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(RESEARCH ARTICLE)

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Effect of gender on difference in flexibility of two joint muscles in lower limb of both right and left side in young adults: A pilot study

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Abstract

Background: Tight muscles are present in both genders and also varies with age, level of activity, hereditary, weight and many other factors. Physiotherapy has proven beneficial in lengthening the tight muscles but not many studies are present to show the comparison between gender and muscle flexibility which can cause altered biomechanics and also can cause muscle strain if not taken care of. Hence our study is small attempt to find the difference in muscle flexibility between males and females.

Objective: To compare the muscle flexibility of Hamstrings, Rectus femoris and Gastrocnemius muscle between males and females in individuals with normal BMI aged 18-25 years old using a standard goniometer. To compare the differences in flexibility.

Methods:60 subjects were allocated in this study (30 males and 30 females). Muscle flexibility of lower limb was measured using a standard goniometer and then comparison was made between males and females on both sides.

Results: In our study we found out that there is a significant comparison of hamstring muscle length of both right and left side (p=0.000) between young male and female. This suggest that female hamstrings are less flexible compared to males. But there was no significant comparison of rectus femoris muscle length of right side (p=0.503) and left side (p=0.944) and of gastrocnemius muscle length of right side (p=0.462) and left side (p=0.625) between young male and female.

Conclusion: There is difference in muscle length of hamstring muscle of both side in males and females and there is no difference in muscle length of rectus femoris and gastrocnemius muscles of both sides in males and females.

Keywords: Hamstring muscles; Rectus femoris muscle; Gastrocnemius muscle; Flexibility; Comparison

1. Introduction

Locomotor system, which includes muscles, bones, joints, associated soft tissues such as tendons and ligaments is affected by various musculoskeletal conditions comprising of more than one hundred fifty diagnoses as listed in the International Classification of Diseases. These musculoskeletal conditions are typically characterized by pain (often persistent) and limitations in mobility and functional ability, thereby reducing people's ability to work and participate in social roles with associated impacts on mental wellbeing, and at a broader level impacts on the prosperity of communities. (Kisner, 2023)

Osteoarthritis of various joints especially knee, low back and neck pain, fractures, injuries, etc. are most common and disabling musculoskeletal conditions. These musculoskeletal conditions most commonly affect people from adolescence

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to older age with its prevalence seen throughout across the life-course. The prevalence and impact of musculoskeletal conditions is predicted to rise as the global population ages, particularly in low- and middle-income settings. Enumerable risk factors are associated with development of these musculoskeletal conditions and injuries grossly saffecting the individual's routine and well-being. Both intrinsic as well as extrinsic risk factors have been suggested to be a causative factor. Intrinsic risk factors include age, gender, limb dominance, muscle length and flexibility, previous injury & inadequate rehabilitation, aerobic fitness, body size, muscle strength imbalances, etc. (Felson, August.,1987)

Flexibility is the ability to move a single joint or series of joints smoothly and easily through an unrestricted, pain-free ROM. Muscle length in conjunction with joint integrity and the extensibility of periarticular soft tissues determine flexibility.

Lack of Muscle flexibility leads to Muscle tightness, which in turn alters the line of pull of muscle action and thereby affecting the Muscle kinetics. Lack of muscle flexibility may produce early muscle fatigue or alter the normal biomechanics of the movement, predisposing to increasing risk of injury. "Muscle tightness" can be a resultant of two mechanisms, active or passive mechanisms.

Passively, muscles can become shortened through postural adaptation or scarring; actively, muscles can become shorter due to spasm or contraction. Regardless of the cause, tightness limits range of motion and may create a muscle imbalance clinically, muscle length cannot be measured directly but it can be measured indirectly by representation of angles formed about the joint. Muscle length testing helps determining the length of the multi joint muscles, crossing more than one joint. It involves elongating the muscle in the direction opposite of its action while assessing its resistance to passive lengthening. The elongation of the muscle is to be performed slowly to avoid quick stretch of the muscle spindle inducing a muscle contraction. Muscle length testing-It involves elongating the muscle in the direction opposite of its action while assessing its resistance to passive lengthening .Positive muscle length tests indicate a loss of extensibility of one or more muscles.

