Original Research

Influence of hamstring tightness on the functions of lumbar and pelvic regions among sewing machine operators in a garment factory of Colombo District

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Abstract

Introduction: Clinical evidence suggests that hamstring tightness influences lumbar pelvic rhythm and shortened hamstring increase the risk of injury to the spine.

Objectives: To determine the association of hamstring tightness with pelvic tilt in standing position, trunk, and lumbar range of motion during forward bending among sewing machine operators

Methods: A descriptive cross-sectional study was conducted among 169 sewing machine operators aged 18-55 years using passive knee extension test, tri-goniometric method, finger to floor test and modified Schober test to measure hamstring tightness, pelvic tilt, trunk flexion and lumbar flexion, respectively.

Results: A weak negative correlation between hamstring tightness and lumbar range of motion during forward bending ($r=-0.28$; $p=0.001$). A significant association between trunk flexion and hamstring tightness ($r=0.47$; $p=0.001$).

Conclusions & Recommendations: Hamstring tightness affects the lumbar and trunk range of motion during forward bending.

Keywords: *hamstring tightness, pelvic tilt, lumbar flexion, trunk flexion, sewing machine operators*

Introduction

Muscle tightness occurs due to reduced ability of the muscle to deform and reduce the range of motion of the joints it acts on (1). Inability to achieve greater than 160° of knee extension when the hip flexes to 90° is considered as 'hamstring tightness' (2). Causes of hamstring tightness are genetic influence, muscle injury, some chronic conditions and sedentary lifestyle (3). Clinical observations suggest that hamstring tightness influences lumbar pelvic rhythm. Shortened hamstring muscle increases the risk of injury to the spine from mechanical stresses (4-5). Furthermore, it is a possible risk factor for mechanical low back pain (4-8).

Sewing machine operators play a key role in the economy as the apparel industry brings the largest export income to the country (9), and forward bending is commonly seen among them during work. Sri Lanka reported high incidence in back pain (57.3%) in the study done by Lombardo (2017) among female garment factory workers (10). Therefore, hamstring tightness can be a significant but unrecognized cause of their back pain. This study aims to find the influence of hamstring tightness on pelvic tilt in standing position and lumbar and trunk flexion during forward bending among sewing machine operators in Sri Lanka.

Methods

A descriptive cross-sectional study was conducted among 169 sewing machine operators from a large-scale garment factory in the district of Colombo. Sewing machine operators aged 18-55 years with a minimum six hours of continuous sitting at work per day for a minimum of five days per week and employed at the current position continuously for a minimum period of six months were selected using a simple random sampling method. Employees with previous musculoskeletal or neurological conditions associated with 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.

Socio-demographic and work experience-related data were collected using an interviewer-administered questionnaire. Questions were explained to the participants by their preferred language and filled according to their best response. In addition, physical assessments were done to test hamstring muscle tightness, pelvic tilt, trunk flexion and lumbar flexion.

Hamstring tightness

Hamstring tightness was measured using the passive knee extension (PKE) test as described by Davis et al. (2008) (2). Validity and reliability of PKE have been described by previous studies (2, 12). When hip was passively extended to 90° and the leg until the participant felt maximum tolerable stretch, the knee extension angle (KEA) was measured. KEA of more than 200 indicated hamstring muscle tightness (2). The dominant leg was determined as mentioned by O'Hara, (2011) (11).

Pelvic tilt

Pelvic tilt was measured using Tri-goniometric Method. The validity and reliability of this method are established in previous studies (16). The procedure was done according to Sanders et al., 1981 (17).

When participant stood with feet approximating a designated line on the floor, the dominant side anterior superior iliac spine (ASIS) and posterior superior iliac spine (PSIS) were palpated and marked with the non-allergic marker pen. Then, depth calliper was placed over the marked ASIS and PSIS, which were compressed to 'firm resistance' and recorded the distance between them. Then, with a sliding pointer on a meter stick mounted on a wooden base, distances from the floor to the marked ASIS and PSIS were measured. All measurements were taken to the nearest millimetre. Pelvic tilt values were categorized into three categories as < 00 anterior pelvic tilt, 00-230 neutral and >230 posterior pelvic tilt (18).

