

Normative data of modified Romberg balance test for risk of fall in elderly population of Pakistan

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Abstract

Objective: To generate normative data of modified Romberg balance test for the risk of fall among the elderly.

Method: The crossectional study was conducted from July 1 to December 31, 2021, and comprised healthy adults of either gender aged 60 years and above from different cities of Pakistan. The participants were screened for balance issues using the Patient Reported Outcomes Measurement Information System Global Health Questionnaire. All th eindividuals were subjected to the modified Romberg balance test. Data was analysed using SPSS 21.

Results: Of the 2004 participants, 1,041(51.95%) were males and 963(48.05%) were females. The overall mean age was 70.36+6.20 years and mean body mass index was 21.92+3.08kg/m2. Overall, 207(10.33%) participants passed all the 4 conditions of the modified Romberg balance test.

Conclusion: With increasing age, the capability to perform modified Romberg balance test decreased, increasing the chance of fall among the elderly.

Key Words: Adult, Balance, Fall, Frail older, Musculoskeletal equilibrium.

(JPMA 73: 515; 2023) **DOI: 10.47391/JPMA.6238**

Submission completion date: 09-02-2022 **— Acceptance date:** 21-09-2022

Introduction

Aging is a universal, inexorable, inescapable and natural process leading to morphological and physiological changes in all bodily systems[1]. Ample research has shed light on the debilitating effects of aging on all spheres and systems of human life and body. It leaves remarkable changes at musculoskeletal and neurological levels. Aging interferes with motor function, like gait, balance control and postural control, and affects normal activities of daily living[2]. Decline in both physical and cognitive functioning is strongly associated with aging which enhances the likelihood of having age-related disorders[3].

As a result of somatic deterioration imposed by increasing age, decreased muscular strength and coordination are usually accompanied by disturbed gait and decreasing balance control[4]. A fall is usually described as a quick and unexpected incident which propels people towards the ground against their volition. It has now become a major public health issue due to its high prevalence among the elderly.[5]

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All these impairments along with decline in cognitive performance ultimately lead to higher risk of fall among the elderly[6].

Falls has been reported as significant cause of injury, functional debility and morbidity among older adults. As per evidence, older adults aged 65 or above, which usually is the chronological age declaring a person elderly[7], suffered an average of one fall during a year[8]. Additionally, the economic burden induced by medical cost attributed to falls have been estimated at around $50 billion in the United States alone[9].

Falls most frequently cause soft tissue trauma, fractures, joint dislocation, and may prove fatal in some cases. Screening for fall risk among the elderly may help prevent the occurrence of fall via implementing suitable rehabilitation interventions by healthcare providers[10].

Moreover, the population of individuals prone to risk of fall is on rise. This predisposes need for devising effective strategies for fall prevention among the growing population of the elderly, and, hence, reducing frequency of falls, consequent injuries and medical cost. Falls adversely affect an individual both at psychological and social levels by increasing fear of fall, decrease in confidence, and limiting social activities, resulting in poor quality of life[11].

Particularly, by using postural control markers, the fall risk can be assessed. For example, it has been revealed that

when the timed-up-and-go (TUG) test requires ≥13.5s to complete, the fall risk is more than doubled. Similarly. the modified Romberg balance test (MRBT) doubled risk with standing period ≤19s[12]. Moreover, it has been established that time to fail about 30s and above increase 2% chances, 20-29s increases 4% chances, 10-19s increases 6.7% chances, and <10s increase 7% chances of fall risk in 12 months[13].

A thorough assessment of risk of fall is necessary at the community level to decrease the chances of falls in the elderly. MRBT is a famous bedside examination used to find whether a postural problem is present or not, and if it is present, then either somatosensory, visual, vestibular or all these systems are involved in causing disruption in the balance[14].

Literature shows no research involving MRBT and healthy elderly population to find the normative data of the test. The current study was planned to fill the gap by generating normative data of MRBT for the risk of fall in the elderly.

Subjects and Methods

The crossectional study was conducted from July 1 to December 31, 2021, in various cities of Pakistan, including Lahore, Chakwal, Rawalpindi, Sialkot, Sargodha, Quetta, Peshawar and Hyderabad. After approval from the ethics review committee of Riphah International University, Lahore, the sample size was calculated using online Qualtrics calculator[15] with 95% confidence interval (CI) and 5% level of significance.

