Endurance and Flexibility of Trunk Muscles in Medical Laboratory Technicians

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Abstract: The aim of the study was to establish isometric endurance times and to compare the differences in trunk muscle endurance and flexibility among Medical Laboratory Technicians with chronic low back pain (LBP) and with those of Healthy Subjects (HS). Eighty-eight Medical Laboratory Technicians participated in the study and were divided into two groups: 50 technicians with chronic low back pain and 38 Healthy Subjects (HS) without having low back pain. The participants performed 2 isometric tests that assess trunk muscle endurance: Trunk Flexor Test and Trunk Extensor Test (Sorensen Test) and 1 flexibility test that assess the low back flexibility: Sit and Reach Test). Independent t test shows that the trunk flexor, trunk extensor endurance and the low back flexibility of LBPG subjects was significantly lesser than healthy subjects ($p<0.05$). In terms of endurance, low back pain group has weaker trunk flexor muscles in comparison to trunk extensor muscles.

1 INTRODUCTION

Healthcare professionals are at high risk of work-related musculoskeletal disorders [8, 12]. Prior studies indicated that incidence of musculoskeletal complaints, particularly low back and neck-shoulder, were high in nurses and X-ray technologists [5, 21]. Among the healthcare professionals, Medical Laboratory Technicians suffer with chronic low back pain which might be due to prolonged standing, improper postures and consequently affecting their strength, endurance and flexibility. A cross-sectional study conducted on laboratory technicians in a tertiary care hospital in India revealed that working in the same position for long periods, working in awkward positions, like forward back bend posture and continuous neck flexion were commonly reported risk factors for work-related musculoskeletal disorders [22].

Impaired function of trunk muscles is closely related to pathogenesis of chronic low back pain (CLBP) [19]. There is some evidence that decreased muscle endurance could be a cause, as well as a consequence of certain musculoskeletal disorders [2] resulting in impairment [2, 6] and disability [7].

Low performance in tests of muscle strength [3], endurance and flexibility [18] were reported as risk factors for low back pain, although many other studies did not find these results [20]. Muscle endurance can be defined as the ability to produce work over time or the ability to sustain effort [11]. The aim of the present study is to establish isometric endurance times and to compare the differences in trunk muscle endurance and flexibility among Medical Laboratory Technicians with chronic low back pain (LBP) and with those of Healthy Subjects (HS).

2 MATERIALS AND METHODS

Eighty-eight Medical Laboratory Technicians participated in the study and were divided into two groups: 50 technicians with chronic low back pain (Low Back Pain Group-LBPG) (Male=12, Female=38) and 38 Healthy Subjects (HS) without having low back pain (Male=13, Female=25). All healthy subjects had no history of low-back pain and were well motivated in this study. Selection criteria included 1) primary low back pain lasting at least for 6 months 2) no accident or no history of back surgery. Informed consent was obtained from all of the subjects and the procedure for this project was reviewed by an Institutional Review Board.

The participants performed 2 isometric tests that assess trunk muscle endurance: Trunk Flexor Test and Trunk Extensor Test (Sorensen Test) and 1 flexibility test that assess the low back flexibility: Sit and Reach Test.

The extensor endurance test (Figure 1) was modified from the Biering-Sorensen test, [4] which has been shown to be consistently reliable as a measure of back extensor endurance. Six subjects laid prone with the lower body fixed to the test bed at the ankles, knees, and hips and the upper body extended in a cantilevered fashion over the edge of the test bench. The test bench surface was approximately 25 cm above the surface of the floor. Subjects rested their upper bodies on the floor before the exertion. At the beginning of the exertion, the upper limbs were held across the chest with the hands resting on the opposite shoulders, and the upper body was lifted off the floor until the upper torso was horizontal to the floor. Subjects were instructed to maintain the horizontal position as long as possible. The endurance time was manually recorded in seconds with a stopwatch from the point at which the subject assumed the horizontal position until the upper body came in contact with the floor.

For flexion testing, participants were positioned supine, with both hips and knees flexed to 90 degrees, trunk inclined at 60 degrees resting on a prefabricated wedge. Stabilization was achieved with a belt around the table and over the dorsum of the feet (with shoes on) for the standard method. Participants crossed their arms across the chest, placing their hands on opposite shoulders, in a manner comfortable to them. Participants maintained their body position for as long as possible after the wedge was moved back 10 cm [15]. Time was measured from the instant the prefabricated wedge was moved back until the participant visually re-established contact with the wedge. This was the same for all methods. Modified testing procedures used a clinician to hold the participants' feet rather than using straps (Figure 3). This researcher stood to the participant's side and used the above-mentioned criteria of the participant's visually re-contacting the wedge as the criterion for ending the endurance test.

