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EFFECT OF LOWER EXTREMITY TIGHTNESS ON STATIC, DYNAMIC BALANCE, AND FUNCTIONAL MOBILITY IN YOUNG ADULTS

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ABSTRACTS

Muscle tightness prejudices young adult's quality of life. Muscle flexibility, balance, and mobility are the key components for maintaining the optimum function or performance of the body. There is a lot of data available for the older population yet little information exists in context to young adults. Hence this study aimed to determine the effect of lower extremity muscle tightness on static, dynamic balance, and functional mobility in young adults. The cross-sectional study was conducted on 100 Young adults (50 females and 50 males) aged 18-25 years. Functional reach test (FRT) was used to assess static balance, Y Balance test (YBT) for dynamic balance, and timed up and go test (TUG) for mobility. Muscle length tests were used for testing muscle tightness- Thomas test for iliopsoas, Straight leg raise for hamstring, Ely's test for rectus femoris, and ankle dorsiflexion range of motion for gastrocnemius. Data was analysed for statistical significance by using SPSS software. Pearson correlation coefficient was used to assess the correlation of lower extremity tightness with static, dynamic balance, and mobility. Significant correlation was found between iliopsoas tightness and anterior reach (p-value = 0.005) and hamstring tightness was significantly correlated with the posteromedial (p-value = 0.001), posterolateral directions (p-value = 0.443), and a composite score (p-value = 0.000) of YBT. The anterior direction (p-value = 0.031) had significant correlation with hamstring tightness in young females. No significant correlation of muscle tightness with the FRT and the TUG was found. Lower extremity muscle tightness, especially hamstring tightness affects dynamic balance and doesn't affect static balance and mobility in young adults.

KEYWORDS: *Balance, Mobility, Muscle length test.*

INTRODUCTION

Young adults especially, college students are viewed as one of the healthiest populations, with a good quality of life.[1] Between the ages of 18 and 39, young adults are physically fit, but as age increases, their flexibility may start to diminish. According to several studies, the age range of young adulthood is often 18 to 22 or 18 to 25 years.[2]

Muscle tightness is an unobserved symptom that frequently impairs young adults quality of life.[1] It is one of the most common motor system factors affecting the balance and mobility of the body.[3] It not only reduces the functional activity of the individual but also causes damage to the musculoskeletal system due to overuse.[4]

It has been established that lower extremity flexibility is critical for both good athletic performance and daily activities. The goniometer is the most widely accepted instrument to measure the joint range of motion (ROM) and thus quantify the length of the muscle.[5]

The coordination of sensory, motor, and biomechanical components is said to be necessary for balance.[6] Static balance is the capacity to retain the centre of gravity within the base of support while maintaining an upright posture (i.e., quiet standing). Dynamic balance is defined as the ability to keep stability while shifting weight, frequently while changing the base of support.[7] YBT, a modified version of the Star Excursion Balance Test (SEBT), is used to assess the dynamic balance. It requires the stance leg balance while the contralateral leg reaches in three directions: anterior, posteromedial, and posterolateral.[8] FRT measures the distance that a person can reach forward beyond arm's length while remaining at a fixed base of support in the standing position.[9]

Functional mobility in an ambulatory person is defined as "the ability to move his or her body capably and independently in order to accomplish daily tasks".[10] A Timed Up and Go test is used to assess functional mobility. The Timed Up and Go (TUG) test measures the time a subject takes to rise from a chair, walk 3 meters, turn, walk back to the chair, and sit down. The time was recorded in seconds on a stopwatch. Subjects are allowed to use standard walking aids but are not allowed to stand up using their arms. No physical assistance is given. A stopwatch is used to record the duration of a functional task.[11]

Innumerable studies emphasis on balance assessment and flexibility measurement but there was scarceness of studies depicting the correlation between muscle tightness, balance and functional mobility especially in the young population. Hence this study aimed to find the effect of lower extremity tightness on static, dynamic balance, and functional mobility in young adults.

