INTRODUCTION

Muscle tightness is caused by a decrease in the ability of the muscle to deform resulting in a decrease in the range of motion at the joint on which it acts.\(^1\) The term has also been to denote a slight to moderate decrease in muscle length; usually the movement in the direction of the elongating muscle is limited.\(^2\)

Muscle tightness usually results from inadequate or improper rehabilitation following sustained muscle injury or low levels of physical activity in individuals. It could make the musculotendinous unit more susceptible to injury, increase resistance to various anatomical structures, which may lead to overuse syndrome.\(^3\) It could also lead to some pathological conditions at the joint on which the muscle acts, especially on a muscle like the hamstring which passes over two joints.\(^4\)

The hamstrings comprise three large muscles, namely semitendinosus, semimembranosus and biceps femoris which originate from the ischial tuberosity. They are located in the posterior compartment of the thigh and span the hip and knee joints.\(^5\)

Hence, they are extensors of the hip and flexors of the knee Rehabilitation professionals routinely assess hamstring muscle length (HML) in persons with injuries...
to the nervous or musculoskeletal system such as hamstring muscle injury spinal cord injury, low back pain, or anterior knee pain.\textsuperscript{[19]} Hamstring tightness may be measured using the active unilateral SLR test; passive unilateral SLR test; the sit and reach test, and the active knee extension test (AKET).\textsuperscript{[6]} A part from being used to measure hamstring tightness, the SLR tests are also widely used as neurological tests; hence they do not give valid measures of hamstring tightness because of pelvic rotation that occurs during the tests.\textsuperscript{[20]} The AKET measures hamstring tightness by the angle subtended by knee flexion after a maximum active active knee extension, with the hip stabilized at 90 degree.\textsuperscript{[7]}

The testrest reliability coefficient for the AKET was reported to be 0.99 for both lower limbs and this has been attributed to the strict body stabilization method, the well-defined end point of motion and accurate instrument placement of the test, previous studies have defined hamstring tightness at different arbitrarily set levels of active extension lag. Some researchers have defined it as at least 15 degree loss of active knee extension while others have defined it as equal to or greater than 30 degree loss of active knee extension with the femur held at 90 degrees of hip flexion.\textsuperscript{[8]}

There seems to be no general agreement on the level of active extension lag that should be regarded as hamstring tightness. It has also been documented that maximum popcitical angle (180 degrees) is measurable from birth to age 2 years after which it decrease steadily to an average of 155 degrees by age 6 years, and then remains steadily.\textsuperscript{[15]} Tight hamstring muscles increase the patellofemoral compressive force because of the increased passive resistance during the swing phase of ambulation and running.\textsuperscript{[9]}

Hamstring tightness has been reported to be the cause of posterior pelvic tilt in reduced lumbar lordosis and exacerbation of existing pain in patients with low back pain.\textsuperscript{[10]} It has been reported to play a role in different forms of lumbar inter – vertebral disc pathology.\textsuperscript{[11]} It’s occurrence has also been found to be signigicantly higher in Nigerian adults with low back pain than in those without low back pain.\textsuperscript{[12]}

Based upon general joint range of motion data, a physical therapist could expect HML to vary between men and women, with women having greater HML than men. Furthermore, a clinician could reason that HML would diminish with an increase in age.\textsuperscript{[16]} A review of the literature does not provide direct answers to these questions about HML, but, based on the literature, generalizations can be age is atrophy of muscle cell number.\textsuperscript{[13]}

It has also been noted that the muscle tissue may become yellow due to deposition of lipofuscin pigment and increased fat cells, or grey due to increased amounts of connective (fibrous) tissue.\textsuperscript{[14]}

The collagen tends to lose its elasticity with age, as well as does capillary blood supply, which ligaments, the collagen and water concentration may decline with age as the labile reducible collagen cross -links decrease, and non-reducible cross-links increase. So, we want to study whether these is any influence of age on hamstring tightness in healthy individuals?\textsuperscript{[17]}

\section*{MATERIALS AND METHODS}

Subject where selected on the basis of inclusion and exclusion criteria 6 groups were made each of 60 subjects. In group 1, subjects of 5-12 years of age where age taken. Group 2, include subjects of 13-19 years. Group 3, includes subjects of 20-29 years.

Group 4 include subjects of 30-39 years. Group 5, include subjects of 40-49 years. Group 6, include subjects of 50 – 59 years. Instruments used in the study were AKET apparataus, full circle goniometer, measuring tape, Velcro strap and stabilizing belt.

\section*{Procedure}

360 apparently healthy individuals were recruited on the basis of inclusion and exclusion criteria. A consent form was made and sign by each subject before any procedure for subjects. Below 18 years of age consent was taken from their parents.

The aim and procedure of the study was explained to the subject and were allowed to withdraw from the study at any point of time. The age of the subjects was recorded as at last birthday to allow for consistency and Height, weight and limb length was recorded for each subject.

\section*{Protocol}

The individuals who participated in study were assessed for inclusion and exclusion criteria. Subjects who were included in the respective groups were measured for age, height, and weight. For measuring limb length the subject was asked to lie down and then pelvis was squared. Squaring of pelvis was done by measuring both side ASIS. After squaring of the pelvis, Measurement was done by measuring Length from Anterior Superior Iliac Spine to medial Malleolus of same side.

