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Original Article

Physiotherapy Section

Correlation between Age and Modified Star Excursion Balance Test in Healthcare Workers: A Cross-sectional Study

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ABSTRACT

Introduction: With advancing age, the ability to maintain postural stability may decline. Healthcare workers might be prone to musculoskeletal symptoms which may lead to greater decline in postural stability with advancing age. However, the relationship between age and balance in healthy hospital staff has not been elucidated.

Aim: To identify the correlations between age and balance measured by the modified Star Excursion Balance Test (mSEBT) performance and determine if age predicts mSEBT performance in healthy male hospital staff.

Materials and Methods: A cross-sectional observational study was conducted at Rabigh General Hospital, Rabigh, Saudi Arabia, from December 2020 to June 2021. Fifteen male hospital staff were included in this study. Participants were instructed to perform three trials of mSEBT. Normalised composite scores and reach distances in each direction for both legs were calculated. Pearson correlation was conducted to identify the correlations between age and mSEBT performance. Also, simple linear regression was performed to determine if age predicts mSEBT performance.

Results: Significant moderate negative correlations were observed between age and non dominant Posteromedial (PM) direction (r=-0.44, p=0.04) and non dominant composite score (r=-0.48, p=0.03). Also, there was a significant strong negative correlation between age and dominant PM direction (r=-0.52, p=0.02) and a significant moderate negative correlation between age and dominant composite score (r=-0.44, p=0.04). The regression analysis showed that age significantly (p=0.046) predicted 27.3% of the variation in the dominant PM reach direction distance (B=-1.35).

Conclusion: The results showed, that age was negatively correlated with PM direction and composite scores for both limbs. Also, age was a predictor of the mSEBT performance only in the dominant PM reach direction.

Keywords: Balance, Dynamic activities, Postural stability

INTRODUCTION

Postural control is maintained by sensory information provided by somatosensory, vestibular, and visual systems [1,2]. Constant sensory input is required from these systems to maintain postural stability during dynamic activities [2]. Among the acclaimed tools to clinically evaluate dynamic balance of the lower extremity are the SEBT and the Y-Balance Test (YBT) [3-6]. The mSEBT is a modified version of the eight-reach direction SEBT which requires participants to reach only in three directions: anterior (ANT), PM, and Posterolateral (PL) while standing on one foot [7-9].

The mSEBT has been reported as a valid and reliable tool to measure balance during dynamic activities in various populations [10,11]. A significant amount of postural control, strength, range of motion, and proprioceptive abilities are required to maintain balance while performing this test. With advancing age, however, the ability to maintain balance might be diminished due to age related changes [2].

Ageing is an inevitable process that may impair several physiological functions, leading to a reduced quality of life [12]. Previous researchers have reported that ageing may impact physical performance due to age related deterioration of organ systems such as the musculoskeletal system [13,14]. The function of skeletal muscle is governed by four distinct characteristics including architecture, excitement contraction coupling, and energy release and production of power and force [15]. Previous study has found a decline in all four characteristics of skeletal muscle with advancing age [16]. These changes may impair individuals' abilities to maintain postural stability, placing an individual at greater risk of fall.

In addition to the age related deterioration affecting postural control, the nature of work may affect physical performance due to musculoskeletal symptoms creating another challenge to maintain postural control. Specifically, healthcare workers might be prone to musculoskeletal symptoms due to their job that may require long shifts, standing for a long time, and lifting and transferring patients. Previous investigators have reported a high prevalence of musculoskeletal symptoms among health-care workers in Saudi Arabia particularly among nurses [17], dentists [18], physicians [19], emergency care service [20], and physical and occupational therapists [21]. Literature has indicated that musculoskeletal symptoms are strongly associated with poor postural control and balance [22-24]. For instance, reduced dynamic balance has been reported in individuals with low back pain [25-27].

Work requirements demand an efficient postural control for the accomplishment of activities in an ecological manner. Understanding age related postural deficits in healthcare professionals may help identify risk factors associated with work related musculoskeletal disorders causing alteration in trunk muscle activity. Furthermore, the periodic assessment and monitoring through postural assessment may help us to identify and develop approaches to rectify the impaired posture and alteration in trunk muscle activity. The mSEBT is an effective tool to identify dynamic measures of postural stability in normal and patient population [10,11]. Application of this tool in healthcare worker can provide reliable, sensitive and cost effective information about postural stability and could help monitor age related postural deficits in response to specific work requirements at hospital settings. Therefore, evaluating the correlation between age and balance using the mSEBT in healthcare workers may provide more insights regarding postural control. Hence, present study was conducted to elucidate the correlations between age and mSEBT performance and determine if age predicts mSEBT performance in healthy male hospital staff.