MATERIALS AND METHODS

Subjects: A cross-sectional study was conducted on randomly selected 100 young adults (50 male and 50 female) who exhibited lower extremity tightness, aged 18-25 years at Guru Nanak Dev University Amritsar. All subjects were informed about the testing procedures and a written consent was taken. None of the subjects had experienced any injury in the previous 6 months in the lower extremity,ear infection, head injury.Ethical approval for the study was obtained from institutional ethical committee with ethical approval No. 1099/HG 22/11/2022.

Procedure

Muscle tightness was measured using a goniometer through the following methods:

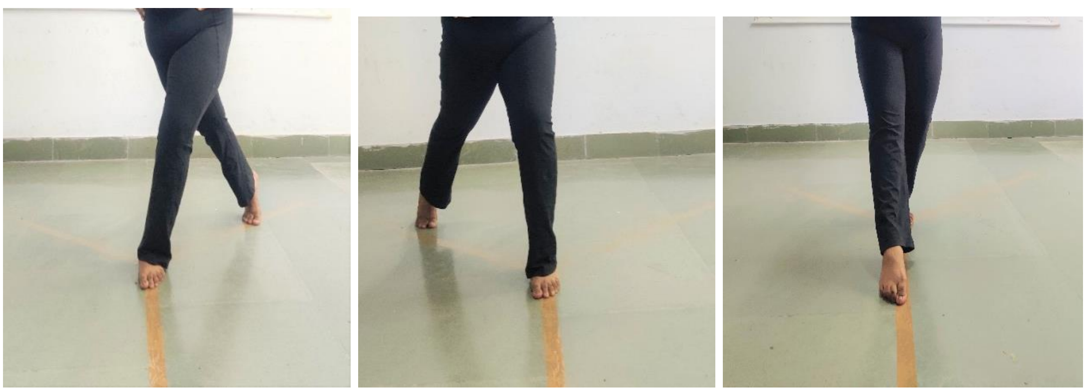
1. Thomas test was used for iliopsoas by measuring the hip angle.
2. Straight leg raise was used for the hamstring by measuring the hip angle.
3. Ely's test was used for rectus femoris by measuring the knee angle.
4. Ankle dorsiflexion ROM in the supine position was measured for gastrocnemius.

The measurements were taken when the subjects were actively moving the joint. The bilateral average scores of muscle tightness were considered.

The lower limb length was measured from the anterior superior iliac spine to the distal tip of the medial malleolus using a measuring tape with the subject lying supine.[16] The YBT apparatus was made by tape on the floor in a Y shape. The angle between the two posterior tapes is 45 degrees and the angle between the anterior and both posterior tapes are 135 degrees. The subject was asked to perform the test barefoot. Hands should be placed on the hips. The subject was asked to balance on one leg while simultaneously reaching as far as possible with the other leg, by lightly touching the tape with their toe, in three separate directions: anterior, posterolateral, and posteromedial directions. This is performed first on the left foot followed by the right foot. Three trials were recorded in each direction. Normalized reach distance (%) was calculated using the formula (reach distance/limb length) x 100. The composite score was calculated using the formula (sum of 3 reach distance/ 3 times the limb length) x 100.

FRT was then performed by asking the subject to stand with their feet shoulder-width apart, create a fist, and lift his/her arm parallel to the floor.The researcher will take an initial reading on a ruler, using the knuckle of the third metacarpal as a landmark. The subject was directed to come forward along the ruler without moving his/her feet. A reading of the farthest reach was recorded.

TUG was performed by asking the subject to rise from a chair, walk three meters, turn, walk back, and sit down. The time was recorded in seconds on a stopwatch.



Anterior direction **Posteromedial direction** **Posterolateral Direction**

Figure 3.1- Y Balance Test (YBT).

