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Flexibility in muscles around the hip among middle aged Indian men engaging in prolonged desk jobs: A cross-sectional study

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Abstract
Sedentary lifestyle can lead to various problems like tightness of muscle, decreased joint range of motion and decreased flexibility upsetting daily activities of an individual. People whose job includes prolonged sitting throughout the day like computer professionals or desk workers are more prone to have adaptive changes that can shorten the hip muscles. Complaints of various work-related musculoskeletal discomforts are common among desk workers. The objective of this study was to screen the middle aged male desk job workers for muscle length and flexibility around the hip joint. Methodology: 120 IT professionals were selected as per the inclusion and exclusion criteria. The procedure was explained and written informed consent was obtained. Using standard tests for measuring muscle length, three hip muscles: Hamstrings, Iliopsoas and Piriformis were measured for length and flexibility. Result and Conclusion: Out of 120 subjects, 96.7% of them were found out to have tight Hamstrings whereas 83.8% showed tight Iliopsoas and 38% had piriformis tightness. In this study we concluded that a majority of desk job professionals have likelihood to developing tightness in the muscles around the hip joint owing to their sedentary work nature and age related factors making them prone to low back pain or other symptoms associated with back or hip in some point of time in their life.

Keywords: Middle aged men, sedentary job, hip muscle tightness, IT professional, long hours of sitting, back pain, active knee extension test (AKE), modified thomas test (MTT), piriformis test (PT)

Introduction
The modern Indian Information technology (IT) and IT enabled industries are employing over 2 million people and this number is on a rise every single day. The sedentary work nature has been the root cause for a variety of musculoskeletal disorders and discomforts which are broadly classified under the umbrella of Work Related Musculoskeletal disorders (WRMSD).
WRMSDs are disorders of the muscles, skeleton and related tissues which have been empirically shown or are suspected to have been caused by a work place activity (particularly a repetitive activity). The common musculoskeletal symptoms reported are pain (55%) stiffness (14.8%) and the common sites affected are neck (44%), low back (30.5%), wrist/hand (19%) and shoulder (12.5%) [1].
Low back pain (LBP) is a multifactorial dysfunction with one of the potential contributing factors being the hip joint. Hip function has been proposed to be related to low back pain (LBP) because of the anatomical proximity of the hip and lumbo-pelvic region. Hip range of motion has been studied in people with LBP because a limitation in hip motion could alter the mechanical forces on the lumbo-pelvic region and, as a result, contribute to LBP [2]. Further one high-quality cohort study by Mei Fang-Lui *et al* reported a positive association between LBP and sitting at work and having a sedentary work nature [3].
A sedentary lifestyle is a major risk factor across a spectrum of preventable diseases that lower the quality of life. Sedentary lifestyle can lead to various problems like tightness of muscle, decreased joint range of motion and decreased flexibility hampering daily activities of an individual [4]. The person who is sitting all day such as a desk worker or student has adaptive changes taking place that can shorten the hip muscles. Prolonged sitting causes alteration in pelvic position into a posterior tilt and my lead to shortening of hamstring length.

Sitting for an extended period of time drives prolonged load on the muscle and increases the risk of injury. It is evident from previous studies that that sedentary nature of work in desktop workers makes them prone to acquire adaptive shortening/ tightness and these changes predominantly occur to a greater degree in muscles around hip joint and therefore be associated with low back pain [5, 6].

Hip joint consists of various muscles, among which the Hamstrings, Iliopsoas and the Piriformis are the main muscles which can go for limited flexibility after a prolonged period of sitting especially in the desk job people. Hamstrings are the muscles of back of the thigh and act as flexors of the knee and the extensors of the hip joint, Iliopsoas are the hip flexors and Piriformis is the external rotator, abductor and extensor of the hip [7]. Adequate flexibility is an important characteristic of physical and health related fitness [8, 9]. Lack of flexibility is associated with problems in executing and sustaining various activities in daily life. For example, muscular low back pain may be caused by poor low back/muscle around the hip which can affect daily activities [10].

