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CORRELATION OF FLATFOOT WITH HAMSTRING MUSCLE TIGHTNESS IN 18- TO 25-YEAR-OLD COLLEGE GOING STUDENTS

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ABSTRACT

Background: Young adults frequently have flatfoot and hamstring discomfort as a result of their sedentary lifestyles and bad posture. Both disorders affect posture and lower limb biomechanics. Examining their relationship can help with musculoskeletal dysfunctions in this population, including early diagnosis, prevention, and treatment.
Objective: In order to facilitate early diagnosis and preventive measures, this study intends to investigate the association between hamstring muscle tightness and flatfoot in college students between the ages of 18 and 25. It will do this by determining the prevalence of flatfoot, assessing hamstring flexibility, and examining the relationship between the two.
Methods: 84 randomly chosen Surat college students, ages 18 to 25, participated in a 6-month comparison study. Among the requirements for inclusion were flatfooted, healthy students. The Foot Posture Index (FPI-6), Active Knee Extension test using a goniometer, and the footprint test were used to quantify foot posture and hamstring flexibility.
Results: A small but statistically significant positive connection between both sides of hamstring tightness and flat foot posture was seen in 84 young people, indicating that biomechanical interdependence links more pronated feet to less hamstring flexibility.
Conclusion: This study discovered a small but significant positive correlation between hamstring tightness and flat foot position, suggesting a biomechanical relationship. Reduced hamstring flexibility was observed in those with more pronated feet, highlighting the significance of foot alignment in musculoskeletal evaluation and treatment methods.
Key words: Foot posture index, Active knee extension test, Flat foot, Hamstring muscle tightness, correlation, young adults, universal goniometer, foot print test

INTRODUCTION

Three longitudinal arches are found in the foot: the transverse, lateral, and median. An osseoligamentous misalignment, a decrease in average longitudinal curvature, and an unattractive appearance are the hallmarks of planus pes, also referred to as flatfoot. Because flatfoot causes a biomechanical alteration in the body's center of gravity and kinetic chain, which increases stretching on the articular structures of the spine, hip, knee, and lower leg, people of all ages have atypical strides and postures.(1)

Many different terms have been used to characterize the flat foot. Among the most common are pes planus, calcaneo-valgus, planovalgus, and fallen arches. The human foot is made up of 26 bones, 10 major extrinsic tendons and the muscles that go with them, several intrinsic musculotendinous units, and more than 30 joints. When the medial longitudinal arch collapses, it's referred to as "flat foot." Flat feet might cause severe discomfort or no symptoms at all. (2)

The hamstrings, which are found in the rear of the thigh, are composed of the semimembranosus, semitendinosus, and biceps femoris muscles. Although each of these muscles plays a part in the lower limb's stability and mobility, their primary functions are hip extension and knee flexion. (3)

The hamstring muscle is a multiple-joint muscle that is frequently harmed by tightness. Because of their increasingly sedentary lifestyles, adults are suffering from hamstring strain. The college student spends the majority of their time sitting down. Sitting over extended periods of time can reduce soft tissue flexibility, especially in the two joints' muscles. During prolonged sitting, a constantly shortened posture causes the muscles to become stiff and produce hamstring trigger points. (4)

Many physical tests can be used to evaluate hamstring tightness, a common musculoskeletal problem. The Active Knee Extension Test (AKET), the sit and reach test, the passive unilateral SLR test, and the active unilateral Straight Leg Raise (SLR) test are often used evaluations. The AKET is one of these that is especially useful and frequently used in clinical settings to assess hamstring flexibility. (4)

Examining flat foot involves a number of examinations, each of which aids in evaluating distinct facets of foot form and function. The Foot Posture Index (FPI) uses a score system to assess total foot alignment. The Navicular Drop Test detects arch collapse by measuring the difference in navicular height between sitting and standing. The Jack Test evaluates the medial arch's flexibility by monitoring how it reacts while the big toe is passively dorsiflexed. The Heel Rise Test examines the strength and function of the posterior tibial tendon by screening for heel inversion. When combined, these tests aid in the diagnosis and categorization of flat foot disorders. (5)

SIGNIFICANCE OF STUDY:

This study is significant because it examines the relationship between hamstring tightness and flatfoot in college students between the ages of 18 and 25. Determining a possible connection can help prevent postural and functional deficits by facilitating early detection and management. Knowing these relationships helps enhance physical therapy evaluations and individualized treatment regimens because this age group is very active and susceptible to musculoskeletal stress. The results may also help develop preventative healthcare plans and raise awareness of the significance of muscular flexibility and foot posture in preserving general musculoskeletal health.