Trunk flexion

Fingertip to Floor Method was used to determine trunk flexion. The validity and reliability of this method have been established in previous studies (19-20). The procedure was done according to Perret (2001) (20). The participant stood erect on a platform 20cm high, feet together and then bent forward as far as possible while maintaining knees, arms and fingers fully extended. The distance between the middle finger of the right hand and platform was measured in centimetres using the tape.

Lumbar flexion

Modified Schöber Test, according to the Bath Ankylosing Spondylitis Functional Index (BASFI), prepared by the National Ankylosing Spondylitis Society (13) was used to determine lumbar flexion. The participant stood with the outer edge of bare feet 30cm apart and feet in a line. The midpoint of L4/L5 junction was marked; and points 10cm above and 5cm below it were also marked. Then the participant bends forward as far as possible while maintaining knees and arms fully extended. The distance between the upper and lower two points was measured. Lumbar motion was categorized into 3 groups: > 4cm – mild; 2-4cm – moderate; and <2cm – severe (13).

Data analysis

The Statistical Package for Social Sciences (SPSS)

version 22.0 was used for data analysis. Descriptive statistics to analyse the characteristics and demographic features and Spearman correlation test to determine the correlation between the variables were used. A P-value less than 0.05 was considered as statistically significant to determine association with hamstring tightness.

Results

In the sample (n=169), with females (n=108; 63.9%) to males (n=61; 36.1%) ratio of 2.6:1, consisted of a mean age 30.69 (SD=8.99) years. Of them, 141 participants had dominant side hamstring tightness (83.4%) while 125 participants had non-dominant side hamstring tightness (73.96%).

In the sample, lumbar motion (LM) during forward bending ranged from 0-20cm (mean=6.05; SD=3.81), pelvic tilts (PT) in erect position ranged from 7.47 to 28.34 (mean=11.08; SD=6.69). Trunk flexion (TF) during forward bending ranged from 0-25cm (mean=8.42; SD=7.36). Mean values of LM, TF and PT in males were 6 (SD=3.9), 7.7 (SD=7.9) and 11 (SD=7.1), while in females, it was 6.2 (SD=3.8), 8.6 (SD=7) and 11.2 (SD=6.5), respectively.

A significant negative correlation between hamstring tightness and LM during forward bending ($p=0.001$) (Figure 1) and another significant correlation between dominant side hamstring tightness and TF during forward bending ($p=0.001$) (Figure 2) was observed.

Figure 1: Correlation between hamstring muscle tightness and lumbar motion (LM) during forward bending

Figure 2: Correlation between hamstring muscle tightness and trunk flexion during forward bending

Discussion

No previous studies have been conducted to find out the relationship between hamstring tightness and pelvic tilt in standing position, and trunk and lumbar range of motion during forward bending among sewing machine operators in Sri Lanka. However, literature revealed a high prevalence of hamstring tightness among sewing machine operators (15).

A statistically significant, moderate correlation ($r=0.47$; $p=0.001$) between dominant side hamstring tightness and trunk flexion during forward bending was found, which was consistent with the findings of Carregaro et al. (21) and Shin et al. (22). This study also indicated a statistically significant weak negative correlation ($r=-0.28$; $p=0.001$) between dominant side hamstring tightness and lumbar motion during forward bending, suggesting that hamstring tightness is not strongly related to the excursion of lumbar spine during forward bending. These findings are consistent with other studies (23). Jhonson et al. (24) concluded that hamstring flexibility is weakly related to the amount of lumbar flexion, while Li et al. (26) revealed that stretching of hamstring was not affected by the amount of lumbar motion during partial and full-forward bending. The study of Esola et al. (25) concluded that participants with low back pain history used more lumbar flexion during the beginning phase of forward bending when the hamstrings are not in a lengthened position.