Flexibility is described as the ability to move a joint through its complete range of motion [11]. Flexibility is the extensibility of muscle as well as the non-contractile tissues like joint capsule, ligaments and tendons [12]. Importance of flexibility as a component of health-related fitness is related to prevention of orthopedic impairments later in life, especially lower back pain. Flexible muscles permit proper pelvic rotation, decrease disc compression, and avoid excessive stretch of musculatures [13, 14]. Muscle flexibility may gradually alter with progressing age and the impact of prolonged sitting may further worsen these parameters.

Among the screening methods for the flexibility of muscular around the hip joint the most common maneuvers used which are also easily and quickly administered are Active Knee Extension Test (AKE), Modified Thomas Test (MTT) and Piriformis Test (PT). Inability to achieve greater than 160° of knee extension with hip at 90° of flexion is considered as hamstring tightness [15]. The available range of motion is measured by the use of goniometer, an inclinometer, or tape measure [11, 13]. Tightness of the hamstring muscles has traditionally been measured using various forms of test among which Active Knee Extension (AKE) test is used more frequently for checking the hamstring flexibility which has a high intra-tester reliability [16]. For checking the Iliopsoas muscle tightness, Modified Thomas test is mainly used [17]. and Piriformis test is used to check the tightness present in the piriformis muscle [18].

Thus, taking the above said factors into consideration it is apparent that reduced muscle flexibility may serve as a predictor of discomfort and screening an individual who has a sitting/ sedentary job may help to prevent the impending musculo-skeletal disorders which are a common occurrence in such job nature. Hip muscle screening as indicated in prior literature provides an insight into the probability of an individual going in for low back discomfort. There is a clear indication that occupational factors influence back disability, and to expand clinician practices in this area it will be required that patient screening methods are incorporated for conceptual clarity, feasibility, and linkages to viable options for intervention. Over the last decade India has seen a surge in skilled workforce which is desk bound and the rise is only imminent in the forthcoming years. Proactive screening techniques even though are known valuable they are less employed in Indian context. Hence this study was conducted with an objective to evaluate the flexibility of muscles around hip joint especially in middle aged men employed in prolonged sitting due to desk jobs.

Materials and Methods

The study was conducted in IT companies in and around South Bangalore which were selected randomly for the study. Study was done on 120 IT professionals who were included by method of convenient sampling. Permission from the authorities to carry out the study was obtained. Middle aged male workers from the age group of 35 to 55 years were selected as per the inclusion and exclusion criteria. The test procedure was explained and an informed consent was obtained from each subject before carrying out the examination. Material and equipments required for the procedure was arranged prior to the test. Demographic data of the subjects were collected and recorded. Before conducting the tests for muscle tightness, the subject was screened for any self-reported discomfort by using VAS scale, its duration, and any known clinically diagnosed conditions in the lower back or the lower extremities. The subjects were next evaluated for the muscle tightness in three muscle groups around the hip joint namely Hamstrings, Iliopsoas and Piriformis using standardized testing procedures using the Universal goniometer (180°).

Inclusion criteria

Male gender, Apparently healthy Indian men in the age group of 35-55 years, Worked in a siting job/desk job for at least 7 consecutive years, Working with a desk job for a minimum of 5 hours /day.

Exclusion Criteria

History of any recent surgeries in low back and lower limbs in past 6 months, History of any recent musculoskeletal injuries like fractures, dislocations, joint instability or any soft tissue injuries in past 6 months, Any congenital deformity of lower limb.

Procedure 1: Active Knee Extension Test (Hamstring Muscle)

The subject taken on an examination table in supine lying position. The subject bends one hip and knee at right angles so thigh is vertical and lower leg is horizontal on the examination table. The foot of the leg being tested was kept relaxed, and the leg was actively straightened until the point when the thigh began to move from the vertical position. The thigh angle at this point was recorded. Then the minimum angle of knee flexion with the thigh
in the vertical position was measured. The measurement unit was in degrees. If the leg was able to be fully straightened, the angle would be recorded as 0.Any degree of flexion was recorded as a positive number, e.g. 10, 20 degrees etc.

