STUDENT ARITCLE

Prevalence of hamstring tightness and associated factors among sewing machine operators

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Abstract

Background:
Hamstring is a key component of flexibility in the human body and it is more prone to get tightened. Inability to achieve greater than 160 degrees of knee extension when the hip is flexed to 90 degrees is considered as hamstring tightness.

Objectives:
This study aims to find the prevalence of hamstring tightness among sewing machine operators and to assess the association of hamstring tightness with prolonged sitting, body mass index, physical activity level and gender.

Method:
A descriptive cross sectional study was carried out among 169 sewing machine operators aged between 18-60 years of a selected garment factory. Passive knee extension (PKE) test was used to measure the hamstring tightness among sewing machine operators. A validated interviewer administered questionnaire was used to determine the physical activity level among the participants.

Results:
Prevalence of hamstring tightness among sewing machine operators is 83.4% (n=141) and it is higher in males (91.8%) than females (78.7%). There was a significant association between prolonged sitting and hamstring tightness in the dominant limb (p=0.02, chi square = 7.79). Significant associations were not found between hamstring tightness with the BMI level (p=0.46, r=-0.05) and physical activity (p=0.41, r=-0.06).

Conclusion:
Majority of the sewing machine operators have hamstring tightness. Prolonged sitting is a contributory factor in hamstring muscle tightness.

Background

Muscle tightness occurs due to the reduced ability of the muscles to deform by reducing the range of motion of the joints they act on. Muscle tightness cause musculoskeletal pain and reduce flexibility[1].

Hamstring is a large muscle group comprised of three muscles; semitendinosus, semimembranosus and biceps femoris which cover the back of the thigh. This muscle group crosses the two joints, hip and knee as it originates from ischial tuberosity and inserts in to the back of the knee (both tibia and fibula). Hamstring functions as knee flexors and hip extensors. Thus it contributes to maintain the flexibility in the human body[1,2].

Hamstring tightness is defined as the inability to achieve more than 160^0 of knee extension while the hip is flexed at 90^0 [3]. Hamstring tightness can lead to many of the musculoskeletal disorders such as low back pain[2,4,5], hamstring muscle injury, patellofemoral pain and plantar fasciitis[6], Furthermore, severity of mechanical low back pain increases with the increase of hamstring tightness[5].

There are over 300-350 apparel industries in Sri Lanka which provide employment to over 300,000 directly and over 600,000 indirectly. Apparel industry brings the largest export income to the country[7]. Sewing machine operators play a key role in this process, but they experience various discomforts and pain. Female garment workers in Sri Lanka have reported a high incidence in back pain (57.3%) and knee pain (31.7%) which interfere with the ability to work while a few have missed their work altogether[8]. In the seated position, hamstring is held at shortened position due to knee flexion and posterior pelvic rotation. In prolonged sitting, this constant shortened position develops hamstring trigger points and cause muscle tightness[2]. Further, seated position increases the pressure on lumbar intervertebral disc. Therefore, prolonged sitting can increase the mechanical stress on lumbar spine[9]. Furthermore, frequent forward bending increase the mechanical stress on the spine with people having hamstring tightness[10]. The above postures are commonly seen among sewing machine operators. Therefore, sewing machine operators can develop low back pain as a result of hamstring tightness. Furthermore hamstring flexibility is influenced by several factors like age, gender, BMI and inadequate physical inactivity[1,11]. Studies have been conducted among different populations such as college students, office workers, physiotherapy undergraduates and athletes but studies are limited among sewing machine operators[12-15]. Therefore, it is important to understand the prevalence of hamstring tightness and possible factors associated with hamstring tightness among sewing machine operators.Aims of this study were to find out the prevalence of hamstring tightness among sewing operators of a garment factory in the Colombo district and to evaluate the association of hamstring tightness with prolonged sitting (more than six hours per day at work), gender, physical activity level (PAL), body mass index (BMI) and dominant leg.

Method

A descriptive cross sectional study was conducted among 169 sewing machine operators from a purposively selected large scale garment factory in the Colombo district. Ethical approval was obtained from the Ethics Review Committee of the Faculty of Medicine, General Sir John Kotelawala Defence University.

