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Comparison of Balance and Generalized Flexibility Between Physically Active and Inactive Young Adults

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Author`s Contribution

[1 2 4] Concept and design of the work, [3 4 5] Acquisition of Volunteers for Data Collection, [1 2 3] Analysis of the data, [1 2 5] Interpreted the results, [1 2 3 4 5] Original manuscript is written by, [2] Drafting, [1 2 3 4 5] Revised the article critically before the approval.

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A B S T R A C T

Background: To know if physically active young adults are more or less flexible and have greater or lesser balance than physically inactive young adults.

Objective: The objective of the study was to determine balance and flexibility in young adults (age group of 18 to 25 years) on the basis of physical activeness and inactiveness.

Methodology: It was a comparative cross-sectional study. The data was collected from a total of n = 370 healthy young adults (18-25 years of age) after taking informed consent from the participants. Participants were divided into 2 groups through WHO activeness criteria. Y – Balance test was used to measure balance while sit and reach test and static flexibility tests were used to measure flexibility.

Results: The data was analyzed on SPSS version 21.0 and significance value was selected to be α = 0.05. Participants taken were from the age range of 18 to 25 years. Normality test was applied which showed the data as non-normally distributed (p-value of Leg Length Composite Score, Right Leg Composite Score and Static Flexibility Score is less than 0.05). Pearson Chi-square test showed non-significant difference in Y – balance scores ((RLC) Right leg composite score (p =0.481) and (LLC) Left leg composite scores (p =0.937)) and Sit and reach (SNR) score (p =0.148) and Shoulder Flexibility (SF) score (p =0.487). Weak correlations were found between physical activity and SNR (r = - 0.054) and SF (r = 0.002) while Y- balance score and physical activity also showed weak correlation RLC r = -0.037 and LLC r = 0.004.

Conclusion: The results of the study conclude that there is no significant correlation neither between physical activity and balance nor between physical activity and generalized flexibility. This is because it is also clear that sedentary time was not taken into account when screening participants into active and inactive groups. The active group also included people who had high activity levels but spent a lot of time sedentary, which may have influenced the results of this study

Keywords: Balance, Flexibility, Physical Activity, Young Adults

Introduction

The World Health Organization has included adolescents and young adults in the category of “young people” and specified their ages to range from 10 to 24 years([1]). On the other hand the United Nations has defined “YOUTH” as individuals of 15 to 24 years of age.[1] The journal of adolescent health 60, 2017 identifies 40 publications[2] that specifically depicted high-risk health status of young people, which have recognized young adults to be 18 to 25 years of age and have also showed that this age group experiences higher rates of mortality and have less access to health care facilities compared with the age groups younger (10-17 years) or older (26-30 years) then them.[2]

The term “physically active” has been defined by World Health Organization (WHO) as a minimum of 150 – 300 minutes per week of moderate intensity aerobic physical activity or a minimum of 75 – 150 minutes per week of vigorous intensity activity for a healthy adult of 18 to 64 years of age.[3] While on the other hand term “physically inactive” is defined to be less than 150 – 300 minutes per week of moderate intensity activity or equivalent[4] which may cause heart disease, cancer, diabetes, osteoporosis, obesity and other health problems.[5] Physical inactivity is recognized as the fourth leading cause of death on a global scale.[6] The physically active and inactive characteristic of an individual can be assessed through a series of self-reported questionnaire, including Modifiable Activity Questionnaire(MAQ), Past Week Modifiable Activity Questionnaire(PWMAQ), International Physical Activity

Questionnaire-Short(IPAQ-S), International Physical Activity Questionnaire–Long(IPAQ-L) and many others.[7]

The concept of balance in clinical terms "human balance" is defined as "the ability of a person to not fall". [8] This term is more widely used with 'postural stability', which means "The act of maintaining, achieving or restoring a state of balance while outside force is acting to disturb or when the body parts are in motion" also known as Dynamic Balance.[8, 9] Static balance is "the ability to maintain stability with COG over the BOS". [9] Dynamic balance is mostly important for the lower extremity balance assessment and to predict lower extremity musculoskeletal injury, prevention and rehabilitation (10). There are multiple methods to measure dynamic balance but the most reliable [10] is Star Excursion Balance Test (SEBT) (10) and Lower Quarter Y- balance Test (YBT-LQ) (10). Currently there are many researches on balance in older adults, children and patients with neuromuscular problems but research lacks in the field of young adults. [13, 9]