MATERIALS AND METHODS

This cross-sectional, observational study was conducted for approximately six months (started on December 24th 2020 and finished on June 20th 2021) at Rabigh General Hospital, Rabigh, Saudi Arabia. Institutional Review Board of the Ministry of Health (H-02-J-002) has approved this investigation and informed consents were obtained from participants before study enrollment.

Inclusion criteria: Male hospital staff (between the age of 20-40 years) who were able to perform the mSEBT were included.

Exclusion criteria: Participants were excluded if they had visual problems, vestibular diseases, neurological disorders, musculoskeletal conditions, or had undergone any surgery.

Study Procedure

The present study was a secondary analysis of a previous study (under review process). A group of 15 male hospital staff participated in this cross-sectional study. Anthropometric measures such as age, weight, height, and dominant side (preferred leg for kicking a ball) were taken and recorded after obtaining informed consent from each participant. While the participant was placed in supine on a table, Leg Length (LL) was measured from the inferior edge of the anterior superior iliac spine to the distal edge of the medial malleolus using a tape measure [5]. Each participant was given a demonstration about the mSEBT according to the procedures previously described [5,10]. In addition, participants were instructed to perform four practice trials in each direction for both feet to reduce the learning effect [28]. The practice trails were performed using the following standardised order: right anterior, left anterior, right PM, left PM, right PL, left PL. After the practice trails, participants were asked to execute formal testing attempts (3 trials) in each direction in the order similar to the practice trials.

In each formal attempt, participants were instructed to maintain balance and stand on one leg with their hands placed on the pelvis while moving the other leg as far as possible and returning back to the starting position [Table/Fig-1] [5]. An investigator marked and measured the distance of the toe touch reach in each direction. Participants were allowed to rest for 30 seconds after each direction to minimise the effect of fatigue [29]. All participants conducted practice and formal testing trials barefoot to prevent the potential effect of the shoes on stability and balance. The average reach distance was reported and normalised to LL for each participant by using the following formula: maximum distance obtained/LL×100 [10]. Also, normalised composite score for each foot was calculated based on the formula: the sum of the 3 reach directions/3×LL×100 [10].

[Table/Fig-1]: The modified Star Excursion Balance Test (mSEBT).

STATISTICAL ANALYSIS

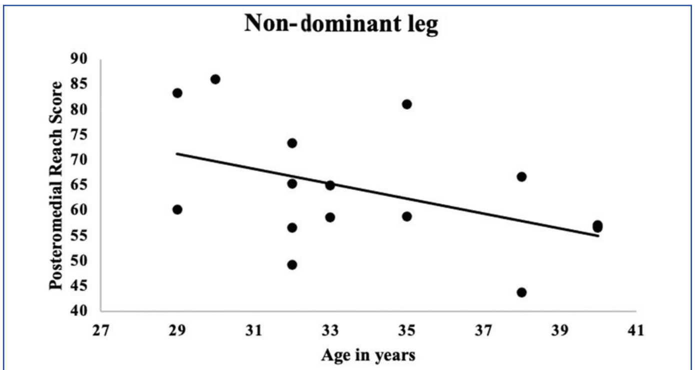
All data were checked for the assumptions of normality and outliers using Shapiro test and box plots. The relationships between age and the mSEBT were determined by calculating Pearson correlation (r). The strength of the correlation was described using the following criteria: strong relationship (r≥0.50), moderate relationship (≤0.30 r<0.50), and weak relationship (r<0.30) [30]. A simple linear regression analysis was performed to determine if age predicts mSEBT performance. The level of significant (alpha level) was set at 0.05. All statistical analysis were performed using Statistical Package for the Social Sciences (SPSS) 25.0 (SPSS Inc, Chicago, IL).