Sewing machine operators aged between 18 - 55 years were selected from the list of workers using the simple random sampling method. The participants with minimum of 6 hours of continuous sitting at work per day for a minimum of 5 days per week and employed at the current position continuously for a minimum time period of 6 months were included in the study. Employees with previous musculoskeletal or neurological conditions associated with the hip, knee or spine, leg length discrepancy, pregnancy and employees who were not physically and psychologically fit at the time of data collection were excluded. To select sewing machine operators to be included in the sample, a table of random numbers was used which included numbers for total number of sewing machine operators in the garment factory. First, a pin is dropped on to the number table and the number closest to the point of the pin is taken as the starting number. This continued on reading the table from left to right to select the participants.
Data collection was done using interviewer administered questionnaires and through physical assessments.

Personal information and working experience data were collected using an interviewer administered questionnaire while Global Physical Activity Level Questionnaire (GPAQ) was used to determine the physical activity level among participants. It is a standard questionnaire which has been developed by World Health Organization (WHO)[16]. The GPAQ showed acceptable evidence of short- and long-term test–retest reliability by activity category and modest validity evidence in Southeast Asian countries[17,18]. Metabolic equivalents (MET) minutes per week were calculated using this questionnaire to detect the physical activity levels of the participants. The Questionnaire comprised of 16 questions that capture physical activity undertaken in different behavioral domains; at work, in transport, discretionary (also known as leisure or recreation) and sedentary behavior. Questions in the work and discretionary domains assess the frequency and duration of 2 different categories of activity defined by the energy requirement or intensity (vigorous- or moderate-intensity physical activity). In the transport domain, frequency and duration of both walking and cycling for transport is captured, but no attempt is made to differentiate between these activities. One additional item is collected; time spent in sedentary activities. Physical activity level was determined by using the analysis guide which is provided by WHO[16].

Hamstring tightness was measured using the passive knee extension test (Figure 1). It is designed to minimize the associated pelvic motion, to have a fixed end point, to be convenient and quickly performed[19]. The reliability of this method was shown to be high and there is no difference between the tests – retest measures found (r=.98) [19,20]. It has moderate concurrent validity (correlation with sit and reach test, r = 0.57, correlation with straight leg raise, r =0.63) [3].

First, the dominant leg is determined as mentioned by O'Hora[21]. Then the participant was placed in the supine position. Hip was flexed to 90^0 and maintained at 90^0 flexion throughout the test by an examiner of the group. Then the knee is passively extended by another examiner gradually until the maximum tolerable stretch of the hamstring muscle is achieved and the participant himself feeling the maximum stretch of the muscle. The knee extension angle (KEA) is then measured. The second measurement of KEA was made about 6 seconds after the first measurement[3]. During the procedure, contralateral lower extremity was placed on the support surface with knee fully extended and the leg was secured using two cloth straps; one across the thigh and another strap across the anterior superior iliac spine to stabilize the pelvis[22]. The same examiners did the procedure for all the participants and used high quality tools to measure the knee extension angle to reduce the measurement errors.

Figure 1. Measurement procedures for hamstring muscle tightness; Q= Knee Extension Angle (KEA)

A KEA of 20^0 has been defined as a cutoff score indicating hamstring muscle tightness. Therefore, KEA $>20^0$ indicates hamstring muscle tightness[3].

In the study the height in centimeters (cm) and weight in kilograms (kg) were taken using an electronic digital column scale and put into the standard calculation to obtain the BMI values. The procedure was done according to the standardized protocol which was adapted by the training manual for weight and height assessment by the Arkansas Centre for Health Improvement[23]. BMI was categorized into four groups according to the conventional WHO classification[24].

Statistical Package for Social Sciences (SPSS) version 22.0 software was used for data analysis. Descriptive statistics were used to analyze the characteristics and demographic features of the study sample. To find out the association with hamstring muscle tightness, Chi-Square test at 0.05 significant level was used thus, P value less than 0.05 was considered as statistically significant. Pearson Correlation test was applied to detect the correlation within the continuous variables. Paired t test was used to compare means of two variables.

