

Original Research Article

## Prevalence of Piriformis Tightness in Healthy Sedentary Individuals: A Cross-Sectional Study

Malika Mondal<sup>1</sup>, Bibhuti Sarkar<sup>2</sup>, Sarfaraz Alam<sup>3</sup>, Shriya Das<sup>1</sup>, Komal Malik<sup>3</sup>, Pravin Kumar<sup>4</sup>, Pallavi Sahay<sup>5</sup>

<sup>1</sup>Professional Trainee, <sup>2</sup>Demonstrator (PT), <sup>3</sup>Senior Professional Trainee, <sup>4</sup>Assistant Professor (PT),  
<sup>5</sup>Physiotherapist,

Department of Physiotherapy, National Institute for Locomotor Disabilities (Divyngajan), B.T. Road, Bonhoogly, Kolkata-700090, West Bengal, India.

Corresponding Author: Malika Mondal

### ABSTRACT

**Background:** Pain in the lower back region is a common concern, affecting up to 90% of population at some point in their lifetime, up to 50% have more than one episode. Prolonged sitting position is the foremost cause of piriformis tightness in sedentary population that may eventually leads to piriformis syndrome and low back pain. Therefore, the present study was designed to identify the prevalence of piriformis tightness in sedentary individuals.

**Methods:** 200 subjects enrolled in this study were evaluated and screened on the basis of the inclusion and exclusion criteria. Tightness of piriformis muscle was assessed using piriformis stretch test and seated piriformis stretch clinical test.

**Results:** Data was analyzed using SPSS version 23. Piriformis tightness was found to be present in 159 subjects (79.5%). Prevalence of piriformis tightness was highest in third decade. However the prevalence of piriformis tightness in males and females was statistically insignificant.

**Conclusion:** In sedentary population the prevalence of piriformis tightness is very high and adult population has more chances to get affected with piriformis muscle tightness that can lead to development of piriformis syndrome and later on low back pain.

**Key Words:** Piriformis muscle tightness, piriformis syndrome, sedentary individuals, piriformis stretch test.

### INTRODUCTION

Low back pain (LBP) is the most disabling condition worldwide and one of the most common causes of LBP is piriformis syndrome that results from tightness of piriformis muscle. Reported incidence rates for piriformis syndrome among patients with low back pain vary widely from 5% to 36%.<sup>[1]</sup> Piriformis muscle originates from pelvic surface of the sacrum between (and lateral to) the first through fourth pelvic sacral foramina, margin of the greater sciatic foramen and pelvic surface of the sacrotuberous ligament and inserted to the superior border of the greater trochanter of the femur via a round tendon that, in many individuals, is merged

with the tendons of the obturator internus and gemelli muscles & it is supplied by sciatic nerve.<sup>[2]</sup> The piriformis muscle acts as an external rotator, weak abductor and weak flexor of the hip, providing postural stability during ambulation and standing.<sup>[1]</sup> Piriformis muscle acts as an external rotator when angle of hip flexion is 60° or less and the function changes when angle of hip flexion is greater than 60°, so that it becomes an internal rotator of the hip.<sup>[3]</sup> From this it could be stated that piriformis remains active during any type of sitting position whether high sitting or cross sitting although its function changes in different styles of sitting. Previous literature showed that sitting in a chair for eight hours or more

