SHORT REPORT

Common balance measures and fall risk scores among older adults in Pakistan: Normative values and correlation

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Abstract

The objective of this study was to assess the balance and fall risk among the community dwelling healthy older adults in Pakistan and to determine the correlation between balance measures and fall risk, for which a cross-sectional correlation study was conducted at Foundation University Islamabad and Fauji Foundation Hospital from March 2016 to February 2017. A total of 77 individuals over 50 years were included via convenience sampling. Individuals with hearing/visual and cognitive impairments, infections, and orthopaedic and severe co-morbid conditions were excluded. Data collection tools included Berg Balance Scale (BBS), Timed Up and Go (TUG) test, Functional Reach Test (FRT) and Fall Risk Score (FRS). Independent t-test and Bivariate Pearson Correlation (CI=95%, $P<0.05$) were used for analysis. Mean value of the BBS, FRS, TUG and FRT was 41.36±2.96, 3.40±1.47, 15.90±2.68 and 13.34±3.45 respectively. Age had a significant ($p<0.05$) positive correlation with FRS and negative correlation with BBS. A significant correlation ($P<0.05$) was found only between FRT & TUG and TUG & BBS.

Keywords: Balance assessment, Berg Balance Scale, Dynamic Posturography, Fall Risk Score, Functional Reach Test, Geriatrics, Pakistan, Timed Up and Go test.

Introduction

With advancement in health care, mortality has decreased, resulting in a rise in geriatric population. A total of 12.13 million people in Pakistan are above the age of 60, which is expected to rise to 17.53 million by 2025.[1] Falls is one of the major concerns in elderly, the worldwide prevalence of which ranges from 17.2-33.1%, and is likely to re-occur in 5.7-15.2% individuals.[2] Literature shows that 1/3 elderly individuals suffer a fall every year, 6% of which results in fractures,[3] and 0.42 million individuals worldwide die from falls every year, 80% of which are from middle and low income countries.[2,4,5] Impaired gait and balance are one of the most important risk factors for falls in the elderly, which can be due to impairments in visual, sensorimotor or vestibular system.[6-8] Age itself is also a risk factor for impaired balance with 30-50% of the individuals greater than 65 years experiencing difficulty in maintaining balance,[6-8] perhaps due to physical and neurological deterioration resulting in impaired balance.[9] For this reason a regular fall risk screening and balance assessment is essential. Unfortunately, the normative balance measures' scores for the elderly population in Pakistan are not established. Moreover balance is divided into static and dynamic balance, the association of which is also not well proven in literature. The purpose of the current study was to assess balance and fall risk scores in the healthy elderly population of Pakistan, so that normative values for these measures can be established, and to determine the correlation between common balance measures and fall risk in older adults.

Methodology

A cross sectional analytical study was conducted at Foundation University Islamabad, and Fauji Foundation Hospital, Rawalpindi from March 2016 to February 2017. A total of 77 community dwelling elderly individuals aged 50 years and above were included via convenience sampling. Individuals with severe hearing and visual impairments, impaired cognition, orthopaedic conditions such as fractures, inflammatory conditions and active infectious diseases, and severe co-morbid conditions like stroke, cardiac failure, dementia and Alzheimer's etc were excluded from the study. Data collection tools included Berg Balance Scale(BBS) which is used for both static and dynamic balance assessment, Timed Up and Go(TUG) test which is used for dynamic balance assessment only, Functional Reach Test(FRT) which is used for anticipatory balance assessment and Fall Risk Score (FRS) which was measured via computerized dynamic posturography using the Biodex Balance System