These study data revealed that the amplitude of trunk flexion is relatively higher than lumbar flexion, and this phenomenon is known as “relative flexibility”, discussed in a previous study (27). The results of mean pelvic tilt in the dominant side (11.08; SD 6.69) and statistically insignificant Pearson correlation ($p<0.05$) between dominant side hamstring tightness and pelvic position in standing were consistent with the findings from previous studies (16, 28).

These results may conflict with the popular clinical opinion that tight hamstring causes posterior pelvic tilting as the mean PKE angle was 25.69. Yet, the decreased muscle length did not significantly influence the pelvic position. This change has been discussed in previous studies (29-30).

Conclusions & Recommendations

Our data indicated weak yet a statistically significant negative correlation between dominant side hamstring tightness and lumbar motion and a statistically significant moderate correlation between dominant side hamstring tightness and trunk flexion during forward bending. Previous studies mentioned that physical activity programs including stretching, weight training and warm-up exercises improve the joint range of motion, flexibility and personal values of employees while reducing work-related musculoskeletal disorders which affect the production quality of companies (14). Further studies with a larger sample size will help to generalize these findings.

Public Health Implications

The findings of our study will be important to make suitable adaptations to prevent and minimize the hamstring tightness among sewing machine operators in future and consider the hamstring tightness during their treatment for musculoskeletal pain. This will be important to reduce the health care cost in the garment and will improve the quality of work of sewing machine operators, which will indirectly affect the economy of Sri Lanka.

Author Declarations

Competing interests: The authors declare that they have no competing interests.

Ethics approval and consent to participate: Ethical approval was obtained from the Ethics Review Committee, Faculty of Medicine, General Sir John Kotelawala Defence University, Sri Lanka.

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Author contributions: GKK & HS participated in designing of the study, analysing the data, collecting the data, drafting the manuscript and approving the final manuscript. AB & DS supervised the research. IW, LB, CD & CDS were involved in the design of the study and collect the data.

References

1. Akinpelu AO, Bakare U, Adegoke BOA. Influence of age on hamstring tightness in apparently healthy Nigerians. *J Nig Soc Physiother* 2005; 15(2): 35-41.
2. Davis DS, Quinn RO, Whiteman CT, Williams JD, Young CR. Concurrent validity of four clinical tests used to measure hamstring flexibility. *J Nig Soc Physiother* 2008; 22(2): 583-588.
3. Fathima G, Qamar MM, Hassan J U, Basharat A. Extended sitting can cause hamstring tightness. *Saudi J Sports Med* 2017; 17: 110-114.
4. Norris CM & Matthews M. Correlation between hamstring muscle length and pelvic tilt range during forward bending in healthy individuals: an initial evaluation. *J Bodyw Mov Ther* 2006; 10(2): 122-126.
5. Reis FJJ & Macedo AR. Influence of hamstring tightness in pelvic, lumbar and trunk range of motion in low back pain and asymptomatic volunteers during forward bending. *Asian Spine J* 2015; 9(4): 535-540.
6. Arab AM & Nourbakhsh MR. Hamstring muscle length and lumbar lordosis in subjects with different lifestyle and work setting: comparison between individuals with and without chronic low back pain. *J Back Musculoskelet Rehabil* 2014; 27(1): 63-70.
7. Phansopkar PA & Kage V. Efficacy of Mulligan's two leg rotation and bent leg raise techniques in hamstring flexibility in subjects with acute non-specific low back pain: randomised clinical trial. *Int J Physiother* 2014; 2(5): 733-741.
8. Radwan A, Bigney KA, Buonomo HN. Evaluation of intra-subject difference in hamstring flexibility in patients with low back pain: an exploratory study. *J Back Musculo skelet Rehabil* 2015; 28(1): 61-66.
9. Export Development Board. *Sri Lanka Apparel Sector; Industry Capability Report* 2016; 1-9.
10. Lombardo SR, Silva VD, Lipscomb HJ, Ostbye T. Musculoskeletal symptoms among female garment factory workers in sri Lanka. *Int J Occup Med Environ Health* 2012; 18(3): 210-219.
11. O'Hara J, Cartwright A, Wade CD, et al. Efficacy of static stretching and proprioceptive neuromuscular facilitation stretch on hamstrings length after a single session. *J Strength Cond Res* 2011; 25(6): 1586-1591.
12. Guex, K. Passive knee-extension test to measure hamstring tightness: influence of gravity correction. *J Sport Rehabil* 2012; 21: 231-234.
13. Jenkinson TR, Mallorie PA, Whitelock H, et al. Defining spinal mobility in ankylosing spondylitis: the Bath Ankylosing Spondylitis Metrology Index. *J Rheumatol* 1994; 21: 1694-1698.
14. Gasibat Qais & Simbak Nordin & Abd Aziz Aniza. Stretching exercises to prevent work-related musculoskeletal disorders – a review article. *Am J Sports Med* 2017; 5: 27-37.
15. Kanishka GK, Sandamali H, Weerasinghe I, Binduhewa L, Dilshara C, De Silva C, et al. Prevalence of hamstring tightness and associated factors among sewing machine operators. *Ceylon J MedSci* 2019; 56(1): 24-31.
16. Gajdosik RL, Hatcher CK, Whitsell S. Influence of short hamstring muscles on the pelvis and lumbar spine in standing and during the Toe-touch Test. *Clin Biomech* 1997; 7(1): 38-42.
17. Sanders G & Stavrakas PA. Technique for measuring pelvic tilt. *Phys Ther* 1981; 61: 49-50.
18. Preece SJ, Willan P, Nester CJ, Graham-Smith P, Herrington L, Bowker P. Variation in pelvic morphology may prevent the identification of anterior pelvic tilt. *J Man Manip Ther* 2008; 16(2): 113-117.
19. Gauvin MG, Riddle DL, Rothstein JM. Reliability of clinical measurements of forward bending using the modified fingertip-to-floor method. *Phys Ther* 1990; 70(7): 443.
20. Perret C. Validity, reliability, and responsiveness of the fingertip-to-floor test. *Arch Phys Med Rehabil* 2001; 82(11): 1566-1570.