Two joint muscle length is measured when it is maximally lengthened across all joints it crosses until firm muscular resistance (firm end feel) is felt which is recorded as an angle at the final muscle length.

2. Material and methods

2.1. Patients

The study was conducted in physiotherapy department of tertiary care hospital with the inclusion criteria :Individuals having normal BMI i.e. 18.5 to 22.9 kg/m^2 (as per the WHO guidelines of BMI).Both males and females Individuals in age group 18-25 age and exlusion criteria:1)True or apparent limb length discrepancy.2)Low back pain since last 3 months.3)Individuals treated with physiotherapy during the previous 3 months.4)Lower extremity fracture and surgery.5)No gym or any sort of fitness training in the past 3 months.

2.2. Design

The design of this study was an Observational cross-sectional study, the subject were allotted in 2 groups based on gender. As it was pilot study, each group consisted of 30 subjects. So the total sample size was 60.

2.3. Method

A universal goniometer was used to measure the range of motion at hip joint for hamstring muscle, at the knee joint for rectus femoris muscle and at the ankle joint for gastrocnemius muscle. For Hamstrings length testing Straight leg Raise test was performed. In order to measure the muscle flexibility of right hamstring muscle; subject was positioned in supine lying. The hip of left limb was strapped for stabilization. The examiner then stabilized the right limb by placing one hand over the anterior superior iliac spine (ASIS) and passively flexed the hip with knee maintained in extension until a firm end feel is felt or if pelvis was seen to move or tilt. Goniometer was used to measure the hip flexion angle. Same procedure was repeated for the left extremity.For Rectus femoris length testing Ely's test was performed .In order to measure the muscle flexibility of right rectus femoris muscle; Subject was positioned in prone position. The left limb's hip was strapped for stabilization. The examiner then held the right limb beyond the ankle joint and flexed the limb at the knee joint. The examiner measured the range when the lumbar spine or pelvis first began to move or with the perception of end feel. Same procedure repeated for left extremity. For Gastrocnemius length testing Passive Dorsiflexion test was. The flexibility of right gastrocnemius was determined by measuring the amount of passive ankle joint dorsiflexion with the knee extended until a firm end feel was felt. The range of motion was then measured at the ankle joint. Same procedure repeated on left extremity

2.4. Statistical analysis

- Data was analyzed using SPSS 16 software
- Descriptive statistics of Mean, Standard Deviation, Confidence Interval of Hamstring ,Rectus femoris and Gastrocnemius muscles of male and female individuals was found
- After passing the normality test ,comparison of lower limb muscle lengths of 2 groups (male and female) was done using unpaired t test
- Statistical significance was set at 0.05

3. Results

Table 1 Demographic data

	Mean	Median	Std. Deviation
Age	21.97	22	2.075
BMI	20.9665	20.865	1.73706

RESULT: The above table shows that the Mean and SD of age was 21.97± 2.075 and that of BMI was 20.9665±1.73706

Table 2 Descriptive of length of Hamstring muscle

Muscle	Gender	Mean	95% Confidence Interval		Median	Std. Deviation
			Lower bound	Upper bound		
HAMSTRING RIGHT	FEMALE	27.83	25.76	29.90	28.50	5.547
	MALE	38.10	33.77	42.43	39.50	11.595
HAMSTRING LEFT	FEMALE	30.30	27.69	32.91	30.00	6.979
	MALE	39.50	35.26	43.74	41.00	11.346

RESULT: The above table shows that the Mean and SD of hamstring muscle length of right side for female is 27.83 degrees ± 5.547 degrees and for male is 38.10 degrees ±11.595 degrees and hamstring muscle length of left side for females is 30.30 degrees ± 6.979 degrees and for male is 39.50 degrees ± 11.346 degrees

Table 3 Unpaired t-test for Hamstring muscle

	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Hamstring right	11.861	0.001	-4.375	58	0.000	-10.267	2.347
Hamstring left	7.388	0.009	-3.783	58	0.000	-9.200	2.432

RESULT: The above table shows that there is a significant comparison of hamstring muscle length of both right and left side (p=0.000) between young male and female. This suggest that females' hamstrings are less flexible compared to males.