RESULTS

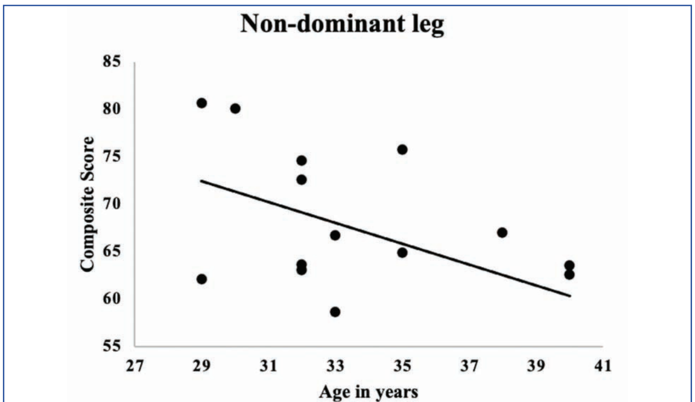
Fifteen participants (age: 33.86±3.68 years; height 1.72±0.05 m; weight 75.26±9.86 kg; BMI 25.48±3.52 kg/m^2) were included in this study. Assumptions of normality and outlier were not violated. [Table/Fig-2] shows dominant and non dominant mean±SD values. Significant moderate negative correlations were observed between age and non dominant PM direction (r=-0.44, p=0.04) [Table/Fig-3] and non dominant composite score (r=-0.48, p=0.03) [Table/Fig-4]. Also, there was a significant strong negative correlation between age and dominant PM direction (r=-0.52, p=0.02) [Table/Fig-5] and a

Variables	Mean±SD	95% Confidence interval
Non dominant (% LL)		
Anterior	68.27±6.50	64.67±71.88
Posteromedial	64.09±12.26	57.30±70.88
Posterolateral	68.50±9.04	63.49±73.51
Composite	67.05±8.33	62.43±71.67
Dominant (% LL)		
Anterior	68.86±4.23	66.51±71.20
Posteromedial	64.46±9.52	59.18±69.73
Posterolateral	67.67±8.98	62.70±72.65
Composite	67.34±5.91	64.07±70.62

[Table/Fig-2]: Showing dominant and non dominant mean standard deviations (SD) and 95% confidence interval for each variable.
LL: Leg length

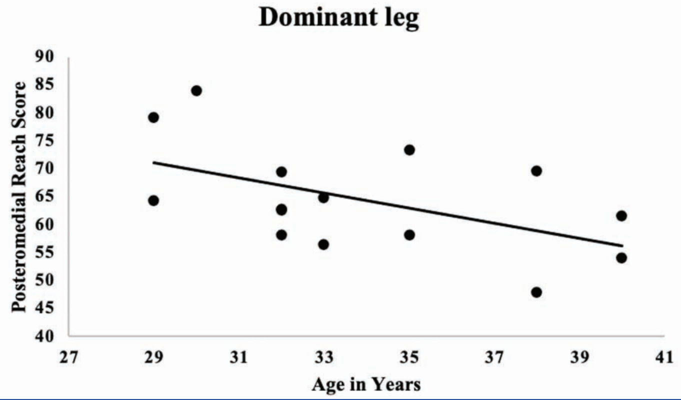


[Table/Fig-3]: Correlation between age and the non dominant posteromedial reach score.

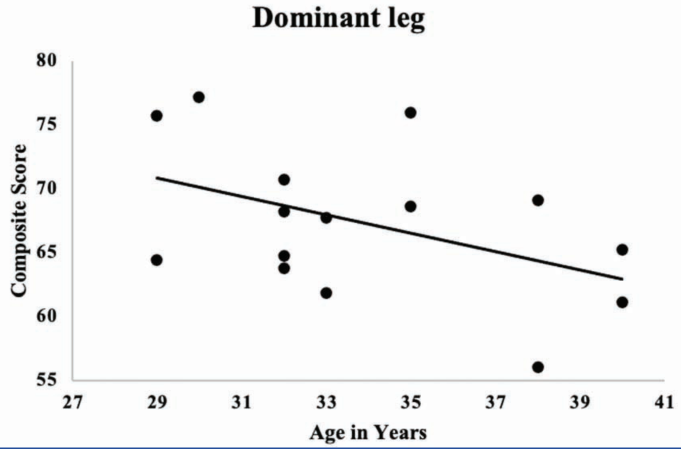


[Table/Fig-4]: Correlation between age and the non dominant composite score.

significant moderate negative correlation between age and dominant composite score (r=-0.44, p=0.04) [Table/Fig-6,7]. The regression analysis showed that age significantly (p=0.046) predicted 27.3% of the variation in the dominant PM reach direction distance (B=-1.35) [Table/Fig-8].



[Table/Fig-5]: Correlation between age and the dominant posteromedial reach score.