2. Modified Thomas Test (ILIOPSOAS MUSCLE)

The subject was made to sit at the very edge of the examination table, and roll back onto the bench while pulling both knees to the chest. This was to ensure that the lumbar spine is flat on the bench and the pelvis is posteriorly rotated. The subject then held the opposite hip in maximum flexion with the arms, while the limb to be tested was lowered towards the floor. For each side, angles were measured using a goniometer. The angle measured is the angle of hip flexion (reflecting the length of the Iliopsoas). The stationary arm of the goniometer was aligned with the lateral midline of the pelvis. The moving arm was aligned with the midline of the femur using the lateral epicondyle as a reference point and the angle is recorded. The procedure was repeated on the opposite side.

3. Piriformis Test (PIRIFORMIS MUSCLE)

The patient in side lying position with test leg maintained uppermost. The patient then flexed the test hip to 60^0 with the knee flexed. The examiner stabilized the hip with one hand and applied a downward pressure to the knee. If the piriformis muscle was tight, pain is elicited in the muscle. After performing the above mentioned tests, the data that is collected was statistically analyzed.

Result

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. The following assumptions on data are made: 1. Dependent variables should be normally distributed, 2. Samples drawn from the population should be random, Cases of the samples should be independent.

Student-t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters.

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis.

Data collected for the study were analyzed using appropriate statistical test and results are given in terms of test materials, tables and figures in following pages.

Table 1: Age distribution of subjects studied

Age in years	No. of subjects	%
36-40	31	25.8
41-46	89	74.2
Total	120	100.0

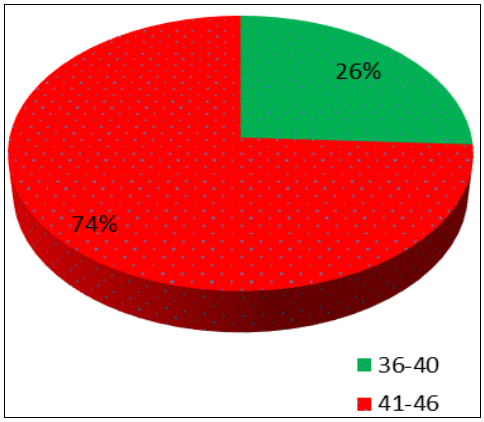


Fig 1: Age in years

The above table and graph shows that out of 120 subjects, 74% were between the age group 41 to 46 years and 26% were between the age group 36 to 40.

Table 2: Years of work distribution of subjects

Years of work	No. of subjects	%
11-16	62	51.7
17-20	56	46.7
>20	2	1.7
Total	120	100.0

Fig 2: Years of work distribution of subjects

The above table and graph show that 51.7% of subjects have 11-16 years of work experience, 46.7% of subjects have 17-20 years of work experience, and 1.7% of subjects have more than 20 years of work experience.

Table 3: Average hours per day distribution of subjects

Average hours day	No. of subjects	%
7	29	24.2
8	60	50.0
9	29	24.2
10	2	1.7
Total	120	100.0

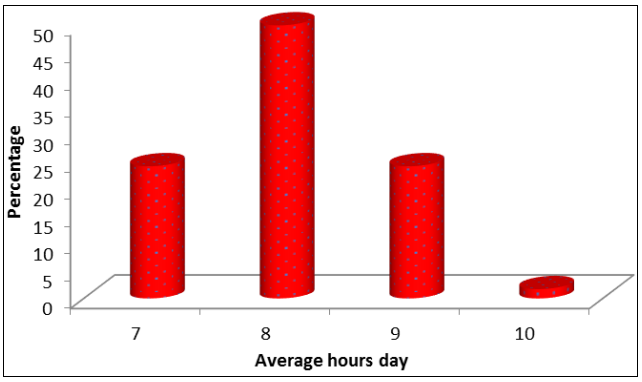


Fig 3: Average hours per day distribution of subjects

The above table and graph shows that 24.2% of the subjects are working for average of 7 hours per day, 50% of subjects are working for average of 8 hours per day, 24.2% of subjects are working for average of 9 hours and 1.7% of subjects are working for average of 10 hours per day.