Results

There were 108 females (63.9%) and 61 males (36.1) in the total of 169 participants. Female to male ratio was 2.6: 1. The mean age of participants was 30.69 ±8.99 years.
Physical characteristics and occupational characteristics of the sample are given in Table 1.

Majority of them had dominant side, non-dominant side hamstring tightness or on both sides. 141 participants had dominant side hamstring tightness (83.4%) and 125 participants had non dominant side hamstring tightness (73.96%). Independent t test was carried out to compare the individual's dominant side and non-dominant side hamstring tightness. According to the results there was no significant relationship between dominant side and non-dominant side hamstring tightness (Table 2).

The results on the Chi square test on the association between dominant side hamstring muscle tightness and number of sitting hours per day at work are depicted in Table 2. A significant association was observed between the hamstring muscle tightness and number of sitting hours per day at work (p = 0.02).

Table 1. Physical and occupational characteristics of the sample

	Frequency	Percent (%)
Dominant side of the leg		
• Right	115	68
• Left	54	32
BMI category		
• Under weight	40	23.7
• Normal weight	55	32.5
• Overweight	16	9.5
• Obese	58	34.3
Number of sitting hours		
• 6 hours chair sitting per day	64	37.9
• 7 hours chair sitting per day	56	33.1
• 8 hours chair sitting per day	49	29
Physical activity levels		
• Physical activity level 1	12	7
• Physical activity level 2	2	1
• Physical activity level 3	121	72
• Physical activity level 4	28	17
• Physical activity level 5	4	2
• Physical activity level 6	2	1

PAL 1 ; < 5000 MET min/week, PAL 2; 50001-10000 MET min/week, PAL 3; 10001-15000 MET min/week, PAL 4; 15001-20000 MET min/week, PAL 5; 20001-25000 MET min/week, PAL 6; 25001-30000 MET min/week

According to Table 2, there is no significant association between dominant side hamstring tightness and BMI. The relationship is shown in Figure 2.

Table 2. Hamstring Muscle Tightness and its associated factors

	Hamstring muscle tight	Hamstring muscle not tight	p value	Chi-square value	d.f
Gender					
Male	56 91.8%	5 8.2%	0.02	4.83	1
Female	85 78.7%	23 21.3%			
No of sitting hours per day at work					
6	47 73.4%	17 26.6%	0.02	7.79	2
7	49 87.5%	7 12.5%			
8	45 91.8%	4 8.2%			
BMI categories					
Under weight	33 82.5%	7 17.5%	0.5	2.133,	3
Normal weight	47 85.5%	8 14.5%			
Overweight	15 93.8%	1 6.3%			
Obese	46 79.3%	12 20.7%			

Considering the Pearson correlation test result, no significant correlation was found between dominant side hamstring muscle tightness and PAL (p =0.41) and the relationship is shown in Figure 3

Discussion

The results of our study shows relatively a high prevalence of hamstring tightness among sewing machine operators. Several studies conducted among different populations also have shown similar results. A study done among college students have shown 82% prevalence of hamstring tightness and office workers have shown 85.7% prevalence [12,13]. The similarity may be as a result of selecting the samples from prolonged sitting populations. In contrast to this, a study performed among undergraduate physiotherapy students in Nepal have shown a medium prevalence of hamstring tightness (40.17%)[14]. This may be due to the physiotherapy students actively participating in exercise prescription in stretching. This may also be due to genetic factor[1].