may develop tightness of back muscle and create strain on joints which remains so long in a constant position, especially when the muscles are under constant low-grade contraction in order to hold and maintain the sitting position. [4] The sedentary individuals frequently complain of low back pain caused by muscular imbalance and if it is left unchecked, this imbalance may create a chronic pain condition in the lower back. Sedentary healthy individual are those who perform sedentary job. Jobs are sedentary if walking and standing are required occasionally and other sedentary criteria like any walking behavior characterized by an energy expenditure of 1.5 METs or less while in a sitting or reclining posture are met. [5] "Occasionally" means occurring from very little up to one- third of the time, and would generally total no more than about 2 hours of an 8-hour workday. [5] Occupation which demands prolonged sitting in a chair include computer professionals, call center workers, piano players / music instrument players, office based work, motor vehicle drivers etc. are more prone to develop piriformis tightness. [6] Piriformis muscle has a predominance of type-I fibers which has a tendency to develop shortness or tightness when the muscle is abnormally stressed. When the piriformis is shortened its diameter increases and because of its location it creates pressure to the sciatic nerve which passes under it in 80% of population. [3] The perpetual loading of the piriformis muscle through over lengthening and eccentric demand during functional activities secondary to weak agonist muscles may result in sciatic nerve compression or irritation. For example, if the hip excessively adducts and internally rotates during weight-bearing tasks due to weakness of the gluteus maximus and/or gluteus medius, a greater eccentric load may be shifted to the piriformis muscle. [7] The piriformis muscle is under strain during the entire gait cycle and it is postulated that it may be more prone to hypertrophy than other muscles in the region. Gait

abnormalities may accentuate this, especially if the result is increased internal rotation or adduction such as with a leg length discrepancy. [8] When the piriformis becomes tight it can put pressure on the sciatic nerve causing irritation and sending pain down the back of the leg (sciatica). [9] Peripheral neuritis of the sciatic nerve caused by pressure of an injured or irritated piriformis muscle or an abnormal condition of the piriformis muscle lead to piriformis syndrome. In most cases of piriformis syndrome due to contracted piriformis muscle, the sacrum anteriorly rotated toward the ipsilateral side on a contralateral oblique axis, resulting in compensatory rotation of the lower lumbar vertebrae in the opposite direction, this facilitation and compensatory somatic dysfunctions may lead to low back pain, thoracic and cervical pain. [1]

Delayed diagnosis of piriformis syndrome may lead to pathologic conditions of the sciatic nerve, chronic somatic dysfunction and compensatory changes and it may cause pain, paresthesia, hyperesthesia and muscle weakness. In extreme cases, misdiagnosis of piriformis syndrome-related back pain with "sciatica" as prolapsed intervertebral disc may lead to unnecessary surgery. [10,11] The prevalence of piriformis tightness in sedentary normal individuals is scarce in the literatures. Therefore, the present study was designed to identify prevalence of piriformis tightness in sedentary individuals so that appropriate preventive and corrective measures can be taken in time which may reduce the rate of development of Low back pain because of piriformis tightness.

## **MATERIALS AND METHODS**

**Subjects:** This prospective cross sectional study evaluated the prevalence of piriformis tightness in healthy sedentary individuals. The subjects included were the students, staff and caregiver of patients coming to NILD, (Divyangjan) OPD, and nearby locality of NILD, Kolkata, India from April, 2016 to December, 2016. Scientific and Ethical approval was taken from Institute

Ethical Committee (IEC) before commencement of the study. The subjects included were the healthy males and females from 18yrs to 60yrs of age with Physical Component Summary (PCS) and Mental Component Summary (MCS) score of SF36 scale above 50 by using convenient sample design.

The subjects were excluded if they had history of back surgery or lower limb surgery, trauma to back or lower extremity, low back pain within the last six months, diagnosed cases of rheumatoid arthritis or osteoarthritis of the spine or hips, spinal deformity, tightness of tensor fascia latae and neurological disease, any history of cardiovascular diseases such as hypertension, stroke or other cardiac disorders, females with pregnancy and uncooperative subjects. Total 230 healthy individuals were approached with the proposal of study, 16 individuals refused to participate. The individuals agreed to participate and signed the consent form were 214. 14 subjects were excluded, amongst them 03 were having spinal deformity, 11 had gone through a period of low back pain in last 6 months. Finally data was collected from 200 healthy individuals.

**Procedures:** Aim and procedure of the study were explained to all subjects in their preferred language before data collection. Informed consent form (which also includes permission to use their data and photograph for presentation and publication purpose) written in their preferred language (English/Hindi/ Bengali) was taken from all the subjects who agreed to participate.