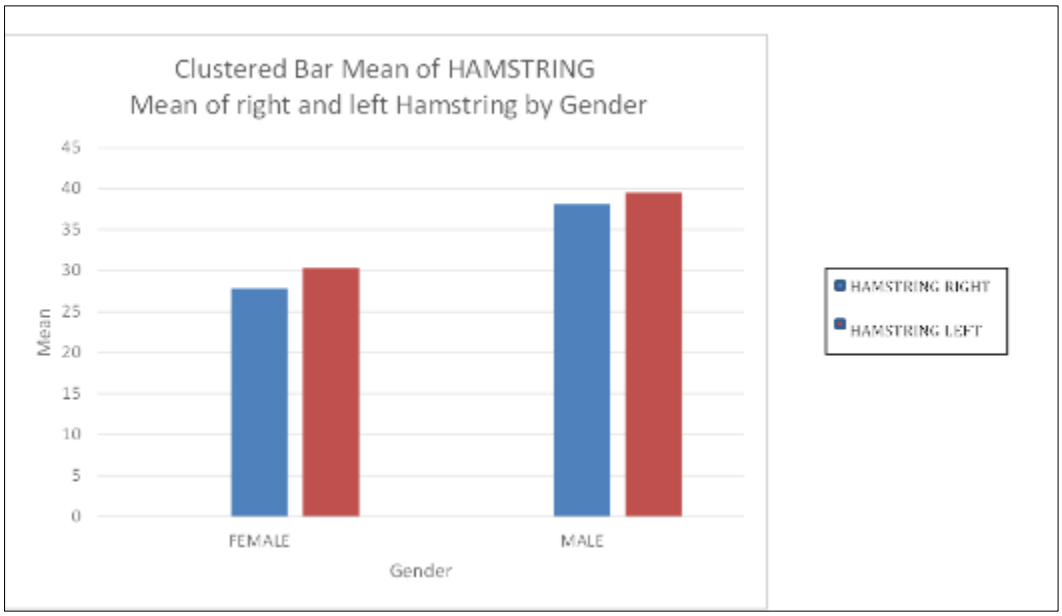

Figure 1 The above graph is a bar graph of Gender with Median of 28.50 in right hamstring female 39.50 in right hamstring male 30.00 in left hamstring female and 41.00 in left hamstring male

Table 4 Descriptive of length of Rectusfemoris muscle

Muscle	Gender	Mean	95% Confidence Interval		Median	Std. Deviation
			Lower bound	Upper bound		
RECTUSFEMORIS RIGHT	FEMALE	55.17	50.21	60.12	54.00	13.269
	MALE	53.00	48.69	57.31	53.00	11.543
RECTUSFEMORIS LEFT	FEMALE	53.47	48.44	58.49	51.00	13.464
	MALE	53.23	48.69	57.77	54.00	12.162

RESULT: The above table shows that the Mean and SD of rectusfemoris muscle length of right side for female is 55.17 degrees ± 13.269 degrees and for male is 53.00 degrees ±11.543 degrees and rectusfemoris muscle length of left side for females is 53.47 degrees ± 13.464 degrees and for male is 53.23 degrees ± 12.162 degrees

Table 5 Unpaired t-test for Rectusfemoris muscle

	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Rectus femoris right	0.184	0.670	0.675	58	0.503	2.167	3.211
Rectus femoris left	0.557	0.459	0.070	58	0.944	0.233	3.313