AIMS AND OBJECTIVE OF THE STUDY:

This study is to investigate the relationship between hamstring muscle stiffness and flatfoot in college students between the ages of 18 and 25. It focuses on determining the frequency of flatfoot, measuring hamstring tightness, and examining the connection between the two. Determining whether flatfoot contributes to muscle tightness will help with early detection and intervention techniques.

METHODOLOGY

Study Design: Comparative Study

Participants: According to G power analysis a Total sample size of 84 participants was required.

Inclusion criteria: Both gender • Age group of 18 to 25 years old college going students • College going student • Healthy student • Students who have flat foot • Foot print test positive

Exclusion criteria: Students who undergone any lower limb surgery • Students who have any traumatic injury • Students who have anterior and posterior pelvic tilt • Any corrective surgery of flatfoot • Students who have spinal deformities • Students have any lower limb injury

Procedure: A sample of eighty-four students was chosen from various Surat colleges. Students were chosen according to inclusion and exclusion standards. Participants were made aware of the study's methodology. Before beginning, each participant was required to sign a consent form. involvement with the research. All participants received instructions regarding the exam in conversational language since they needed to familiarize themselves with the procedure, and the study's objectives, requirements, and testing sequence were explained to them. The usual technique described below was used to acquire data on outcome factors.

First demographic data was collected. Then, Foot print test was done to assess the foot arch and detect flatfoot. Then, use the foot posture index (FPI) to determine whether flatfoot is present or not and For hamstring tightness, active knee extension test was performed. Every subject underwent the identical testing process, and reading was noted on the datasheet.

Outcome Measures:

Foot print test: The arch should be observed by the examiner. Analyzing the footprint patterns frequently reveals variations between the arches. After adding powder to the subject's foot and telling them to take a step, the footprint pattern can be seen.

Foot posture index: The examiners assessed the subject concurrently to minimize participant movement and enable the use of the FPI-6 manual. Each participant was instructed to position themselves comfortably, support their double limbs (each foot bearing the same weight), keep their arms at their sides, and look straight ahead. Because twisting might result in poor foot posture and an erroneous FPI6 score, the subject was told not to try to view the assessor.

The FPI-6 criteria were used to quantify foot position. Each of the six anatomical criteria used in this kind of examination is evaluated from 0 (neutral) to +1 or +2 (pronated) and 1 or 2 (supinated): (1) Talar head palpation, which involves feeling the talus head in the medial and lateral parts of the ankle; (2) supra and infra lateral malleolar curvature, which is seen in the area behind the ankle. 3) Calcaneal frontal plane position, which uses the calcaneal tendon's orientation on the supporting surface as a guide. (4) Bulging of the talonavicular joint (5) Height and congruence of the medial longitudinal arch (6) Adduction or abduction of the forefoot. Normal is defined as a total score of 0 to +5, pronated as +6 to +9, extremely pronated as +10 to +12, supinated as −1 to −4, and strongly supinated as −5 to −12. The final score ranges from -12 to +12, which represent highly pronated and very supinated, respectively.

Active knee extension test: The hamstring tightness was assessed using the active knee extension test.

Active knee extension was measured with a goniometer. The participants were instructed to lie on the table. The tested limb kept actively flexing until it reached 90 degrees from the table. Full extension of the contralateral leg was maintained. A typical universal goniometer was placed across the lateral femoral condyle with the foot in a neutral posture and the knee bent at a 90-degree angle. The goniometer's two arms were positioned along the leg, pointing toward the lateral malleolus and the thigh point toward the greater trochanter, respectively. The subjects were told to extend their knee until they encountered significant resistance, and then to hold that position for two to three seconds in order to assess the goniometry.

In order to quantify range of motion when resistance was felt throughout the test, the examiners used a goniometer and documented and examined the findings.

RESULTS AND STATISTICAL ANALYSIS:

	N	Minimum	Maximum	Mean	Std. Deviation
Age	84	18.00	25.00	21.2619	2.18494
height	84	4.10	15.30	5.3488	1.15909
weight	84	30.00	91.00	53.8929	12.28381
Valid N	84				

Table 1: Distribution of participants on the basis of age, height and weight

According to a descriptive study of 84 individuals, the average weight was 53.89 kg (SD = 12.28) and the average age was 21.26 years (SD = 2.18), with substantial variability. Although a maximum of 15.30 indicates a possible data input, the average

	Frequency	Percent	Valid Percent	Cumulative Percent
F	70	83.3	83.3	83.3

M	14	16.7	16.7	100.0
Total	Total 84	100.0	100.0	

Table 2: Distribution of total participants on the basis of gender

With 70 individuals (83.3%) identifying as female and 14 (16.7%) as male, the sample (N = 84) was primarily female. This indicates a distribution that is skewed by gender. There were no missing replies in the gender data, guaranteeing proper representation in the analysis.