Demographic data including age, sex and occupation was collected. Short Form-36 scale (SF-36) (English/Bengali Version) was filled by therapist (M.M) by asking the questions from subjects. Prior to the test, all the subjects underwent warm up with 10 minutes comfortable walk at self-determined pace around the research venue under therapist supervision (M.M).

Piriformis tightness was checked through piriformis stretch & seated piriformis stretch test. Piriformis Stretch

Test [3] was done with the subjects positioned in supine, the tested leg was placed in flexion at the hip & knee so that the foot rests on the table lateral to the contralateral knee (the tested leg was crossed over the straight non-tested leg, as shown in figure 2) The angle of hip flexion was maintained at 60°. It was ensured by measuring universal goniometer (Fig-4.2). Therapist was standing beside the plinth at the tested side to stabilize the non-tested side ASIS by one hand and to prevent pelvic motion during the test. The knee of the tested side was pushed into adduction, to place a stretch on the piriformis muscle. If the adduction ROM was limited & the patient reported discomfort posterior to the tested greater trochanter tested side piriformis was considered tight (positive).

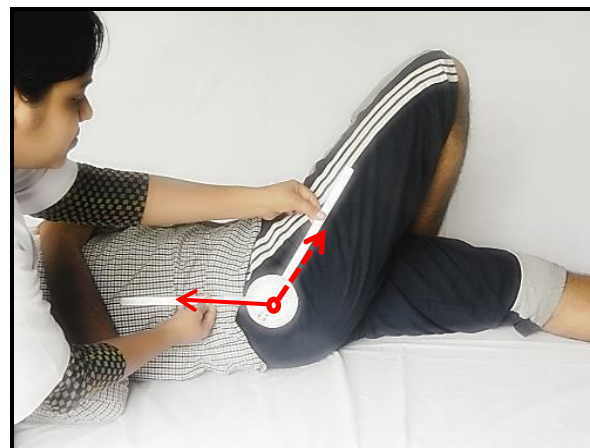


Figure 2: Hip flexion ensured by universal goniometer

Seated Piriformis Stretch Test [12] was done with the subject in high seating position over the edge of treatment couch, the tested leg placed into flexion at the hip approximately 90° & knee extended (as shown in figure 3). Therapist was sitting in front and beside the plinth at the tested side. The weight of the trunk provides some stabilization. The subject grasped the edge of the plinth to stabilize the pelvis. By palpating the sciatic notch, therapist adducted and internally rotated the tested limb, to place a stretch on piriformis and created dural tension of the sciatic nerve. Test was considered positive if recurrence of the subject's (familiar complaints) of

gluteal pain and / or paraesthesia, radiating

into posterior aspect of the lower extremity.