RESULT: The above table shows that there is no significant comparison of rectusfemoris muscle length of right side (p=0.503) and left side (p=0.944) between young male and female. This suggest that there is no comparison in flexibility of rectus femoris muscle on both sides between male and female

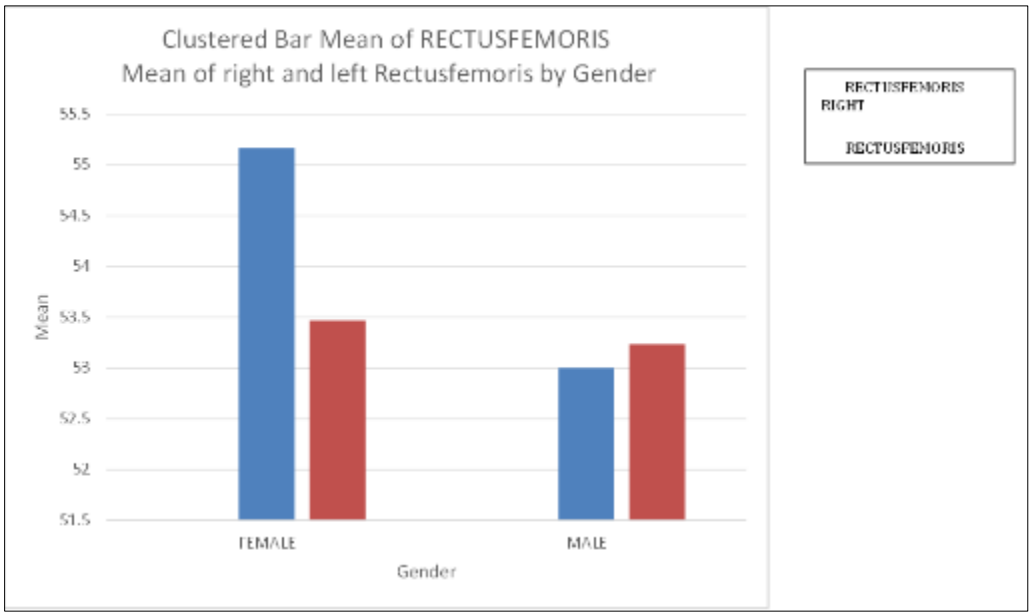

Figure 2 The above graph is a bar graph of Gender with Median of 54.00 in right rectusfemoris female **53.00 in right rectusfemoris male 51.00 in left rectusfemoris female and 54.00 in left rectusfemoris male**

Table 6 Descriptive of length of Gastrocnemius muscle

Muscle	Gender	Mean	95% Confidence Interval		Median	Std. Deviation
			Lower bound	Upper bound		
GASTROCNEMIUS RIGHT	FEMALE	12.10	10.61	13.59	11.50	3.994
	MALE	12.90	11.27	14.53	12.50	4.366
GASTROCNEMIUS LEFT	FEMALE	11.33	9.98	12.68	10.50	3.614
	MALE	10.80	9.03	12.57	10.00	4.730

RESULT: The above table shows that the Mean and SD of gastrocnemius muscle length of right side for female is 12.10 degrees ± 3.994 degrees and for male is 12.90 degrees ± 4.366 degrees and gastrocnemius muscle length of left side for females is 11.33 degrees ± 3.614 degrees and for male is 10.80 degrees ± 4.730 degrees

Table 7 Unpaired t-test for Gastrocnemius muscle

	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Gastrocnemius right	0.270	0.605	-0.741	58	0.462	-0.800	1.080
Gastrocnemius left	3.491	0.067	0.491	58	0.625	0.533	1.087

RESULT: The above table shows that there is no significant comparison of gastrocnemius muscle length of right side (p=0.462) and left side (p=0.625) between young male and female. This suggest that there is no comparison in flexibility of gastrocnemius muscle on both sides between male and females