Generally, flexibility is defined as "the range of motion of muscles and connective tissues in a joint or group of joints". [11] Flexibility is a component of fitness [11] and many authors have explained this term as muscle 'tension' or 'tightness' (Kraus and Raab, 1961), [11] or 'the ability to change and adapt to range of states' (Gupta and Goyal, 1989).[12] All of the authors agree that flexibility is important to respond or restrict to changing environment.[12] The Sit-and-Reach (SNR) is best suited to estimate lower limb flexibility in young adults [13], as it has high validity and reliability[13] among other field tests. The Static flexibility test also known as broomstick test is used to measure upper limb flexibility in athletes and young adults.[14] There are only a few researches that have measured and studied flexibility in young adults.[15,16]

Furthermore, studies have shown that body balance and flexibility are correlated with each other[17] which typically depends on muscle strength and power that could be improved with exercise training or is naturally better in individuals who are physically active.[17] Moreover, studies on balance and physical activity on different populations have shown that regular activity has multiple health benefits including increase in flexibility, in joint's ROM, in balance, coordination and movement of individuals, all these ultimately decrease the risk of falls and injuries.[18] For sedentary individual with the advancement of age they experience changes in their posture and balance which causes increased risk of fall and may lead to dependent ADLs and reduced quality of life. PA has effect on health of individuals as it improves walking, improves balance and ultimately reduces the risk of falls.[25, 26, 27, 28]

Vahid Valipor Dehnou and Reza Motmedi conducted a research in July, 2018 on assessment of balance and flexibility in comparison to each other in the age group of 60-79 years in both elderly male and female. The study showed that balance and flexibility of both genders decreased as the age progresses.[31] Dr. Deepti Chandrasheel Thokal and Dr. Shayam devidas Ganvir conducted a research in September 2021. The study showed how Tai chi exercises affected balance, it proved that Tai Chi helps in improving balance of participants.[32] Essra A. Bataweel and Alaa I. Imbrahim conducted a cross – sectional study, in April 2020. The study focused on balance and musculoskeletal flexibility in obese participants. The study showed that stability levels were impaired in participants and in terms of flexibility of muscles, the distance of lunges was shorter.[33] This study is conducted to explore young adults in regard of effects of physical activity on their balance and flexibility while the previous researches targeted only the younger population, older population, population with disability and neurological diseases while little or no data is available for healthy young adults (i.e. 18 – 25 years of age).

Methodology

It was a Comparative Cross-sectional Study. Non-Probability purposive sampling was used to collect data from Foundation University Islamabad (FUI). The study was approved by Ethical Review Committee after careful consideration with ref no. **(FF/FUMC/215-186 Phy/22)** Sample size was calculated using Openepi software, with the following parameters, population size = 110136 (19, 20), Hypothesized % frequency of outcome factor in the population = 50% ± 5, Confidence limits as % of 100 (absolute ± %) = 5%, Confidence level (%) = 95 % was found to be 385.

Healthy individuals of age range 18-25 years, living in Islamabad and Rawalpindi were included in this study while individuals with diagnosed any musculoskeletal disorder or injury, psychological problem, cardiorespiratory issues and BMI of more than 25 were excluded from this study.

Screening Tool - Short IPAQ (95% CI 0.64–0.70)[21] Was used for screening out physically active and in-active participants in combination with WHO criteria. Questionnaire based analysis of physical activity of past 7 days on the recall of participants. The participants were divided into 2 groups based on their physical activity and inactivity according to WHO physical activity set criteria. (Table I)

Y- Balance Test [22] (Reliability ICC = 0.88- 0.99) [23] was used to access balance, participants were instructed to place their heel of one leg on the intersection of the measuring tapes while the other leg steps forward on the anterior tape where you are most

stable then step with the same leg on the measuring tape placed posterolateral and lastly step with the same leg on the measuring tape placed posteromedial and vice versa. (Table II) Difference in right and left limb reaches is calculated and recorded. Composite score is calculated using following formula.[24]

Table I: Short IPAQ Scoring Criteria for Inclusion of Participants.