The sample was raised using quota sampling technique in different cities to which our representatives belonged, making it easy to collect data from the community. Those included were healthy adults of either gender aged 60 years and above. Informed written consent was taken from all the participants. Individuals with history of dizziness or fall in the preceding 12 months, adults with neurological, otological, orthopaedic or any other disease affecting balance, like peripheral neuropathy or orthostatic hypotension, those taking centrally acting medications and depending on another person for assistance or using supportive devices, like canewalkers etc, and patients who took analgesics, diuretics, anti-depressants or benzodiazepines were excluded.

Demographic data, like name, age and education, as well as anthropometric details, including height and weight, were collected. Initially, the subjects were screened for balance issues by using Patient Reported Outcomes Measurement Information System (PROMIS) Global Health Questionnaire[15].

Figure-1: Participants standing on foam pads.

NEBT was the main study tool, assessing balance control on firm and compliant (foam pad) support surfaces (Figure 1). MRBT is used to evaluate the subject's ability to stand upright without any assistance in four different testing conditions[14].

It is feasible, easy-to-execute and can be performed in all types of settings without the requirement of any expensive equipment[16]. These conditions are specifically designed to test the sensory information that contributes to balance maintenance. Balance testing scored on a pass/fail basis. Test was conducted with open eyes and with closed eyes for both firm and compliant surfaces. With open eyes on firm surface, visual, proprioceptive and vestibular systems were tested. However, with closed eyes on firm surface, only vestibular and proprioceptive systems were targetted. On the other hand, on foamy pad with eyes opened, visual and vestibular systems were challenged. Lastly, with closed eyes on foam, only vestibular system was tested.

Test failure was considered when the subject needed to open his/her eyes, moved his/her extremities to maintain stability, or began to fall, or required the therapist's assistance to maintain balance. As the difficulty level increased with each successive test condition, the test was ended whenever the participant failed any test condition.

Data was analysed using SPSS 21. Chi-square test was used to find the association of age, gender and body mass index (BMI) with MRBT result to assess the risk of fall. For continuous data, Spearman's correlation tool ws used. $P<0.05$ was considered statistically significant.

Results

Of the 2004 participants, 1,041(51.95%) were males and 963(48.05%) were females. The overall mean age was 70.36+6.20 years and mean BMI was 21.92+3.08kg/m^2 (Table 1).

Table-1: Demographic data.

Basic Demographics	Mean + SD
Mean Age	70.36 + 6.20
Mean Height	165.88 +7.11
Mean Weight	60.00 + 6.74
Mean BMI	21.92 + 3.08
Gender Distribution	N(%)
Male	1041 (51.95%)
Female	963 (48.05%)

BMI: Body mass index, SD: Standard deviation.

Table-2: Modified Romberg Balance Test (MRBT) results on the basis of BMI and Age

BMI-Categories	Final Result of MRBT (Mean ± SD) (sec)	Fail	Pass	N (total)
Under-weight	17.89±8.06	155	21	176
Normal	17.42±8.40	1043	105	1148
Over-Weight	17.28±8.33	571	81	652
Obese	15.37±7.86	28	0	28
Total	17.44± 8.34	1797	207	2004
Pearson Chi-Square (p-value)		0.036		
Age Groups of participants	**Final Result of MRBT (Mean ± SD) (sec)**	**Fail**	**Pass**	**N (total)**
60 - 65 yrs.	22.56± 7.95	139	374	513
66 - 70 yrs.	19.16± 7.29	46	533	579
71 - 75 yrs.	16.33± 6.68	14	485	499
76 - 80 yrs.	10.77± 6.62	8	258	266
above 80 yrs.	8.60± 4.76	0	147	147
Total	17.44± 8.34	1797	207	2004
Pearson Chi-Square (p-value)		0.000		

BMI: Body mass index, SD: Standard deviation.

Those aged 60-65 years were 513 (25.60%), 66-70 years 579(28.89%), 71-75 years 499(24.90%), 76-80 years 266(13.22%) amd >80 years 147 (7.39%). Those from Punjab were 1359(67.81%), from Sindh 300(14.97%), from Khyber Pakhtunkhawa (KP) 178(8.88%), and from Balochistan 167(8.33%).

With respect to BMI, 176(8.78%) subjects were underweight, 1148(57.29%) had normal weight, 652(32.53%) were overweight and 20(1.40%) were obese.

The first stage of MRBT was passed by all the 2004(100%) participants, the second stage by 1350(67.4%), the third stage by 884(44%). The final stage, and, as such, the entire MRBT was passed by 207(10.33%) participants.