Table 4: Years of work and average hours a day in relation to age in years of subjects

variables	Age in years		Total	P value
	36-40	41-46		
Years of work	14.52±0.18	17.31±0.17	16.59±0.18	<0.001**
Average hours day	7.97±0.12	8.06±0.08	8.03±0.07	0.571

Student t test

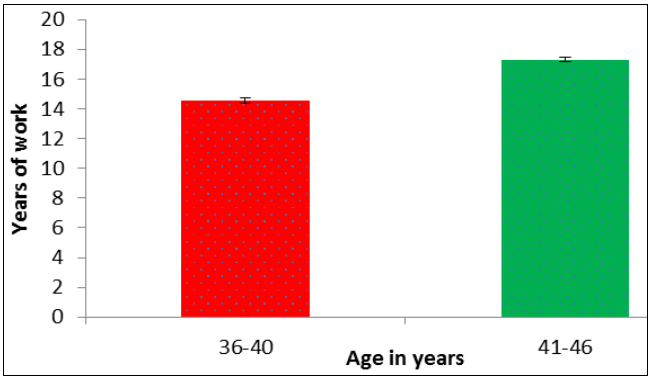
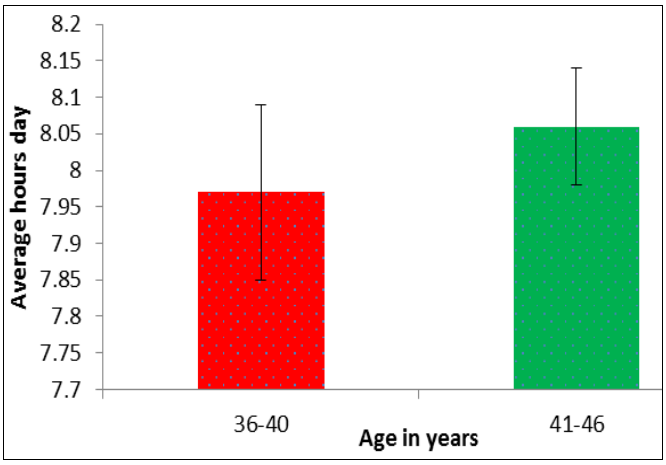


Fig 4: Years of work and average hours a day in relation to age in years of subjects



The above table and graph explains about years of work and average hours a day in relation to age in years of patients studied. It shows that between the age group 36-46 the employees had an average 16.59±0.18 years of work with P value of <0.00 and worked for 8.03±0.07 average hours a day with P value of 0.571.

Table 5: Active Knee Extension test distribution of subjects

AKE Test	No. of patients (n=120)	%
Right		
0	4	3.3
1-10	12	10.0
11-20	22	18.3
21-30	33	27.5
31-40	37	30.8
>40	12	10.0
Left		
0	4	3.3
1-10	11	9.2
11-20	27	22.5
21-30	37	30.8
31-40	36	30.0
>40	5	4.2

