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Screening in healthy individuals for risk of falls by employing various tools: A clinical study

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ABSTRACT

Body posture involves the relative position and control of the musculature with respect to each other. Muscles play a pivotal role in maintaining the balance which controls the posture. Present study involves the use of TETRAX® related tools to determine the risk of falls in different young adults group. In this approach we employ modified Romberg's Test, Static Postural Alignment Examination and TETRAX® Posturographic method in order to validate our hypothesis. We have chosen subjects of different age group such as 20-25 years, 26-30 years, 31-35 years and 36-40 years designated as Group A, B,C and D respectively. Present approach segregated all the subjects on the basis of demographic analysis. Comparison was done in different age groups for risk of fall. In descriptive analysis, it was concluded that there is high risk of fall is observed in case of group A as compared to other groups. Statistical analysis did not prove the same due to the limitation in number of subjects.

KEY WORDS: SCREENING; HEALTHY INDIVIDUALS; POSTURE; BALANCE; RISK OF FALL

INTRODUCTION

Body Posture involves the relative position and control of the musculature with respect to each other (Andre et al., 2015). Muscle recruitment is necessary for maintaining the postural control; therefore muscle should be active for maintaining the balance. Balance is a condition in which all forces acting on the body are being at equilibrium such that the centre of gravity lies within the base of support (Quitschal et al., 2014). Balance and posture is being defined by the System Model of Balance, its components are visual, somato-sensory and vestibular. The impairments in balance can be a consequence of changes in motor, sensory and integrative aspects of motor control (Rey et al., 2017). The central nervous system integrates all the cues coming from the environmental organiza-

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tion and the sensory system orients it. Incidence of high risk of fall and increased postural sway is being seen in older adults and due to these falls there are higher incidence of fractures other than any injuries (Villiers and Kalula, 2015), whereas some literatures report that young adults are also affected with poor posture control and balance and therefore, more cases of upper extremity fractures have been reported in young adults due to falls (Quitschal et al., 2014, Akdeniz et al., 2016 and Aydın et al., 2017).

Various tools or measures were employed such as plumb line or weighted line for normal postural alignment, visual inspection for postural alignment and interactive posturography system for postural stability (Paillard et al., 2015). Researchers also employed measures of the initial stance position, centre of alignment, mean sway path, total excursion and the zone of stability and considered as reliable measures of postural control (Anna et al., 2015 and Hung et al., 2016). Amalgamation of other tools were also being employed such as TETRAX® biofeedback video games for balance training is a feasible adjunctive program that may augment conventional therapy in persons with chronic hemiplegic stroke (Hung et al., 2016 and Yun & Yoo, 2016). The study concluded that there is relation risk of fall, balance and neuromuscular function in 60 years women (Akdeniz et al., 2016).

Aforementioned studies employed the TETRAX® tool in combination with other interventions but there is limited study on the age group 20-40 years. Therefore, there is need to determine that whether the risk of fall is the problem in geriatric population only or is it an alarming problem within young adults of age group (Garcia & Navarro, 2016 and Rey et al., 2017).

As there is higher risk of fall and stability index in individuals with low physical activity. The aim of this study is screening of balance and postural control in individuals. The objective of this study is to determine the risk of fall in the healthy young population by employing measures such as Modified Romberg's Test, TETRAX® Posturographic method and Static Postural Alignment Examination. These tests have intrinsic characteristic features such as accuracy, non-invasive and weight distribution etc. (Lee et al., 2016) which make them reliable tools for the determination of risk of fall among different age group and also on gender bias.

MATERIAL AND METHODS

Young healthy adults between age 20-40 individual were included in the study and were with 10 subjects each in four respective Groups A (20-25) years, B (26-30) years, C (31-35) years and D (36-40) years as per their age. The study was performed at RLJT Hospital & Research Centre, Jhunjhunu. All subjects were included after performing Romberg's test. Exclusion criteria history of neurological (Guler et al., 2012) or musculoskeletal disorder, laxity in joints pregnancy (Aydın et al., 2017), ankle sprain, marked cognitive impairment (Avni et al., 2006), low vision, insufficient English and Hindi language skills lack of interest to participate The experiment was conducted on the basis of Demographic data and Anthropometric characteristics of the subjects was recorded including Name, Age, Gender, Height and Weight, therefore BMI was also recorded prior to the study. Manual Screening for Postural Control was done by Modified Romberg's test and Plumb line Posturography method.

Tools employed for the screening of healthy individuals for risk of falls: Modified Romberg's Test was employed in four different conditions and each condition must be fulfilled in order to move to the next condition. All the conditions were performed standing with feet together and arms crossed. Condition 1: Each subject would be supposed to stand on the floor (firm surface) for 15 seconds eyes open. Condition 2: Each subject would be supposed to stand on the floor (firm surface) for 15 seconds eyes closed.