21. Carregaro RL & Coury HJ. Does reduced hamstring flexibility affect the trunk and pelvic movement strategies during manual handling. *Int J Ind Ergon* 2009; 39(1): 115-120.
22. Shin, Gwanseob & Shu, Yu & Li, Zheng & Jiang, Zongliang & Mirka, Gary. Influence of knee angle and individual flexibility on the flexion-relaxation response of the low back musculature. *J Electromyogr Kinesiol* 2004; 14: 485-494.
23. Mellin G. Correlations of hip mobility with the degree of back pain and lumbar spinal mobility in chronic low-back pain patients. *Spine* 1988; 13(6): 668-670.
24. Johnson, EN & Thomas JS. Effect of hamstring flexibility on hip and lumbar spine joint excursions during forward-reaching tasks in participants with and without low back pain. *Arch Phys Med Rehabil* 2010; 91(7): 1140-1142.
25. Esola MA, McClure PW, Fitzgerald GK, Siegler S. Analysis of lumbar spine and hip motion during forward bending in subjects with and without a history of low back pain. *Spine (Phila Pa 1976)* 1996; 21(1): 71-78. .
26. Li Y, McClure PW, Pratt N. The effect of hamstring muscle stretching on standing posture and on lumbar and hip motions during forward bending. *Phys Ther* 1996; 76(8): 836-845.
27. Rose SJ, Sahrmann SA, Norton BT. Quantitative assessment of lumbar-pelvic rhythm. *Phys Ther* 1988; 68: 824.
28. Toppenberg RM & Bullock MI. The interrelation of spinal curves, pelvic tilt and muscle lengths in the adolescent female. *Aust J Physiother* 1986; 32: 6-12.
29. Link CS, Nicholson GG, Shaddeau SA, Birch R, Gossman MR. Lumbar curvature in standing and sitting in two types of chairs: relationship of hamstring and hip flexor muscle length. *Phys Ther* 1990; 70: 611-618.
30. Kendall FP, McCreary EK. *Muscles: Testing and Function*. 3rd ed. Baltimore: Williams and Wilkins, 1983, pp 283-285.