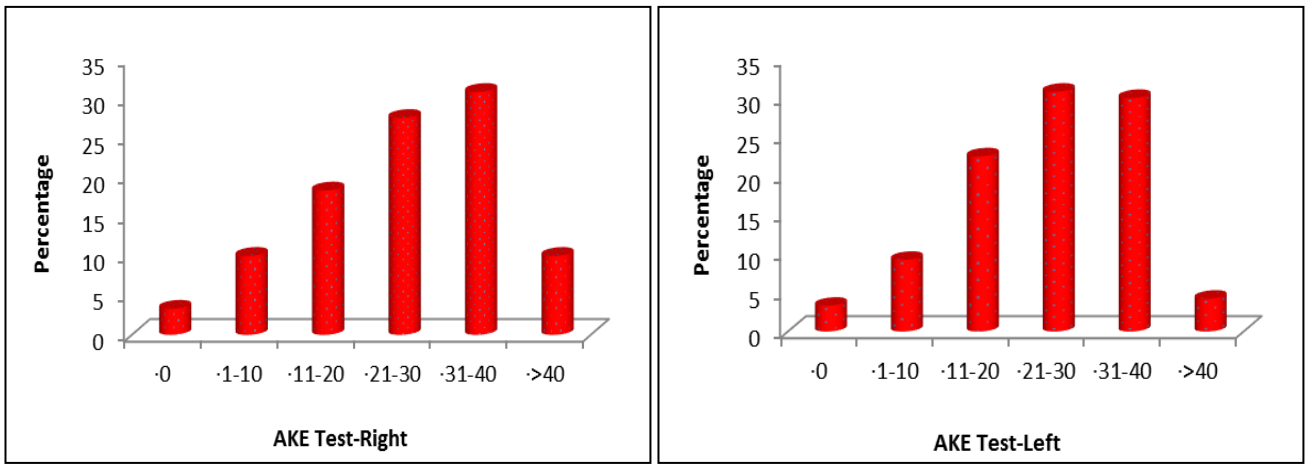


Fig 5: Active Knee Extension test distribution of subjects

The above table and figure demonstrate the average percentage of subjects that showed varying degrees of hamstring tightness both on right and Left sides. While only 3.3% of subjects showed no tightness 10% on the right and 4.2% of subjects on left side showed severe tightness. 30.8% on the right side and 30% of subjects on the left showed moderate to severe tightness in hamstrings muscle.

Table 6: AKE Test in relation to age in years of subjects studied

AKE Test	Age in years		Total	P value
	36-40	41-46		
Right	25.06±2.28	27.04±1.24	26.53±1.09	0.428
Left	23.32±2.21	25.28±1.19	24.78±1.05	0.415

Student t test

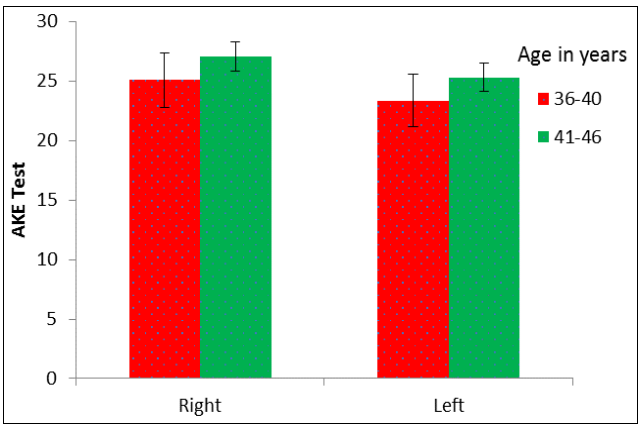


Fig 6: Active Knee Extension Test in relation to age in years of subjects studied

The above table and graph explains about AKE Test in relation to age group between 36-46 years of subjects studied. In the total subjects studied the average AKE values in degrees for right side was 26.53±1.09 with P value of 0.428 and left AKE Test was 24.78±1.05 with P value of 0.415

In the age group studied i.e. 36-46 years, greater average Hamstring tightness was observed on the right side more than the left.

Table 7: Modified Thomas Test distribution of subjects

MTT	No. of patients (n=120)	%
Right		
0	20	16.7
1-10	15	12.5
11-20	62	51.7
21-30	21	17.5
31-40	2	1.7
>40	0	0.0
Left		
0	18	15.0
1-10	29	24.2
11-20	55	45.8
21-30	18	15.0