Condition 3: Each subject would be supposed to stand to on the memory foam with eyes open for 30 seconds. Condition 4: Each subject would be supposed to stand on the memory foam with eyes closed for 30 seconds. Documentation- It would be done by PASS/FAIL condition.

Failure of the test was defined under three parameters i.e 1) The subjects open their eyes in the condition 2 and 4 2) The subjects move their feet or arms to maintain stability 3) Beginning to fall or requiring intervention of the examiner to maintain the balance within 30 seconds threshold time. Static Postural Alignment Examination: Normal postural alignment in standing can be determined by using a plumb line. In standing position, the centre of mass lies at the second sacral vertebrae. Static posture is examined by using the plumb line method in standing position with the feet apart, normal stance width. When viewed from the Sagittal plane the vertical line of gravity (LOG) is expected to fall close to the external auditory meatus, anterior to the shoulder joint, anterior to the thorax, posterior to the hip joint, and slightly anterior to the knee and ankle joint.

TETRAX® Posturographic method: Tool used is TETRAX® Computerized Static Posturographic tool. This system helps in the screening of the Static Postural balance in healthy individuals. The subjects was asked to stand in the middle of the four force plates which would be placed at the right rear, right front, left rear and left front of the patient's feet. The sensor plates would then record the weight bearing based on vertical pressure

being applied to the platform via the heels and the toes. Documentation was done in eight different conditions i.e.:

1. Normal open position (NO) that is standing straight with eyes open
2. Normal closed position (NC) that is standing straight with eyes closed
3. Pillow open (PO) that is standing straight on pillows with eyes open
4. Pillow Closed (PC) that is standing straight on pillows with eyes closed
5. Head right (HR) that is standing straight on sensor plates with eyes closed, head turned to the right
6. Head left (HL) that is standing straight on sensor plates with eyes closed, head turned to the left.
7. Head back (HB) that is standing straight on sensor plates with neck in extension
8. Head Forward (HF) that is standing straight on sensor plates with neck fully flexed.

The study was performed at same time of the day. Each position is maintained for 30 seconds. Tetrax® Software computed the following parameters. Risk of falls with Numeric value of (0-100)

- Low fall risk: 0-35
- Moderate fall risk- 36-57
- High fall risk- 58-100

Data Analysis: The data analysis was done using Statistical Package for Social Sciences software Version 17 applying the descriptive data included mean standard deviation were also calculated Anova test was applied to calculate the difference in between four groups using F distribution . The data was analysed using the F- value and the F crit value. If the F value is greater than the F crit value then the null hypothesis is rejected but if F value is less than the F crit value then the research hypothesis is rejected.

Table 1. Demographic and anthropometric data of the subjects

Characteristics	Mean ± Standard Deviation
Age	30.77 ±5.78
Height (cm)	164.25 ±7.70
Weight (kg)	64.43 ± 13.83
Body Mass Index (kg/m)	23.98 ± 4.35
Gender (Male/Female)	24/16

RESULTS

Segregation of healthy individuals according to demographic analysis:

Subjects (40) were included in the study with mean age of 30.77 ± 5.78 years. The mean height was 164.25 ± 7.70 cm and mean weight was 64.43 ± 13.83 kg. The mean BMI was also calculated as 23.98 ± 4.35 and mean risk of fall was calculated as 34.25 ± 20.32. The ratio of male and female in the group under investigation was 3:2 (Table 1).

Comparison within groups for risk of fall: Comparison was done between the risk of fall 34.25 ± 20.32 years of 4 different age groups 30.77 ± 5.78 years and it was found that there was no significant difference seen in the risk of fall between different age group of healthy population. (F value> F crit value), (p value > 0.05) (Table 2.)

For Intra- group comparison, descriptive analysis was done in which each group subjects were classified under low risk of fall, moderate risk of fall and high risk of fall

It was found that in Group A equal number of people fall under the category of moderate and high risk of fall. In Group B 50% of the population was under low risk of fall and 20% of population is under high risk of fall .As

Table 2. Comparison of risk of fall and Age

Age (Mean ±SD)	Risk of fall (Mean ±SD)	F value	p value	F crit value
30.77±5.78	34.25±20.32	2.575758	0.068935	2.866266
Significant at F value Significant at ≤0.05 level or> F critical value				

Table 3. Result analysis

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	2847.5	3	949.1667	2.575758	0.068935	2.866266
Within Groups	13266	36	368.5			
Total	16113.5	39				
Significant at ≤0.05 level or Significant at F value > F critical value						