Figure 2a: Starting Position of piriformis stretch test



Figure 2b: End Position of piriformis stretch test



Figure 3: Starting Position of seated piriformis stretch test

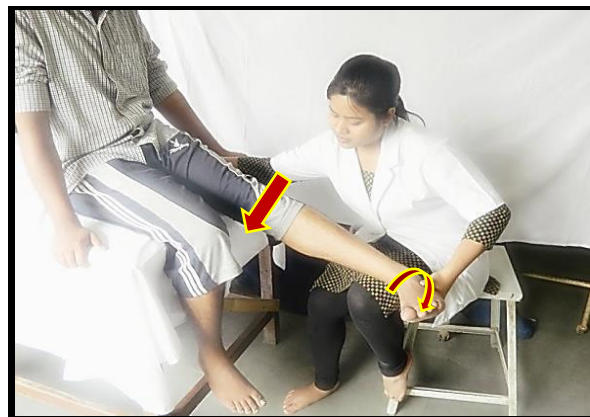


Figure 3a: End Position of seated piriformis stretch test

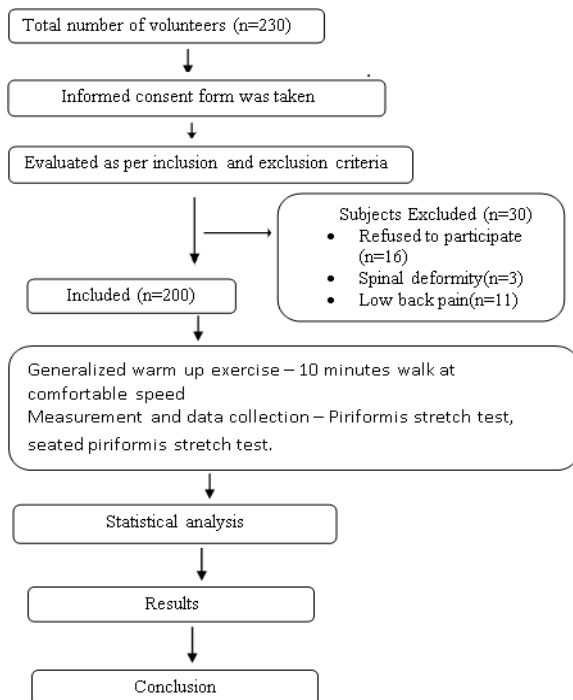


Figure1: Flow chart

### Statistical Analysis

Data were analyzed using SPSS version 23 software. Descriptive statistics

was used to determine the frequency of piriformis tightness in male and female subjects and among all ages. Two sample proportion z-tests were used to test the significance of piriformis muscle tightness with respect to clinical test in male and female population. The tests were applied at 95% confidence interval and level of test was set at 0.05.

### RESULTS

Prevalence of piriformis muscle tightness was checked among 200 healthy sedentary subjects with an age range of 18-60 years (mean age of  $32.3 \pm 11.4$ ), out of which 105 were males & 95 were females. Out of 200 subjects, 159 subjects were clinically diagnosed with piriformis tightness & 41 subjects had no tightness. This overall prevalence of the piriformis tightness was found to be statistically significant (at 5% level of significance) which is shown in table 1.

**Table 1: Comparison between with and without piriformis muscle tightness**

Total number of subjects (n=200)					
With piriformis muscle tightness (n=159)			Without piriformis muscle tightness (n=41)		
Percentage	z-value	p-value	Percentage	z-value	p-value
79.5	1.96	0.05	20.5	1.96	0.05

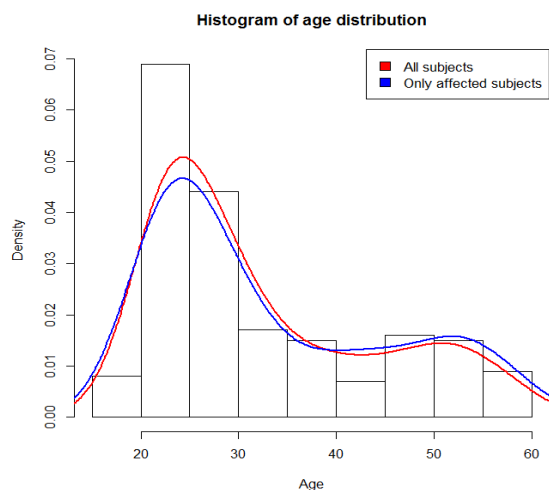
The prevalence of piriformis muscle tightness in male and female was statistically insignificant [ $|Z| < 1.96$  and at 5% level p-value  $> 0.05$ . ( $\tau_{0.025} = 1.96$ )].

Therefore males were affected as much as the females. This prevalence of piriformis muscle tightness between genders was shown in table 2.

**Table 2: Difference of piriformis tightness prevalence between genders**

Total no of subjects included (n=200)		Total no of subjects affected (n=159)	
no of male affected (n=80)	no of female affected (n=73)	no of male affected(n=80)	no of female affected(n=73)
Percentage of involvement		Percentage of involvement	
40%	36.5%	54.1%	45.9%

The prevalence of piriformis muscle tightness among different ages is shown through the histogram (H1). Red and blue curve indicates the fitted density line of total subjects included in that class and total subject affected with piriformis tightness in that class respectively. From descriptive statistics of histogram (H1) class 20-25 years was found to be modal class as most of the subjects included in the sample dataset belong to this class and most of the subjects affected from piriformis muscle tightness also belongs from this class i.e. 20-25 years.