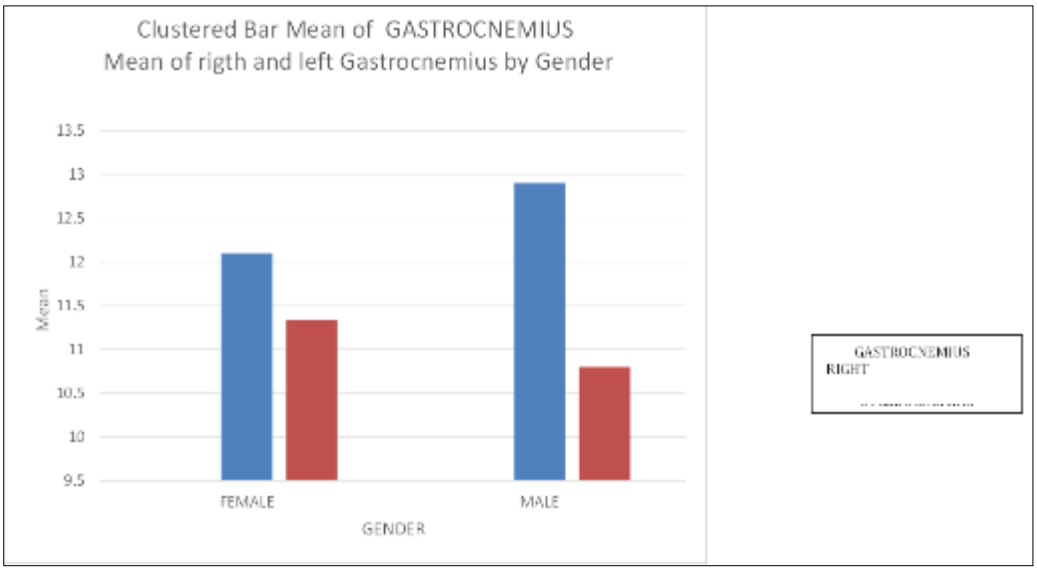

FIGURE 3 The above graph is a bar graph of Gender with Median of 11.50 in right gastrocnemius female 12.50 in right gastrocnemius male 10.50 in left gastrocnemius female and 10.00 in left gastrocnemius male

4. Discussion

This study was done to find out the difference in length of two joint muscles of both right and left side in males and females.

Our study showed that there is significant difference in both right and left side hamstring muscles of males and females as females muscle length is less compared to males.

Our study showed that there is no significant difference in both right and left side rectus femoris and gastrocnemius muscles of males and females.

According to a study conducted by (Corkery M. B. H., 1st May,2007) (3), there was only significant difference between males and females hamstring flexibility (right hamstring p=0.000 and left hamstring p=0.001).They had utilized one-way ANOVA to compare male to female differences between right and left. For rectus femoris and gastrocnemius, there were no significant differences between males and females.

They found significant gender difference, with females being more flexible which is also consistent with the findings of Youdas et al. (2005).

But according to our study, males have more hamstring flexibility as compared to females (right hamstring p=0.000 and left hamstring p=0.000).

5. Conclusion

There is difference in muscle length of hamstring muscle of both side in males and females and there is no difference in muscle length of rectus femoris and gastrocnemius muscles of both sides in males and females.

Compliance with ethical standards

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Strength and Limitation

- Strength: Equal number of males and females and also same age group
- Limitation: small sample size i.e. 60 individuals and all the age groups were not included.

Consideration of sitting posture, standing posture, working posture, hours of work, and level of activity of the individual which could affect the readings

Suggestion

- Further studies should be carried out using BMI instead of Gender
- Large sample size including all age groups

Also further studies should be carried showing co-relation between muscle flexibility and osteoarthritis

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

Author Contributions

Riddhi Arvind Manjrekar -concept; design; definition of intellectual content; literature search; clinical studies; experimental studies; data acquisition; data analysis; statistical analysis; manuscript preparation; manuscript editing and manuscript review.

Bharati D. Asgaonkar- concept; design; definition of intellectual content; data analysis; statistical analysis; manuscript editing and manuscript review.

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