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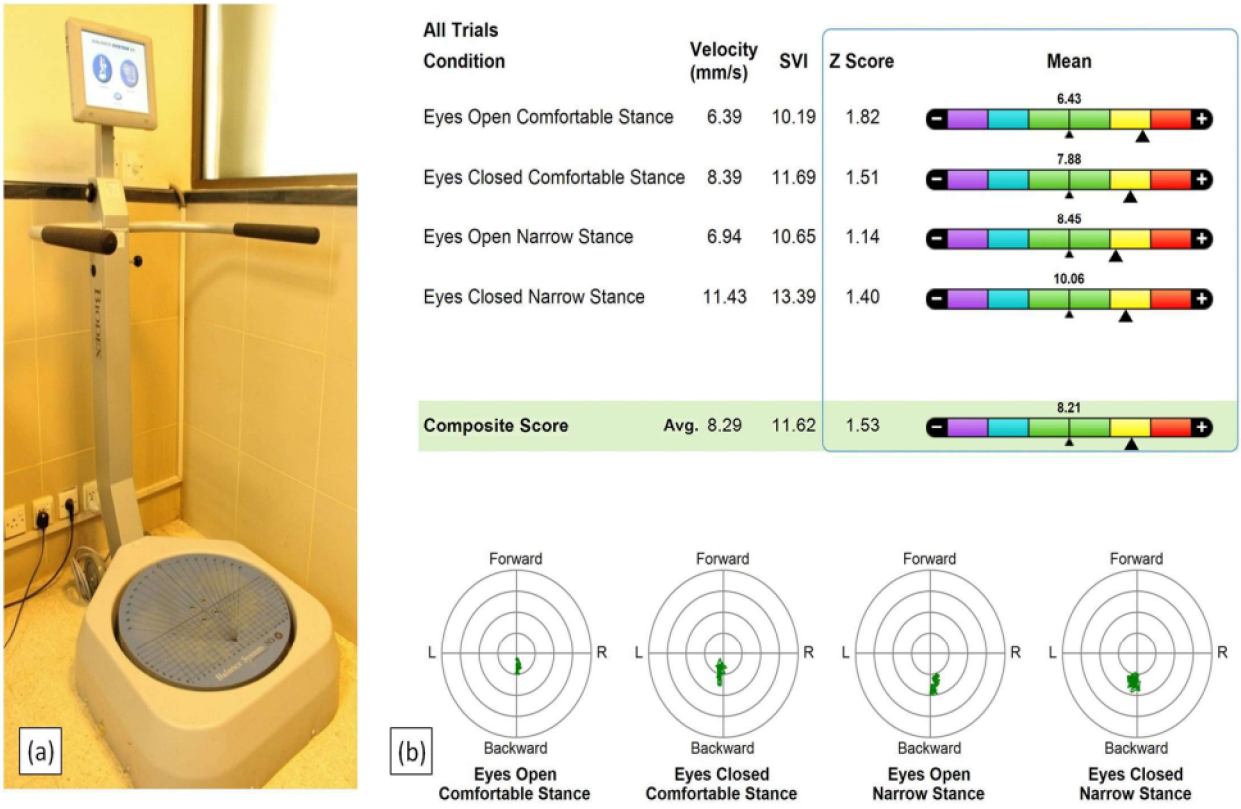

Figure: (a) Biodex Balance System SD used for measuring Fall Risk Score via computerized dynamic posturography. (b) Fall Risk Score output received via computerized dynamic posturography using the Biodex Balance System SD.

SD (Figure I a+b). Data was analyzed using SPSS v21.0. Independent t-test was used for gender based comparison and Bivariate Pearson Correlation was used to determine the association between age, BBS, TUG, FRT and FRS (CI=95%, P<0.05).

Results

Of the total 77 participants, 26 were males and 51 were females. The mean age of the participants was 62.10±8.84 years, and the mean weight and height was 73.47±8.75kg

Table-1: Gender based comparison in terms of age, weight, height and balance outcome measures.

Variable	Male (Mean ± S.D)	Female (Mean ± S.D)	*p*-value
Age	62.85±6.37	61.75±7.11	0.501
Weight	73.73±10.58	73.33±7.77	0.853
Height*	165.90±5.86	160.30±7.17	0.001
Fall Risk Score (FRS)	3.81±1.65	3.20±1.33	0.084
Berg Balance Scale (BBS)	41.35±3.15	41.37±2.90	0.971
Timed Up and Go (TUG) test	15.99±1.66	15.86±1.34	0.847
Functional Reach Test (FRT)	12.88±4.03	13.58±3.14	0.402

Table-2: Correlation between age, Fall Risk Score (FRS), Timed Up and Go (TUG) test scores.

		Age of Participants	Berg Balance Scale (BBS)	Fall Risk Score (FRS)	Timed Up and Go (TUG) test	Functional Reach Test (FRT)
Age of Participants	Pearson Correlation	1	-.323*	.166	.261*	-.035
	Sig. (2-tailed)		.004	.149	.022	.763
Berg Balance Scale (BBS)	Pearson Correlation	-.323*	1	-.160	-.254*	.186
	Sig. (2-tailed)	.004		.165	.026	.105
Fall Risk Score (FRS)	Pearson Correlation	.166	-.160	1	.046	-.045
	Sig. (2-tailed)	.149	.165		.694	.696
Timed Up and Go (TUG) test	Pearson Correlation	.261*	-.254*	.046	1	-.239*
	Sig. (2-tailed)	.022	.026	.694		.036
Functional Reach Test (FRT)	Pearson Correlation	-.035	.186	-.045	-.239*	1
	Sig. (2-tailed)	.763	.105	.696	.036	

*. Correlation is significant (2-tailed).

and 162.19±7.23cm respectively. Mean value of the BBS was 41.36±2.96, FRS was 3.40±1.47, TUG was 15.90±2.68 and FRT was 13.34±3.45.A significant difference (P<0.05) was observed only in height, however no significant differences (P>0.05) were found in age, weight and balance outcomes in terms of gender (Table-I). Increasing age had a significantly (p<0.05) positive correlation with FRS and a non-significant (P>0.05) positive correlation with TUG test scores (Table-2). Increasing age had a significantly (p<0.05) negative correlation with BBS and a non-significant (P>0.05) negative correlation with FRT scores (Table-2). A significant correlation (P<0.05) exists only between FRT & TUG and TUG & BBS (Table-2).