Statistical analysis was conducted using SSPS (statistical package for social sciences, version 18). The Pearson correlation coefficient was used to determine the correlation of lower extremity muscle tightness with static, dynamic balance, and functional mobility with significance set at p $\leq$0.05 and p$\leq$0.01. The correlation coefficient was classified as follows: 0 = no correlation, 0< | r |< 0.5 = weak correlation, 0.5< | r |<0.8 = moderate correlation, | r |<0.8 = strong correlation, and 1 = perfect correlation.

RESULTS

Table 1 showed the characteristics of the subjects. Females had sightly higher age than males. The males had the higher mean values in height, weight, BMI, limb length right and left than their female counterparts showing no significant differences in any case.

The Descriptive statistics of muscle tightness (in degrees) was given in Table 2. Males had the higher mean values in tightness in Iliopsoas, Hamstring, Rectus femoris and lesser tightness in Gastrocnemius than females. However no significant differences were found in case.

Significant correlations were found between the bilateral average lower extremity tightness and bilateral average YBT sores in males (Table 3) and females (Table 4). Significant positive correlations are found between hamstring tightness and posteromedial (r=0.445, p=0.001), posterolateral (r=0.443, p=0.001) directions, and average composite scores (r=0.465, p=0.000) in males and average anterior reach direction (r=0.388, 0=0.005) of YBT in males. A significant correlation is found between the Hamstring tightness with the average anterior direction of YBT (r=0.307, p= 0.031) in females. There is no significant correlation found between lower extremity muscle tightness and TUG in males and females (Table 5). There is no significant correlation found between lower extremity muscle tightness and FRT in males and females (Table 6).

Table 1: Characteristics of the subjects.

	Males (n=50)		Females (n=50)		Total (n=100)	
	Mean	SD	Mean	SD	Mean	SD
Age (years)	20.68	1.974	21.60	1.773	21.13	1.920
Height (cm)	172.24	6.651	159.02	6.226	165.62	9.233
Weight (Kg)	66.00	9.390	55.68	7.636	60.83	9.974
BMI (Kg/m^2)	22.22	2.782	22.06	3.155	22.14	2.960
Limb Length right (cm)	90.34	5.305	84.52	4.046	87.43	5.530
Limb Length left (cm)	90.34	5.305	84.52	4.046	87.43	5.530

Table 2: Descriptive statistics of muscle tightness (in degrees)

	Males (n=50)		Females (n=50)		Total (n=100)	
	Mean	SD	Mean	SD	Mean	SD
Iliopsoas	10.39	5.03	11.55	6.399	10.97	5.755
Hamstring	55.88	8.779	56.70	11.720	56.29	10.309
Rectus femoris	130.16	18.984	132.31	16.291	131.23	17.632
Gastrocnemius	9.46	3.123	8.18	3.995	8.82	3.624

Table 3: Correlation of muscle tightness with YBT in males (n=50).

Variables	YBT							
	Anterior		Posteromedial		Posterolateral		Composite	
	R	P	R	p	r	p	R	p
Iliopsoas	**0.388****	**0.005**	-0.203	0.157	-0.243	0.089	-0.102	0.480
Hamstring	0.211	0.141	**0.445****	**0.001**	**0.443****	**0.001**	**0.465****	**0.000**
Quadriceps	-0.056	0.699	0.163	0.258	0.183	0.203	0.152	0.292
Gastrocnemius	0.056	0.699	-0.024	0.868	-0.005	0.972	0.032	0.825

*Correlation is significant at the 0.05 level; **Correlation is significant at the 0.01 level

Table 3: Correlation of muscle tightness with YBT in females (n=50).

Variables	YBT							
	Anterior		Posteromedial		Posterolateral		Composite	
	R	P	R	p	R	p	r	P
Iliopsoas	0.129	0.37	0.068	0.638	0.181	0.208	0.131	0.364
Hamstring	**0.307***	**0.031**	0.177	0.218	0.012	0.934	0.177	0.218
Quadriceps	0.223	0.119	0.103	0.476	0.091	0.529	0.171	0.235
Gastrocnemius	-0.091	0.527	0.004	0.978	-0.122	0.398	-0.072	0.619

Table 5: Correlation of muscle tightness with TUG.