[Table/Fig-6]: Correlation between age and the dominant composite score.

mSEBT	Age	
	r-value	p-value
Non dominant		
Anterior	-0.32	0.12
Posteromedial	-0.44	0.04*
Posterolateral	-0.40	0.06
Composite	-0.48	0.03*
Dominant		
Anterior	-0.20	0.23
Posteromedial	-0.52	0.02*
Posterolateral	-0.22	0.21
Composite	-0.44	0.04*

[Table/Fig-7]: Correlations between age and mSEBT.
Pearson Correlation; *indicates p<0.05

Predictor	Unstandardised coefficients		Standardised coefficient		R^2	p-value
	Beta	SE	Beta	p-value		
Age	-1.352	0.612	-0.523	0.046	0.273	0.046

[Table/Fig-8]: Regression model.
Simple Linear Regression

DISCUSSION

The investigation was conducted to identify the correlations between age and the mSEBT performance and to determine if age predicts mSEBT performance among healthy male hospital staff. The findings of this investigation support the hypothesis that there will be negative correlations between age and mSEBT performance. The results revealed that significant moderate negative correlations were observed between age and non dominant PM direction (r=-0.44, p=0.04) and non dominant composite score (r=-0.48, p=0.03). Additionally, there was a significant strong negative correlation between age and dominant PM direction (r=-0.52, p=0.02) and a significant moderate negative correlation between age and dominant composite score (r=-0.44, p=0.04).

The most important finding of this investigation was that age was a significant predictor (p=0.046) of the mSEBT performance only in the dominant PM reach direction. Decreased reach distance in PM direction has been linked to ankle instability in recreationally college students [31]. In another study of 30 participants, a significant correlation between PM reach direction and hip abduction strength was reported (r=0.51, p=0.004) [32]. Previous researchers have reported that increased hip abductors and extensors strength may help individuals to increase their reach distance in both PM and PL directions [32]. In a study of 73 healthy participants, a linear regression analysis showed that hip abduction strength was significantly predictive of Y balance performance [33]. Previous investigators have found a negative relationship between age and hip abduction strength in healthy subjects [34]. Therefore, this finding suggests that the reduced reach distance in the PM direction may be attributed to hip abductors weakness.

Compared with other studies evaluating mSEBT performance [9,10,35], the reach distances observed in the current investigation were relatively small. Unlike other researchers who found that the PM reach distance scores were about 80% of the LL [8], the PM reach distance scores were less than 65% of the LL in the current investigation. This discrepancy in the PM reach distances could be related to differences in the sample age (33.86±3.68 years) in this investigation compared with the sample age in other studies. Additionally, averaging the scores of the three trials may lower the final scores in this investigation compared with a previous study in which the highest scores were utilised for data analysis [10].

The human body is composed of 40% skeletal muscles and ageing is associated with loss of muscle mass known as sarcopenia [36]. Muscle mass reduction is mainly caused by a decline in the number of type II myosin heavy chain isoform [37]. The magnetic resonance imaging technique of muscle fibre revealed a decline in the physiologic index of muscle quality due to a reduction in muscle density and increased intermuscular fat [38]. Ageing is associated with reduced muscle strength, with a 1.0-1.5% decline annually and it is more noticeable in the lower extremities [39]. With age, there is a significant reduction in type II than type I skeletal muscles fibres as well as the repair or recovery is reduced due to a reduced number of satellite cells in the skeletal muscles [40].

Clinical implications that can be drawn from the study's findings should be discussed. Exploring the negative relationships between age and the PM and composite score for both legs may highlight the significant of implementing strengthening and coordination programs that aim to improve balance and potentially decrease risks of future injuries. Furthermore, knowing that age predicted mSEBT performance only in the dominant PM direction may emphasise the importance of designing training programs focusing on the PM direction as this direction has been linked to ankle instability.

Limitation(s)

Certain limitations to this investigation need to be addressed. The small sample size may limit the generalisability of the current investigation. Categorising participants into groups based on their age or profession was not performed due to the small sample size in the current investigation. Age related changes may not be pronounced due to the mean age of the sample (about 33.86 years). Also, the inclusion of only male participants may limit the generalisability of the study.

CONCLUSION(S)

The findings of this investigation indicated that significant moderate negative correlations were found between age and non dominant PM direction and composite score. Additionally, age was strongly negatively correlated with the dominant PM direction and moderately negatively correlated with the dominant composite score. Also, age was a significant predictor of the mSEBT performance only in the dominant PM reach direction.

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