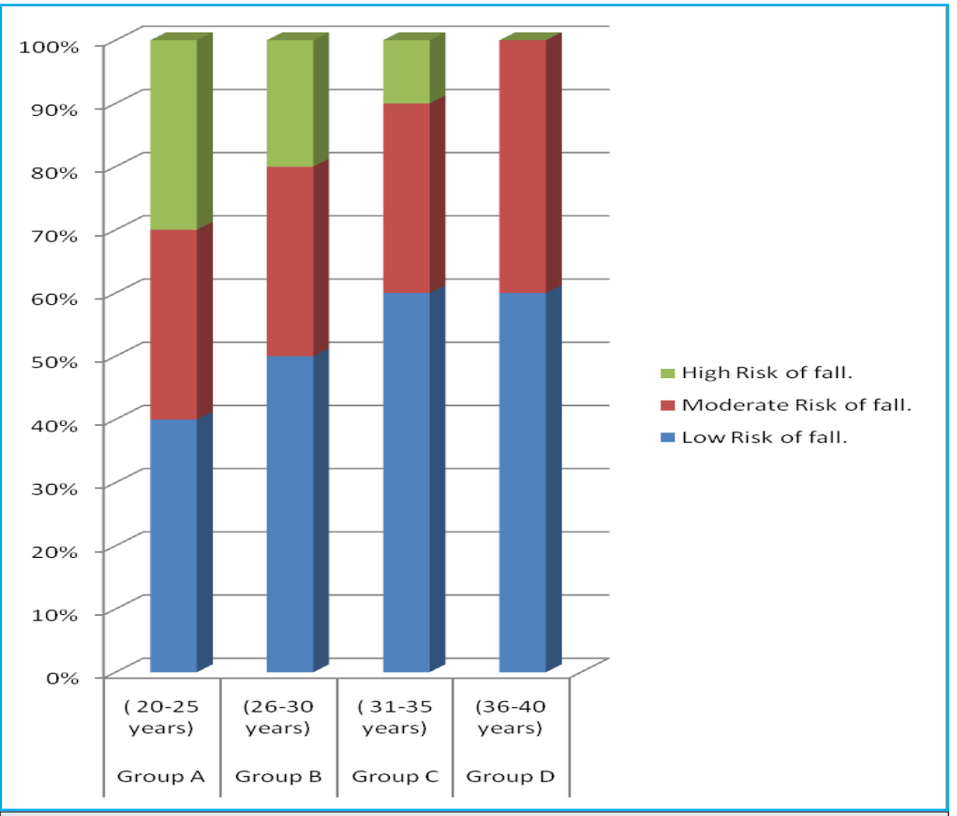

FIGURE 1. Illustrate the intragroup risk of fall in percentage

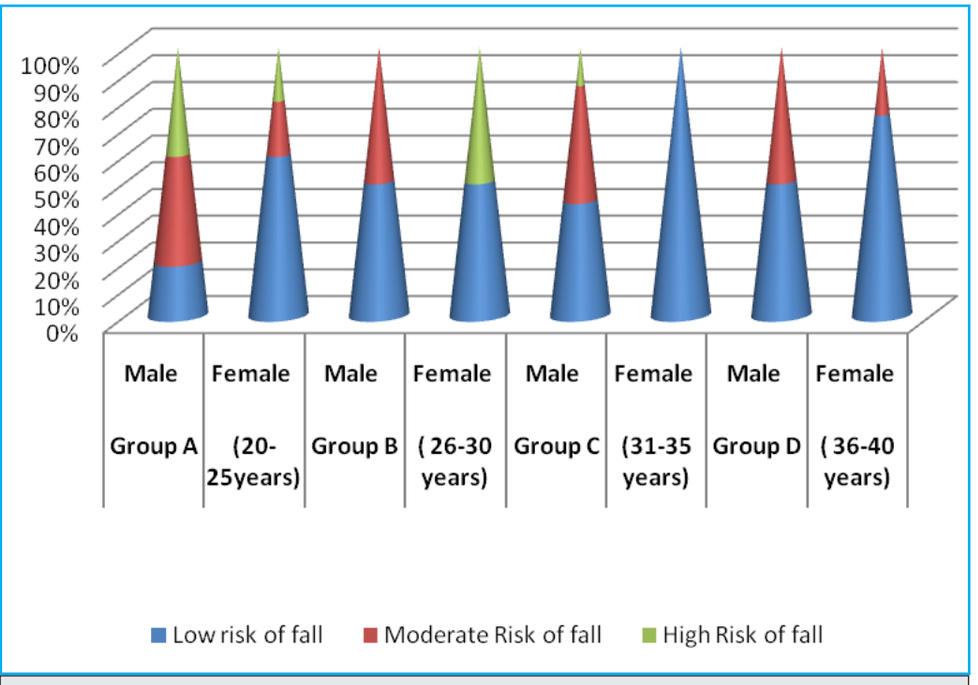

FIGURE 2. Representation of percentage Risk of fall on the basis of gender

Table 4. Intragroup relation between Demographic details and Risk of fall

Characteristics	Group A (20-25 years)	Group B (26-30 years)	Group C (31-35 years)	Group D (36-40 years)
Gender (Male: Female)	5:5	6:4	7:3	6:4
Age (Mean ± SD)	23±1	28±1.55	33±1.44	34±1.46
Height (In cm) (Mean ± SD)	167±8.89	163.44±7.59	164±6.93	162±7.41
Weight(In kg) (Mean ± SD)	62±14.50	60.5±8.54	69±9.31	67±19.9
BMI (Mean ± SD)	22±4.58	22.73±3.49	26±2.57	26±5.31
Risk of fall (Mean ± SD)	43±21.70	37.6±19.20	28±18.48	25±17.10

Table 5. Intragroup categorization of risk of fall

Risk of fall	Group A (20-25 years)	Group B (26-30 years)	Group C (31-35 years)	Group D (36-40 years)
Low Risk of fall.	4	5	6	6
Moderate Risk of fall.	3	3	3	4
High Risk of fall.	3	2	1	0

we move towards the higher Age groups C and D There was large decrement in the risk of fall, In Group D 0% Population is under high risk of fall (Figure .1).

It was also found that in higher age group i.e. Group D neither Males nor Females fall under the category of high risk of fall and in Group B and C females were not seen in the category of moderate risk of fall (Table 5 Table 6 & Figure 2).

Statistically, Anova test was used and it was seen that F value is less than F-crit value therefore the Research hypothesis was rejected. But through descriptive analysis there is significant difference seen in risk of fall within the Age groups

DISCUSSION

In previous studies TETRAX® tool was being used to assess balance and postural control in individuals with some disorders, may it be neurological or musculoskeletal (Dunsky et.al., 2017 and Claeys et.al., 2016). One study had revealed the reliability of TETRAX® tool in young adults also with low physical activity According to this study, TETRAX® measured low fall of risk with lower body endurance with increment in vigorous activity and total activity score (Akkaya et al 2015). Researchers employed these tools for the risk of fall in geriatric population (Garcia, 2016 & Rey et al., 2017) but none of the studies has screened only the young individuals. Therefore we were aimed to introduce TETRAX® TOOL for measuring risk of fall among various young individual groups.