Figure 2. Relationship between hamstring muscle tightness and BMI

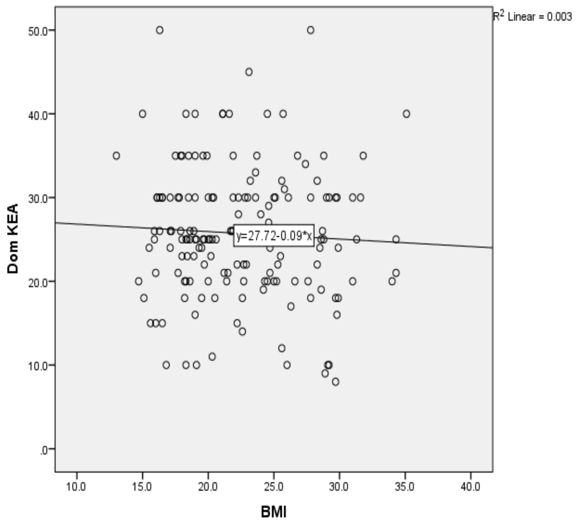
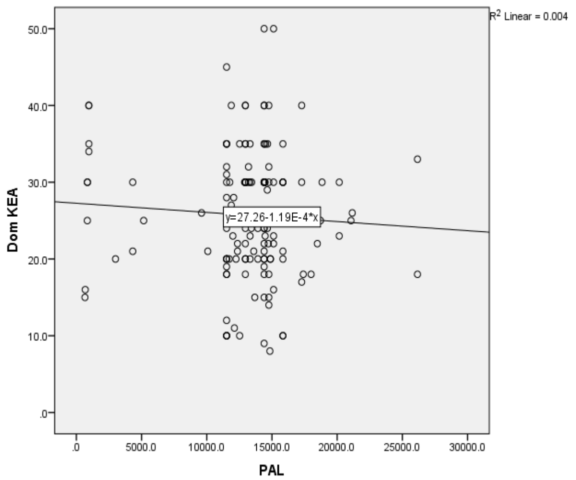


Figure 3: Relationship between hamstring muscle tightness and PAL



According to the current study, chi square test shows a significant association between the hamstring tightness and number of sitting hours at work (p=0.02, x^2=7.79). Similarly, Fathima states a significant association of hamstring tightness with chair sitting hours (p=0.01) and Waqas also states a significant positive correlation between hamstring tightness and prolonged sitting [12,13]. Adar also states that hamstring shortening increases with sitting hours and has found a significant negative correlation with the straight leg raising test(r=-0.2794, p=0.0007) [9]. In contrast to the above results, Arab states that among all subjects with sitting work setting, 46% of subjects with LBP and 24% of normal subjects had hamstring tightness and in subjects with standing work setting, 40% of subjects with LBP and 16% of normal subjects had hamstring tightness. He also state that his findings shows work setting (Sitting/Standing) has no effect on hamstring tightness[2].

The current study did not find any significant relationship between dominant side and non-dominant side hamstring tightness (t=1.94, p=0.05). A study conducted among healthy young people also has shown that there was no significant difference with knee extension angle and dominant limb[25]. Another study conducted among LBP patients have revealed that non dominant side hamstring is tighter than dominant side[10]. However further studies should be done to further assess this difference .Other than that most of the studies showed differences between the range of motion or muscle flexibility of right and left extremities[26-28].

Most of the literature supported the fact that females have greater hamstring muscle flexibility than men[13,14,29]. Furthermore, another study reported that females were found to have significantly greater range of motion than males [30]. Literature state that female tends to be more flexible than the male of same age throughout life. This is because of anatomical variation in joint structure and also performance of more rigorous physical work by men, resulting in greater micro trauma[11].

Although previous studies on influence of BMI on hamstring tightness are limited, there are some studies that show a weak association between hamstring muscle tightness and BMI[31].

In the current study the hamstring tightness was insignificantly associated with PAL (p=0.41). These results were consistent with the previous study findings[32]. These results contrast a study done to determine the association between BMI and hamstring /back flexibility among the 300 adolescents in Mumbai where physical activity level was shown to be a significant factor for hamstring tightness seen among adolescents irrespective of the BMI value[33].

Conclusion and recommendations

There is a high prevalence of hamstring muscle tightness (83.4% in dominant side and 73.96% in non-dominant side) among sewing machine operators of the selected garment factory and it is higher in male (91.8%) compared to female (78.7%). Hamstring tightness is significantly associated with the increase of number of sitting hours. There is no significant association of hamstring tightness with BMI, physical activity level and dominant limb.

Muyor stated that offering physical activity programs at the work place can be an efficient strategy to increase muscle flexibility[34]. For this, static stretching exercise for hamstring can be practiced during the working hours. We recommend effective interventions to improve hamstring tightness at work setting should be assessed in further studies. Further studies with a large number of sewing machine operators will help to generalize the findings.

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