Variables	Males (n=50)		Females (n=50)	
	R	P	R	P
Iliopsoas	0.029	0.203	0.237	0.097
Hamstring	-0.139	0.335	-0.077	0.595
Rectus femoris	-0.035	0.809	-0.114	0.430
Gastrocnemius	-0.061	0.673	-0.170	0.237

Table 6: Correlation of muscle tightness with FRT.

Variables	Males (n=50)		Females (n=50)	
	R	P	R	P
Iliopsoas	-0.183	0.203	-0.138	0.339
Hamstring	0.211	0.141	0.070	0.630
Quadriceps	0.152	0.291	-0.043	0.766
Gastrocnemius	0.039	0.788	0.026	0.857

DISCUSSION

The purpose of the present study was to find out the effect of lower extremity muscle tightness on static, dynamic balance, and functional mobility in young adults. The findings of the present study showed a highly significant positive correlation of hamstring tightness with the posteromedial (r = 0.445, p = 0.001), posterolateral reach directions (r = 0.443, p = 0.001), and a composite score (r = 0.465, p = 0.000) of YBT in males. The present study is in agreement with the findings of a study conducted by Overmoyer & Reiser,[5] showed a significant correlation of hip flexion AROM with average posteromedial, posterolateral, and composite scores of YBT as hamstring muscle tightness is quantified by the hip flexion AROM. A study conducted by Nelson et.al.[12] on kinematic predictors of YBT showed that posteromedial and posterolateral reach distance depended upon the hip flexion angle which is also in agreement with the present study.

A significant positive correlation was found between the hamstring tightness and the anterior reach distance (r = 0.307, p = 0.031) of YBT in females in the present study. A study conducted by Fullam et al.[13] on the kinematic predictors of SEBT and YBT showed that the anterior reach distance is directly proportional to the hip flexion angle i.e., as the hip flexion angle increases, anterior reach distance increases. A study conducted by Robinson & Gribble[14] reported that hip flexion depicted significant correlation with reach distances in all three directions. Hamstring tightness can influence the hip joint flexion angle, therefore, can influence the anterior reach distance of YBT. Hence, these studies are in agreement with the present study.

The present study showed a significant positive correlation of the iliopsoas with the anterior reach of YBT (r = 0.388, p = 0.005) in males. A study conducted by Mills et.al.[15] found that there is less activation of the gluteus maximus and relatively greater activation of synergistic biceps femoris in subjects with iliopsoas tightness as compared to normal individuals. This is the explanation for the positive correlation of iliopsoas tightness with the anterior reach distance.

However, no significant correlation was found between lower extremity muscle tightness and FRT and TUG in young adults (18-25 years) in the present study. A study conducted by Akhtar et.al.[1] showed a significant weak negative correlation of hamstring tightness with the mobility. This finding is in support of the present study where a negative correlation is also found between hamstring tightness and mobility however, the result is not significant in males (r-value = -0.139, p-value = 0.335) and in females (r-value = -0.077, p-value = 0.595).

Some limitations can be taken into account. The study is limited to the age group of 18-25 years. Low regional variability was considered a limitation. As the subject come from different socio-economic groups, their dietary habits, lifestyle, and physical fitness were different which were considered as limitations of the study.

CONCLUSION

The present study showed that hamstring and iliopsoas tightness affect the dynamic balance in young adults while lower extremity muscle tightness doesn't affect the static balance and functional mobility in the young adults. Hence, the flexibility of muscles should be maintained to prevent the risks of injuries and to improve balance. This will also promote long-term wellness and physical activity.

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Conflicts of interest

There are no conflicts of interest.

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