The most important finding of this study is that with increase in age, within the group descriptive analysis showed that 0 % of the subjects were under high risk of fall. Previous studies also indicated that there is no correlation between age and risk of fall. Through statistical analysis, F value is higher than F crit value. Therefore,

Table 6. Classification of Risk of fall on the Basis of gender

		Low risk of fall	Moderate Risk of fall	Moderate Risk of fall
Group A (20-25years)	Male	1	2	2
	Female	3	1	1
Group B (26-30 years)	Male	3	3	0
	Female	2	0	2
Group C (31-35 years)	Male	3	3	1
	Female	3	0	0
Group D (36-40 years)	Male	3	3	0
	Female	3	1	0

statistically no significant difference is being seen in the risk of fall between the various age groups. It can be ascribed due to the fact that strict exclusion criteria and small population size can be major setback in this finding. Furthermore the subjects were also screened only for one time. However descriptive analysis concluded that there is significant difference seen in risk of fall within the Age groups. In futuristic approach larger population may allow evaluation of correlation between risk of fall and age statistically also. In descriptive analysis, young age group (20 - 25 years) showed high risk of fall as compared to older age group (36 - 40 years) which can be due to the equal weight distribution on both the lower limbs of older age group but low sample size is the limitation of this discussion.

CONCLUSION

Present study involves the employment of TETRAX® tool in combination with the Modified Romberg's Test and Static Postural Alignment Examination to determine the risk of fall within young adults of different age group. Earlier reported literatures employ various tools in geriatric population for risk of fall. Limited study was performed in case of young adults. Therefore we were directed to employ the tools in young adults for risk of fall. Our results concluded that in descriptive analysis, there is significant difference in the percentage of risk of fall in different age group. Risk of fall is greater in younger adults as compared to the subjects having more age according to descriptive analysis. But statistically our study did not proof the same due to the limited number of subjects. The results of this study demonstrates difference is being observed in risk of fall within the group of healthy population but after statistical analysis there was no significant difference was being seen between the different age groups of healthy population, therefore the research hypothesis is being rejected.

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