Discussion

BBS, TUG and FRT are perhaps the most common balance measures performed not only in clinical but also in research settings. According to a systematic review conducted by Langley FA, BBS and TUG test are the most vigorously tested balance measures and are found to have the greatest published validity and reliability with community dwelling older adults among 17 commonly used functional balance tests.[10] The mean score of BBS of 41.36±2.96 with a mean age of 62.10±8.84 years in the current study was in the low fall risk (41 to 56) category, however it is still lower than the overall mean score of 54.0±1.5 for age group of 60 to 69 years in a similar study conducted by Lusardi MM et al in the United States (US).[11] Similarly a TUG score of 15.90±2.68 in the current study was higher than 7.9±0.9 in the study conducted by Lusardi MM.[11] These findings in view of the existing literature suggest a comparatively poorer static and dynamic balance among the elderly in Pakistan as compared to those in the US.

The findings of the current study show that a significantly negative correlation (P<0.05) exists between FRT and TUG scores showing that anticipatory balance and dynamic balance have a positive association with each other as increase in functional reach (FRT) is associated with a decreased time during TUG. Moreover, even though the correlation between FRT and BBS was positive, it was not significant. Moreover, as BBS assesses both static and dynamic balance it can be suggested that even though anticipatory balance improves with an improvement in dynamic balance, association between anticipatory and static balance is not conclusive. However, a significantly negative correlation exists between BBS and TUG scores in the current study. This finding may suggest that both tools measure dynamic balance so they possess a significant correlation, or maybe there is an association between static and dynamic balance as BBS assesses both static and dynamic components of balance, and for this reason the relationship between static and dynamic balance needs to be further investigated. A similar study conducted by Drowatzky JN et al looked into the interrelationship between static and dynamic balance measures in which 6 different balance measures were used, out of which 3 were used to assess the static and 3 were used to assess the dynamic components of balance. However, only one coefficient of correlation showed a p value of less than 0.05, for the measures of sideward leap and bass stepping stone, both of which were in fact measures of dynamic balance, thus showing no significant correlation between measures of static and dynamic balance.[12] It is important to point out that the balance measures used in Drowatzky JN et al's study were not common clinical measures used in balance assessment, and secondly the study was conducted on grade 7 girls instead of older adults. Moreover, in the current study none of the balance measures show a significant correlation with FRS. This may suggest that static and dynamic balances alone are not the only predictors of fall risk, and perhaps there is a major contribution by other factors such as muscular performance, gait and anthropometric parameters.[13-16]

A study conducted by Greve J et al showed that more displacements are required to maintain postural balance as BMI is increased,[15] which may increase risk of fall, emphasizing the contribution of anthropometric changes in postural balance and fall risk. Similarly a study conducted by Hausdorff JM et al on older adults showed that stride time variability predicted falls (p<0.05).[13] Another study conducted byVerghese J et al showed that slower gait speed, worse performance on swing, double support phase, swing time and stride length variability, all predict fall risk,[14] emphasizing the contribution of gait in risk of fall. In terms of importance of muscle performance predicting fall risk it is shown that muscle strength especially of the lower extremity is an essential aspect that should not only be assessed but also treated in the elderly who are at risk for falls.[16]

Thus in view of the existing literature and findings of the current study, even though there is an increasing trend of balance assessment and training among the

rehabilitation professionals a significant correlation between common balance measures and fall risk does not exist, and it is imperative to point out other factors such as muscle performance, gait and anthropometric parameters are also important contributors and should also be assessed and treated accordingly in the elderly who are at risk of fall.

Conclusion

Our study suggest a low fall risk for the elderly population in Pakistan but still Pakistani older adults are found to have poorer balance in comparison to the West. Moreover, no significant correlation is observed between common balance measures and fall risk scores.

Limitations and Recommendations

The current study was a single centered study with a limited sample side. It is suggested that multi centered studies with statistically calculated samples should be conducted, and correlation of other factors such as anthropometric measures, gait and muscle performance etc with fall risk should also be explored.

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