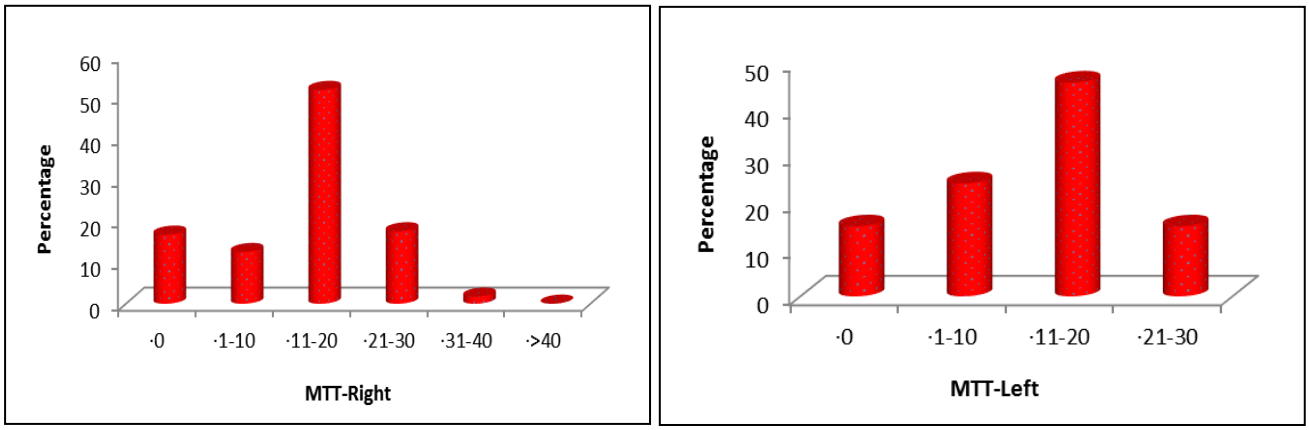


Fig 7: Modified Thomas Test distribution of subjects

The above table and figure demonstrate the average percentage of subjects that showed varying degrees of Ilio-Psoas tightness both on right and Left sides. 16.7% of subjects on the right side and 15% on the left side showed no tightness while 17.5% subjects on the right and 15% on left demonstrated moderate tightness. None of the subjects who were evaluated showed severe tightness of Ilio-psoas muscle on either right or left sides.

Table 8: Modified Thomas Test in relation to age in years of subjects

MTT	Age in years		Total	P value
	36-40	41-46		
Right	13.29±1.38	13.72±0.94	13.61±0.78	0.811
Left	12.74±1.31	12.13±0.79	12.29±0.67	0.695

Student t test

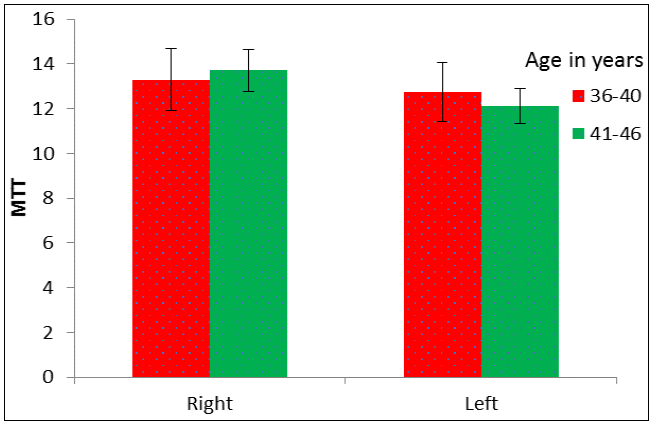


Fig 8: Modified Thomas Test in relation to age in years of subjects

The above table and graph explains about Modified Thomas Test (MTT) values used to assess Illio-Psoas tightness, in relation to age group between 36-46 years of subjects studied. Average MTT values in degrees on the right side were 13.61±0.78 with P value of 0.811 and left MTT was 12.29±0.67 with P value of 0.695.

Among the total subjects studied the Illio-Psoas tightness was also elicited and was observed more on the right hip as compared to the left side.

Table 9: Piriformis tightness in relation to age in years of subjects

PT	Age in years		Total	P value
	36-40	41-46		
Right	9(29%)	29(32.6%)	38(31.7%)	0.714
Left	9(29%)	29(32.6%)	38(31.7%)	0.714