TYPE OF ACTIVITY	WHO CRITERIA	Active	Inactive
Moderate-Intensity Aerobic	Minimum 150-300 min (2hrs. 30mins. To 5 hrs) per week	YES	NO
Vigorous-Intensity Aerobic	Minimum 75-150 min (1hr. 15 min. to 2hr. 30 mins) per week	YES	NO

$$\text{Composite Score} = \frac{(Anterior + Posteromedial + Posterolateral)}{(3 \times Limb\ Length)} \times 100$$

Before starting data collection all participants were asked to sign consent after being informed about research purpose, then they were asked to fill out their demographics and then short IPAQ. Furthermore, participants gradually performed sit and reach test, static shoulder flexibility test and Y-balance test as described.

Results

The data was collected from a total sample of n= 370 participants which includes young adults of age range 18-25 years, both male and females were included in the study, and all the participants were from Rawalpindi and Islamabad. The frequency bar graph (Figure 01) shows the age distribution of the participants in both groups that was active group and inactive group. The data shows total of 370 participants divided in the age category of 18 to 25- years. The bar graph (Figure 02) demonstrates the gender distribution among the participants included in the study.

Table II: Scoring of Different Variables. (Y Balance, Sit & Reach Test and Static Flexibility Test)

Scoring of Y Balance (25)	SCORE	NORMAL	Indication of Neuromotor Deficit
	COMPOSITE SCORE	> 94%	< 94%
	DIFFERENCE IN RT. & LT.	< 4 cm	> 4 cm
Scoring of Sit and Reach Test	RATING	MEN (cm)	WOMEN (cm)
	Excellent	> 46.5	> 45.5
	Good	46.5 – 38.0	45.5 – 38.0
	Average	37.5 – 27.0	37.5 – 29.0
	Below Average	26.5 – 17.0	28.5 – 20.0
	Poor	< 17.0	< 20.0
Scoring of Static Flexibility Test	RATING	MEN (cm)	WOMEN (cm)
	Excellent	> 17.8	> 12.7
	Good	17.78 – 29.21	12.7 – 24.76
	Average	29.21 – 36.83	24.76 – 33.02
	Below Average	36.83 – 50.16	33.02 – 45.08
	Poor	< 50.16	< 45.08

Sit and Reach Test (Reliability= 0.92 ICC) [26, 27] was used to access flexibility of lower limb, participants were instructed to sit with your back and buttock completely touching the wall and legs must be fully extended. They must slide forward over the measuring scale without bending knees as far as possible and where you can breathe comfortably. (Table II) The farthest reach of the participant is noted from the measuring scale and the data is compared with respect to the standard values to assess flexibility. [28]

Static Flexibility Test was used to access flexibility of upper limb, participants were instructed to hold the rod in front of them and then bring it above your head and gradually open your arms while sliding the rod behind your back. (Table II) Hold the position when the rod fully touches your back.

the average of the three trials is calculated and subtracted from the shoulder width measured and then compared with respect to the following standard data.[29]

The test of Normality, Kolmogorov-Smirnov was applied as the sample size was greater than 50 and since the *p*-value was less than 0.05 indicating non-normally distributed data, non-parametric test was applied. The participants were equally distributed between the two groups 185 (50%) participants were screened and included in Active group while 185 (50%) participants were screened and included in Inactive group. Pearson Chi-square test was run through the data for comparison of balance and flexibility between the 2 groups.

The Pearson Chi-square (Table III) showed weak association ($r < 0.3$) between group of participants and Sit and reach score ($p = 0.148$) and shoulder flexibility ($p = 0.487$), depicting no significant correlation among physical activity and flexibility. Weak association ($r < 0.3$) was also found between group of participants and right leg composite score ($p = 0.481$) and left leg composite scores ($p = 0.937$), indicating no significant correlation among physical activity and balance.