There was a significant association between age and final MRBT result (p=0.000). Similarly, the association between BMI and final MRBT result was significant (Table 2), and scatter plots confirmed the significance of both age (Figure 2) and BMI (Figure 3).

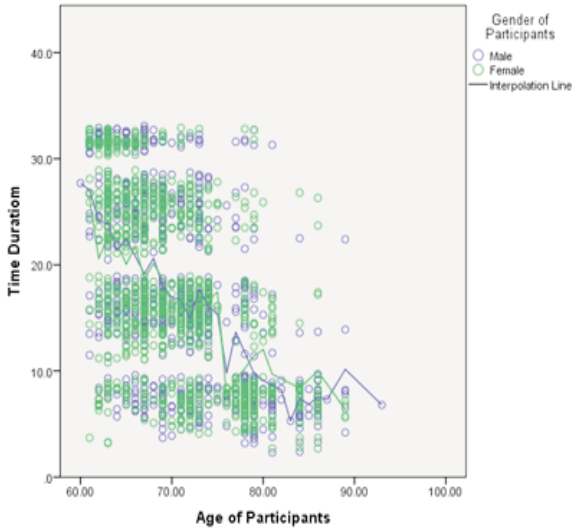

Figure-2: Scatter plot between time to fail Modified Romberg Balance Test (MRBT) and age.

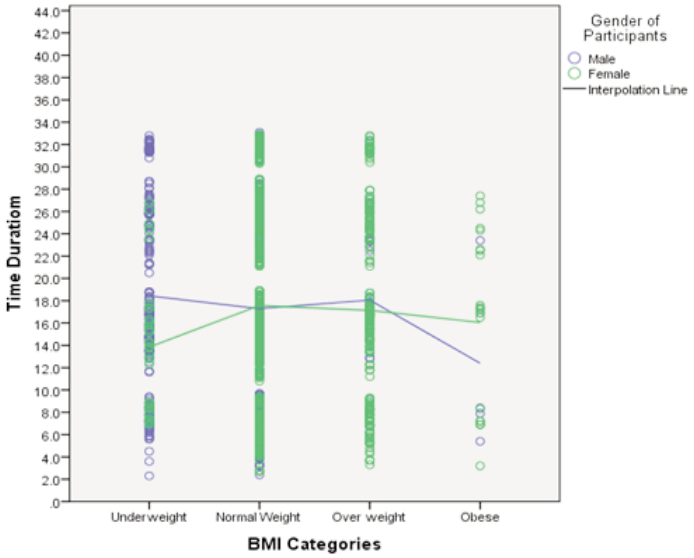

Figure-3: Scatter plot between time to fail Modified Romberg Balance Test (MRBT) and body mass index (BMI).

Of the 1,041(51.95%) males in the study, MRBT was passed by 122(11.72%), and, of the 963(48.05%) females, MRBT was passed by 85(8.83%).

Height did not have a significant correlation with time to

fail MRBT (p=0.95), while weight showed weak but significant correlation (p=0.05).

Discussion

In the current study, time to fail MRBT decreased with increasing age, leading to elevated risk of fall. Of the 2004 participants, only 884 cleared the first three stages of MRBT. Of them, 677(76.5%) failed the fourth stage, and in 480(71%) of them the time to failure was <20s.

Yuri Agrawal et al. also reported that participants who failed the fourth stage had vestibular dysfunctions, and reported a significant association between the risk of fall and vestibular dysfunction.[17]

In the current study, 207(10.33%) subjects were able to pass the last stage. Carry et al. found that odds of falling increased as the time to failure shortened[13].

The present study noted that risk of fall increased with age even if the person is healthy, which is in line with an earlier study[13].

The current study observed that high percentage of females did not pass MRBT, indicating that females are more at risk of fall compared to the males of same age. This is in line with literature[18].

A study about MRBT effectiveness in screening people with vestibular problems concluded that MRBT scores increased with increasing age in healthy people, and that gender did not show any impact on MRBT scores.[19]

The present study showed a significant relationship between BMI MRBT results. Another study concluded that obesity was associated with higher prevalence of falls in the elderly[20].

The current study had two major limitations. Firstly, the screening of participants for different medical conditions and diseases was done on the basis of subjective data. Secondly, there was lack of funds and our study only covered nearby areas and those in which our friends and acquaintances were living owing to scarce funds for living and travelling expenses.

Conclusion

With increasing age, time to MRBT failure shortened, increasing the odds of falling. Besides, elderly women had higher risk of fall compared to males. Obese older population was found to have the worst odds in this regard.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

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