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
18.00	13	15.5	15.5	15.5
19.00	8	9.5	9.5	25.0
20.00	15	17.9	17.9	42.9
21.00	6	7.1	7.1	50.0
22.00	14	16.7	16.7	66.7
23.00	7	8.3	8.3	75.0
24.00	20	23.8	23.8	98.8
25.00	1	1.2	1.2	100.0
Total	84	100.0	100.0	

Table 3: Distribution of total participants on the basis of age

The 84 individuals, who made up a young adult sample, ranged in age from 18 to 25. Twenty and twenty-two were the most common ages, followed by twenty-four (23.8%). There was only one 25-year-old participant. Of them, half were under 21. Every age statistic was precise and comprehensive.

		FPIrt	**AKErt**
FPIrt	Pearson Correlation	1	.231*
	Sig. (2-tailed)		.035
	N	84	84
AKErt	Pearson Correlation	.231*	1
	Sig. (2-tailed)	.035	
	N	84	84

Correlation is significant at the 0.05 level (2-tailed).

Table 4: correlation of FPI and AKE on right side

Active Knee Extension (AKErt) and Foot Posture Index (FPIrt) had a weak but significant positive connection (r =.231, p =.035), according to a Pearson correlation study of 84 participants. This implies that kinetic chain interactions may be linked to decreased hamstring flexibility in people with more pronated foot position.

		FPIlt	**AKElt**
FPIlt	Pearson Correlation	1	.250*
	Sig. (2-tailed)		.050
	N	84	84
AKElt	Pearson Correlation	.250*	1
		.050	

	Sig. (2-tailed) N	84	84

Correlation is significant at the 0.05 level (2-tailed).

Table 5: correlation of FPI and AKE on left side

Active Knee Extension (AKElt) and left Foot Posture Index (FPIlt) showed a small but statistically significant positive connection (r =.250, p =.050) according to a Pearson correlation study of 84 participants. This implies that through biomechanical interactions, a higher pronated foot position may be associated with less hamstring flexibility.

DISCUSSION

(Interpret findings, compare with existing literature, mention limitations, and discuss clinical implications.)

The purpose of this study was to investigate the relationship between young adults' hamstring muscle stiffness and flat foot posture. The main outcome measures were the Active Knee Extension (AKE) test, which measured hamstring flexibility, and the Foot Posture Index (FPI), which measured the degree of foot pronation. Data was gathered and analyzed from 84 participants in order to investigate the connection between hamstring stiffness and foot position. A positive and statistically significant association was found in the data, suggesting that people with more pronated feet (higher FPI scores) also tended to have less flexible hamstrings (higher AKE values). This points to a possible biomechanical connection by indicating that hamstring muscle stiffness increased in tandem with the degree of flat foot. These results are consistent with earlier studies that have indicated that changes in foot posture may have an impact on lower limb biomechanics.

Previous research has suggested that excessive foot pronation could result in compensatory postural adjustment and elevated tension in the hamstring muscles, specifically in the posterior chain. The current study's findings support these hypotheses and emphasize how crucial it is to take foot posture into account when diagnosing and treating hamstring pain in clinical or athletic contexts.

These findings are consistent with other research suggesting a biomechanical relationship between muscle function and foot position. Changes in lower limb mechanics, such as internal tibial rotation, pelvic tilt, and modifications in lumbar posture, which can all put more strain on the muscles of the posterior chain, especially the hamstrings. As the base of the kinetic chain, the foot can affect more proximal segments through compensatory motions and changed loading patterns, according to this study.

In the study by Purva Gulrandhe et al. (6) the Foot Posture Index (FPI) and Active Knee Extension (AKE) test were used to investigate the relationship between young adults' foot posture and hamstrings. 188 people between the ages of 18 and 25 made up the sample. FPI and AKE showed a strong positive association on both sides (right r = 0.678, left r = 0.653, p = 0.0001), suggesting that hamstring flexibility is inversely correlated with foot pronation. These results emphasize the distal and proximal segments' biomechanical relationship and provide credence to the kinetic chain theory. According to the study, treating hamstring tightness is crucial for controlling or avoiding problems with foot posture.