Table III: Pearson Chi-Square Test.				
Comparison of Flexibility & Balance in Physically Active & Inactive Young Adults				
	Group		**Pearson Chi-square**	***p*-Value**
	Active	**Inactive**		
Sit & Reach score	185	185	-0.054	0.148
Shoulder Flexibility			0.002	0.487
Right leg Composite Score			-0.037	0.481
Left Leg Composite Score			0.004	0.937

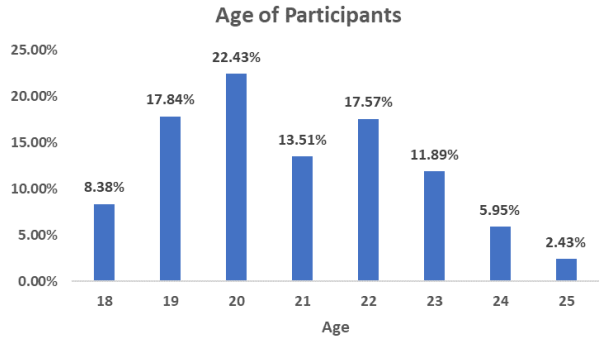

Figure 1. Age Distribution of Participants.

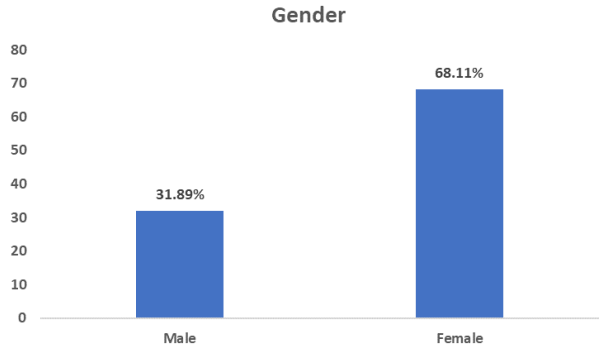

Figure 2. Gender Distribution among Participants.

Discussion

Physical activity plays a vital role in providing multiple health benefits and specifically in young adults (18 – 25 years of age) physical activity may have effect on their balance (postural stability/ dynamic stability) as well as flexibility. This study is conducted to explore specifically healthy individuals in the age range of 18 – 25 years in regards of the effects physical activity has on balance and flexibility also to understand these effects especially on young adults as 18 – 25-year age since an active and healthy life style prevents problems of balance and coordination, decreases the risk of falls and prevents joint issues in old age.[3]

Studies have shown that balance, flexibility and physical activity are co-related as exercise improves these qualities of an individual.[30] The results of this study showed that there was no significant correlation in the Y- balance score between Active and Inactive groups. Right leg composite score (p =0.481) and left leg composite scores (p =0.937) with Pearson Chi square correlation of r = -0.037 and r = 0.004 respectively suggests that physical activity does not influence balance of healthy young adult. In contrast to the results of this study Wenfei Zhu and Yufeng Li et. al. in October 2021 had shown that moderate to vigorous intensity physical activity is negatively associated with sway area (p = 0.030) and sedentary time was positively associated with sway area (p= 0.0004). As they had measured PA continuously for 7 days using accelerometer. Furthermore, study showed that increasing moderate to vigorous physical activity and decreasing sedentary breaks improves static balance in young adults. [31]

Results of this study showed that there is no significant correlation in the values of sit and reach score (p =0.148) r = - 0.054 between Active group and Inactive groups. The results of this study showed that there is weak correlation in the values of static flexibility score (p =0.487) r = 0.002 between active and inactive groups which suggests that physical activity has no effect on upper and lower limb flexibility in healthy young adults.

Similar to this study, Gite, A. A. Mukkamala, N. et al. studied the relationship between body mass index and flexibility in young adults in which they had used sit and reach test (SART) for lower back and hamstring flexibility along with active knee extension test (AKET) and global physical activity questionnaire (GPAQ) for physical activity levels. The results of their study showed that there was weak positive correlation between GPAQ and SART (p = 0.000) along with weak negative correlation between GPAQ and right AKET (p = 0.004). Which concluded that no statistically significant correlation was found between BMI, physical activity and flexibility.[32]

Limitation in this study are disproportion of male and female ratio, it is time bound since it is a cross sectional study and is only limited to participants of same geographical area. Future studies in this respect can have equal male and female ratio in both groups, can use longitudinal study, can also take participants from different geographical areas, can use better tools to objectively measure the parameter and can have equal measures of weight, height and age for minimizing confounding variables.

Conclusion

The results of the study conclude that there is no significant correlation neither between physical activity and balance nor between physical activity and generalized flexibility. This is because it is also clear that sedentary time was not taken into account when screening participants into active and inactive groups. The active group also included people who had high activity levels but spent a lot of time sedentary, which may have influenced the results of this study

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