**Graph 1: H3 - Difference between the age distribution of subjects affected with piriformis muscle tightness and overall age distribution**

## DISCUSSION

Sedentary population frequently complain of low back pain caused by

muscular imbalance because they usually involved with prolonged sitting job with certain amount of walking and standing occasionally to carry out job duties which require energy expenditure of 1.5 METs or less. [5] Sitting in a chair for eight hours or more may develop tightness of back and hip muscles such as hamstrings, iliopsoas, piriformis etc and create strain on joints which remains in a constant position for long time, especially when the muscles are under constant low-grade contraction in order to hold and maintain the sitting position. [4] When the piriformis becomes tight it can put pressure on the sciatic nerve causing irritation and pain down the back of the leg (sciatica). [9] Peripheral neuritis of the sciatic nerve caused by pressure of an injured or irritated piriformis muscle or an abnormal condition of the piriformis muscle lead to piriformis syndrome. [13,14]

In most cases of piriformis syndrome due to contracted piriformis muscle, the sacrum anteriorly rotated toward the ipsilateral side on a contralateral oblique axis, resulting in compensatory rotation of the lower lumbar vertebrae in the opposite direction, this facilitation and compensatory somatic dysfunctions may lead to low back pain, thoracic and cervical pain. [10] Janda suggested that spasm of the piriformis pulls on the sacrotuberous ligament, causing SI joint pain. [15] Previous studies have stated that the prevalence of piriformis syndrome among the cases of low back/buttock pain

with sciatica but there is lack literatures that can state the prevalence of piriformis tightness in healthy sedentary population. So the present study was designed and conducted with a goal to find out the prevalence of piriformis tightness in healthy sedentary individuals.

In this study, total 200 sedentary healthy individuals subjects were included, among them 159 subjects were identified as having piriformis muscles tightness, the prevalence of piriformis tightness thus was 79.5%. It was difficult to find any previous study which was directly showing the prevalence of piriformis muscle tightness but one study by Singh US et al (2013) could be cited in previous literature which showed the prevalence of piriformis syndrome as 6.25% in low back pain patients which is mainly caused by the piriformis tightness as mentioned above. [8]

The piriformis muscle is considered as a postural muscle and the postural muscles has the tendency to become overactive, hypertonic, weak and shortened in length. The piriformis muscle gets overactive and hypertonic during prolonged sitting and walking. When there is a weakness of the primary muscle which is responsible for specific joint movement causes the synergistic muscle to overcome and behave as a primary muscle. Primary work of piriformis is external rotation of the hip and it work as a synergistic muscle to gluteus muscle during hip abduction. [16]

Currently, people spend more time sitting than standing due to the development of science and technology and automation. Dependence on automobiles, even for traveling short distances and long periods spent working on computers; contribute to today's sedentary lifestyles. According to Nicholson S the gluteus muscles are the most neglected group of muscle in whole body as individuals spend their most of the time in sitting and walking very little on the track. So, this may leads to the weakness of gluteal muscle group and synergistic activation of piriformis muscle. This over activation may cause the hypertonicity as

well as the tightness of piriformis muscle. Another reason for the over activation of piriformis muscle during a maintained posture is the small size of its muscle fibers. According to Hennemans size principle, the smaller the fiber the easier it activates, the larger the fiber the faster it conducts. [17] That's why postural muscles have abundant red fibers. The neurons are smaller and easier to activate, constantly sending impulses with correction messages to the postural muscles to maintain body position. Prolonged activation of muscle may lead to localized muscle tension, muscle strains, muscle fatigue, and other soft-tissue damage. These reasons clearly explain the high prevalence of piriformis muscle tightness in sedentary population.