In compare to earlier research, the current study used the Foot Posture Index (FPI) and Active Knee Extension (AKE) test to examine the relationship between hamstring muscle tightness and foot posture in 84 people between the ages of 18 and 25. A weak but statistically significant substantial positive connection on the left (r = 0.250, p =.050) and right (r = 0.231, p =.035) sides. These results corroborate the notion of a biomechanical relationship between the proximal (hamstring) and distal (foot) components of the kinetic chain by indicating that people with more pronated feet tended to have less hamstring flexibility.

Gi-Mai Um et al. (7) used myotonometry to examine how lower limb muscle tone and stiffness were affected by flexible flat feet. Three groups of thirty individuals were created: one-sided flexible flat foot, bilateral flexible flat foot, and normal foot. foot group. The bilateral flexible flat foot group exhibited noticeably more stiffness in the rectus femoris, medial gastrocnemius, biceps femoris, and tibialis anterior when compared to the normal foot group, according to measurements of these muscles. Despite the fact that additional variations in muscle tone and stiffness were not statistically significant, the general pattern showed that those with flexible flat feet had more rigid muscles, which may indicate compensation mechanisms brought on by changes in foot biomechanics.

Using the Foot Posture Index (FPI) and Active Knee Extension (AKE) tests, the current study, in compare, examined the connection between 84 participants' hamstring flexibility and foot posture. There was a slight positive connection that was statistically significant. decreased hamstring flexibility and foot pronation (left: $r = 0.250$, $p = .050$; right: $r = 0.231$, $p = .035$). The idea of kinetic chain interaction, which holds that proximal muscle function is influenced by distal foot posture, is supported by this data. Both findings support the use of flat foot position in clinical evaluations and therapies by highlighting its biomechanical effects on the musculature of the lower limbs.

By investigating how foot posture may actively affect hamstring function during movement, the current study closes this gap and offers a therapeutically useful viewpoint for physical therapy and rehabilitation. both complementary results highlight the fact that foot position affects both intrinsic muscle tone and functional flexibility, and that both factors should be taken into account simultaneously during evaluation and treatment. In the end, this study adds to the body of evidence by showing that foot biomechanics are linked to proximal muscular function rather than being isolated. This supports the idea that patients who present with either hamstring tightness or abnormal foot posture should have a thorough lower limb evaluation.

LIMITATION:

The study's findings cannot be applied to other age groups or clinical populations due to its small sample size of 84 young adults (18–25 years old).

Due to recognized anatomical and flexibility variations, the lack of sex-specific analysis may affect the interpretation of the results, even if gender data were gathered.

Because the study did not differentiate between unilateral and bilateral flat foot disorders, it may have missed the differences in how each condition affected postural alignment and muscle stiffness.

CONCLUSION

The results of this study show a weak but statistically significant positive relationship between the flexibility of the left and right hamstring muscles and flat feet. More pronated or "flat" posture is indicated by higher Foot Posture Index (FPI) scores. Foot posture—which indicated more hamstring tightness—was linked to higher Active Knee Extension (AKE) values. The idea of a biomechanical connection between foot alignment and posterior chain muscle function is supported by these findings, which imply that those with flatter feet typically have less hamstring flexibility. Despite being minor, the observed connection suggests that foot posture may affect hamstring extensibility, maybe as a result of modified kinetic chain dynamics and lower limb mechanics. These revelations highlight the significance of taking foot shape into account when diagnosing, treating, and preventing musculoskeletal problems, especially those involving the flexibility of the hamstrings. It is advised that more study be done to examine the therapeutic implications and underlying processes of this association in various age and population groups.

FUTURE RECCOMONDATION:

To improve external validity and generalizability, future research should employ larger, more varied samples from a range of age groups, activity levels, foot kinds, and musculoskeletal disorders.

By monitoring changes over time and assessing interventions, longitudinal or interventional studies are advised to elucidate the causal link between hamstring tightness and foot position.

To lessen bias and support causal inferences, future studies should take confounding variables like BMI, limb dominance, activity level, pelvic tilt, and injury history into consideration.

In order to determine sex-specific patterns in hamstring tightness and foot biomechanics and to guide focused treatment techniques, studies should conduct gender-based subgroup analyses.

Future studies should examine unilateral and bilateral flat feet independently to see if the type of involvement has a different impact on compensatory mechanics or muscular tension.

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