Limb lengths of both limbs were measured. Individuals were assessed for hamstring tightness with AKET apparataus.\textsuperscript{[22]} The apparatus was made by placing two vertical and one horizontal bars being attached with the couch where patient will be assessed. The subjects were made to lie supine on the examination couch. A pliable
Goniometer was strapped to the knee by Velcro fasteners. The fulcrum of goniometer was placed over the lateral epicondyle of femur proximal arm was aligned with the lateral midline of the femur taking greater trochanter as the reference point.

The distal arm was aligned with the head of the fibula and lateral malleolus. Subjects were asked to bend the leg to be tested and the height of the crossbar was adjusted such that it was contact with the distal anterior aspect of the thigh. The range of hip flexion was measured using another goniometer to ensure that it was 90 degrees.[22]

The 90 degrees crossbar horizontal prevent further flexion at hip. The subject actively held this position with the knee in flexion at the ankle in plantar flexion and was asked to extend a knee.[23] At the first point where myoclonus was noticed the subjects were asked to stop further extension.

The angle of knee flexion was observed on the goniometer that was attached to the knee.[24] The extended leg was calculated by subtracting knee flexion angle from 180 degree and was recorded as hamstring tightness. The same procedure was done for measuring the hamstring tightness of opposite extremity also.

**STATISTICAL ANALYSIS**

The desctiptive analysis was used for demographic variables like Age, Weight, Height and BMI, ANOVA was used to compare left and right Hamstring Tightness between Group 1, 2, 3, 4, 5 and 6.

Independent t-test was used to compare left and right hamstring tightness between males and females. Paired t test was used to find our difference between left and right hamstring tightness in all 6 groups. (P value <0.05 was considered significant).

**RESULTS**

Between group comparison of right hamstring tightness. The mean right hamstring tightness and standard deviation for Group 1 was 40.69±2064 degrees, Group 2 was 36.91±4.89 degrees, Group 3 was 42.59+3087 degrees, Group 4 was 43.64+2.64 degrees, Group 5 was 44.71+4.30 degrees, Group 6 was 53.11+2.88 degrees. The result showed significant difference between the group (f=117.69, p=.0001).

Post hoc (Bonferroni) pairwise comparison showed significant differences between Group 1 and Group 2 (p=.0001), Group 1 and Group 4 (p=.0001), Group 1 and Group 5 (p.0001) and Group 1 and Group 6 (p=.0001), Group 2 and Group 3, Group 2 and Group 4, Group 2 and Group 5, Group 2 and Group 6, Group 3 and Group 5, Group 3 and Group 6, Group 4 and Group 2 and Group 5, and Group 6. There was significant difference between Group 1 and Group 3 (p=.113).
DISCUSSION
The result showed that hamstring tightness was present in all age groups studied and that it tended to increase with age. However, there was no significant difference in hamstring tightness in subjects in age groups 5-12, 20-29, 30-39, 40-49. In age groups 40-49 and 50-59 years, hamstring tightness was higher than that for any of the younger age groups.

It was significantly higher in age groups 50-59 years when compared with age group 40-49 years. These findings suggest that in this environment, hamstring tightness occurs in early childhood and it tends to increase with age.

Except in group 13-19 the reason for that could be highest involvement of sports activity in this group which may be the important factor for such variation in the results. However, it does not significantly increase until the 30-49 years age range, after which it seems to fall. This corroborates the observations that hamstring tightness in juveniles is less than that in adults.

The progressive decline in flexibility with age has been attributed to changes in elasticity and decreased level of physical activity. Results also showed that males recorded higher values of hamstring tightness compared to their female counterparts across the age groups. This supports the finding that females of most ages have greater trunk/hip flexibility than males.

Right side hamstring tightness is significantly higher than that of the left side hamstring tightness this result is correlated with the previous research which stated that the tightness in the dominant limb us always higher than the non-dominant limb.

We were able to support our hypothesis that there is a statistically significant effect of gender on hamstrings Muscle length (HML), with women having more HML than their male counterparts for both dependent measures examined in previous study Men have approximately 8 degree less passive straight Leg Raise (PSLR) than women, and 11 degree less PA than them. Gajdosik et al reported that PSLR is the clinical test most often used to assess HML.

According to Kendall et al the resulting angle between the longitudinal axes of the trunk and thigh should be about 80 degree for HML to be considered normal. However, Kendall et al appear to have based this HML estimate on clinical observations rather than original data gathered from a cohort of healthy persons. Additionally, Kendall et al assume that the 80 degree value should be identical for both men and women.

It has been purported that the decrease in joint range of motion and muscle flexibility with aging may mechanical characteristics of collagen at the cellular level. Moreover, the loss of joint range of motion of muscle flexibility is likely multifactorial and also influenced by a generalized decline in activity level suspensions age.

Limitation of Study
- Effect of hamstring length on hamstrings tightness is not considered.
- Level of physical activity was not taken in to account.

Scope for Further Study
Association of hamstring muscle length and limb length with hamstring tightness can be found.

CONCLUSION
The findings of this study suggest that hamstring tightness is present in early childhood and increases with age in apparently healthy subjects.

CONFLICT OF INTEREST:
The authors declared no conflict of interest.

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Ethical Clearance: It has obtained from Institute review board

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