The subjects who participated in this study were healthy adults from 18 to 60 years of age. Most of subjects (n=86) affected with piriformis tightness were found in third decade. In this group subject included were college student and spend most of the time in sitting position. Others profession in third decade which may lead to piriformis tightness include computer professional, teachers, businessman, bus driver, housewife, police etc. all were spending sedentary lifestyle in their job area as well as at home. Now a days, individuals spend their leisure time in recreational activities that also include sitting posture such as watching T.V, playing video game and indoor games such as playing cards, carom, chess etc.

In this study, the number of male subject (n=105) was slightly more than the females (n=95) with male to female ratio as 21:19. Out of total affected subjects (n=159), 86 subjects were male and 73 subjects were female who were presented with piriformis tightness which was clinically diagnosed by piriformis stretch test & seated piriformis stretch test. There was no statistically significant difference of piriformis tightness found between male and female. But the reasons of piriformis tightness in both the genders are different. Males have the tendency to sit in a more

open leg position, so their piriformis or outer thigh muscle serve as external hip rotator and get tighten.<sup>[18]</sup> Apart from this, it is opposite in case of females, they use to sit with leg crossed.<sup>[18,19]</sup> Previous studies have indicated that people prefer sitting with the legs crossed because it change the weight or load on soft tissues and muscles; and provides stability to the lower extremities or because of social situations or for aesthetic reasons.<sup>[18,19]</sup> If an individual habitually adopts such postures, part of the body will deviate from proper alignment and deformation will be aggravated, to compensate for the unstable state causing problems in the musculoskeletal system. Park Y et al 2014 concluded the subjects with the habit of sitting with their legs crossed for at least three hours per day had statistically significant differences in the heights of the acromion processes and the ASISs between the two sides.<sup>[18]</sup> If an individual works for an extended period of time in a sitting position, maintaining a proper posture may become difficult and muscle fatigue increases. So, the reason of piriformis tightness in females during cross sitting could be –

a) Inhibition and weakness of gluteal group of muscle over a time can further leads to over activation of piriformis muscle. Dieterich et al (2015) reported that maximal-effort internal rotation torque in healthy persons increased by about 50% with the hip flexed as a compared to extend. This increased internal rotation torque with flexion may be due to the increased leverage of some of the internal rotator muscles such as the anterior fibers of the gluteus medius, as depicted in , but also to a reversal of rotary action of some of the traditional external rotators, such as the piriformis, or posterior fibers of the gluteus medius.<sup>[20]</sup>

b) In crossed leg position piriformis muscle was is excessive lengthening position as the hip is flexed and externally rotated position. Because the piriformis is actually an internal rotator in a position of marked hip flexion, incorporating external rotation into the stretch appears to be a rational approach.

Snijders et al (2006) in their study have shown that cross-legged sitting, which combines flexion and external rotation of the hip, increases the length of the piriformis by 21% as compared to its length in upright standing.<sup>[21]</sup> This may leads to cumulative injury and tissue trauma which results in development of piriformis spasm. After a prolonged time, this spasm leads to muscle imbalance and tightness of piriformis muscle in females.

**Limitations of the study:** Strength of gluteus medius was not measured which may leads to piriformis tightness. Sample size was small and data was collected from a single center.

**Suggestions:** Further studies are recommended with large sample size and data collected from multiple centers. Risk factors that lead to development of piriformis muscle tightness need to be studied.

## CONCLUSION

Prevalence of piriformis muscle tightness in sedentary individuals was found to be 79.5% in this study which concludes that person who have long hour of sitting and certain period of standing and walking are affected mostly with piriformis tightness. Young adults mostly in third decade were found to be most affected with piriformis muscle tightness than any other age group. So, the preventive measures such as proper sitting posture, strengthening of abductor muscles and change in walking habits etc. could be explained to sedentary population to prevent piriformis tightness which further prevent the piriformis syndrome and the episodes of low back pain.

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## Contributions of authors:

MM: Evaluation of subjects and data collection.

KM: Evaluation of subjects and supervision of warm-up exercise.

SA: Statistical analysis

BS: Designing the methodology section and Manuscript preparation

P.K: Recruitment of subjects and suggestions in Manuscript preparation

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