Chi-Square test/fisher Exact test

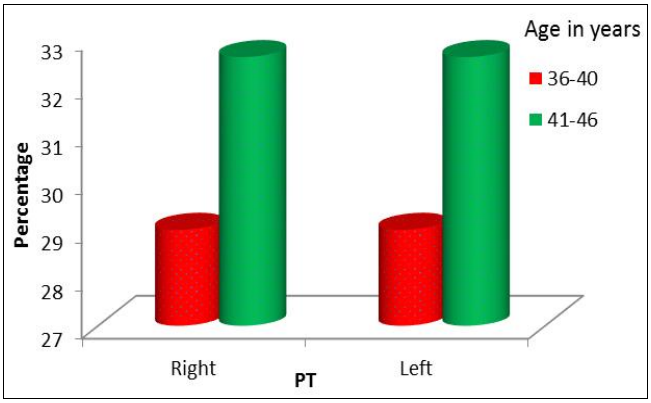


Fig 9: Piriformis tightness in relation to age in years of subjects

The above table and graph shows Piriformis tightness in relation to age group between 36-46 years of subjects studied. It shows right piriformis tightness in 31.75% subjects with P value of 0.714 on both right and left sides. The piriformis tightness was demonstrated equally on both right and left sides.

Conclusion and Discussion

The study was intended to evaluate and screen the middle aged male desk job workers for flexibility of muscles around the hip joint specifically Iliopsoas, hamstrings and piriformis muscles. Out of 120 subjects, 96.7% of them were found out to have tight Hamstrings whereas 83.8% showed tight Iliopsoas and 38% had piriformis tightness.

Sedentary work nature is a major risk factor across a spectrum of preventable diseases that lower the quality of life. Sedentary work habits can lead to various problems like tightness of muscle, decreased joint range of motion, decreased flexibility, further adding discomfort and hampering daily activities of an individual. In the present study it was found that, out of 120 desk job workers predominantly the IT industry employees, 96.7% subjects were found to have hamstring muscle tightness, and the greater average Hamstring tightness was observed on the right side more than the left. 83.8% subjects were found to have variable degrees of Iliopsoas muscle tightness with left side Iliopsoas muscle tightness slightly exceeding the right side. 16.7% of subjects on the right side and 15% on the left side showed no tightness in Iliopsoas while 17.5% subjects on the right and 15% on left demonstrated moderate tightness. None of the subjects who were evaluated showed severe tightness of Iliopsoas muscle on either right or left sides. Whereas 38% subjects were found to have piriformis muscle tightness on both right and left sides.

In the present study it was found that hamstring tightness in middle aged men was very commonly observed. Akinpelu *et al* who studied the influence of age on hamstring length had concluded that hamstring tightness increased with age up to age group 40-49 years. Although in the present study the influence of age is not considered but the findings of increased tightness correlates well with their conclusion.

Iliopsoas tightness (83.8%) was also very frequently seen in the subjects screened in the present study. According to Cote and Guidotti TL who in their individual researches have drawn a correlation between hamstring and Iliopsoas tightness and low back pain due to the adaptive shortening associated with prolonged sitting jobs also reinforced the above statistic. The biomechanics behind the low back pain associated with tight hamstrings is due to the excessive posterior tilt of the pelvis that tends to flatten the lumbar spine.

The extensive occurrence of hamstring and Iliopsoas tightness surely calls upon incorporating strategies for awareness and prevention among the subjects and may be studied in future. As it is known that Iliopsoas is the only muscle that connects lumbar spine to the hip, in case of shortening, it increases the anterior pelvic tilt and puts excessive strain on lumbar spine as well as intervertebral disc resulting in low back pain.

Similarly Piriformis muscle tightness was reported in 38% of subjects. This is a significant muscle which may create discomfort on prolonged sitting and also create pain in the low back. Many researchers like Papadopoulos EC, Lijec Vjesn *et al* in their previous research findings arrived at a similar conclusion probable mechanism being the proximity of sciatic nerve to this muscle resulting in exertion of pressure on the nerve producing radiating pain into the lower extremity or low back.

Proper ergonomic setup, frequent rest, stretching and strengthening exercises may all reduce few degrees of physiological and psychological load on the body. Various therapeutic strategies like postural education, muscle lengthening procedures etc have been used and found variable levels of evidence for their use but their application in Indian context will have to be further investigated. This study was conducted with an aim of screening for muscle flexibility and an association considering other variables may be done in future. This study highlights the occurrence of tightness of muscles around the hip joint in majority of middle aged Indian men with a longer work history who have desk job, making them prone to low back pain or other symptoms associated with back or hip in some point of time in their life.

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