3. RESULTS

In terms of body weight and height, there were no significant differences between the groups (Table 1). Occupations were similar for both groups. The mean age, height and weight of healthy subjects were 25.31 ±4.0 years, 160.28 ±9.9 cm and 55.18 ±9.3 kg respectively; and for Medical Laboratory Technicians with chronic low back pain were 27.06 ±6.5 years, 158.09 ±11.7 cm and 55.2 ±11.0 kg respectively. Ages ranged from 19 to 40 years in case of

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Healthy Subjects and 19-60 years in case of LBP group. There were no significant differences in the age, height and weight for both the groups.

Table 1. Demographic details of Healthy Subjects (HS) and LBPG

Number (n)	Healthy subjects		LBPG		HS	LBPG	p value
	Men	Women	Men	Women			
	13	25	12	38	38	50	
Age (years)							
Mean	26.08 ±3.5	24.9 ±4.3	26.58 ±2.6	27.21±7.3	25.31± 4.0	27.06 ±6.5	0.14
Range	22-32	19-40	22-30	19-60	19-40	19-60	
Height (cm)							
Mean	166.96 ±7.04	153.67±8.10	167.61±6.7	155.41±11.5	160.28 ±9.9	158.09 ±11.7	0.92
Range	157.4-180.3	132.08-162.5	157.48-180.34	121.92-172	132.08-180.34	121.92-180.34	
Weight (kg)							
Mean	60.84 ±9.6	49.25±6.19	60.63±5.8	53.66±11.6	55.18 ±9.3	55.2±11.0	0.40
Range	40-73	40-65	49-72	37-85	40-73	37-85	

Results indicated that the low back flexibility of LBPG subjects was significantly lesser than healthy subjects ($p<0.05$). In terms of flexibility, a major percentage (52%) of subjects in LBPG were found to be in need improvement category indicating that their trunk flexibility is very poor in comparison to Healthy Subjects (Fig 1).

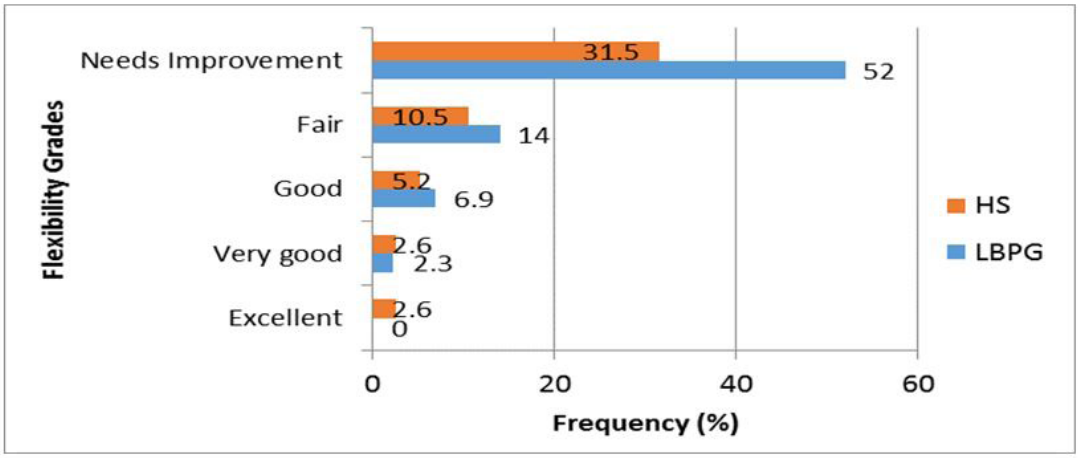

Fig 1. Comparison of trunk flexibility between LBPG and Healthy Subjects

Figure 2 and Figure 3 shows the performance time during both procedures. The endurance time was much longer in the Healthy Subjects than in the subjects of LBP group during any procedures ($p<0.05$). During the flexor endurance test in the males, the mean value was 26.6±17.9 seconds and 21.22±17.5 seconds for Healthy Subjects and LBPG subjects, respectively. During the extensor endurance test in the males, the mean value was 73±26.5 seconds and 48.22±19.7seconds for Healthy Subjects and LBPG subjects, respectively.

During the flexor endurance test in the females, the mean value was 36±38.1seconds and 27.89±45.6seconds for Healthy Subjects and LBPG subjects, respectively. During the extensor endurance test in the females, the mean value was 44.61 ±25.5seconds and 36.07 ±21.7 seconds for Healthy Subjects and LBPG subjects, respectively. Independent t test shows that the trunk flexor and extensor endurance of LBPG subjects was significantly lesser than Healthy Subjects ($p<0.05$). Paired t-test shows that there is a significant difference in the trunk flexor and the extensor endurance times across the LBPG subjects ($p<0.05$) and also among all the subjects. Chi square test shows that there is a significant difference in the endurance times of trunk muscles across the gender ($p<0.05$). In trunk flexor test, it was found that the trunk endurance time for females of LBPG is significantly more in comparison to males in LBPG. In trunk extensor test, it was found that the trunk endurance time for males of LBPG is more in comparison to females of LBPG.

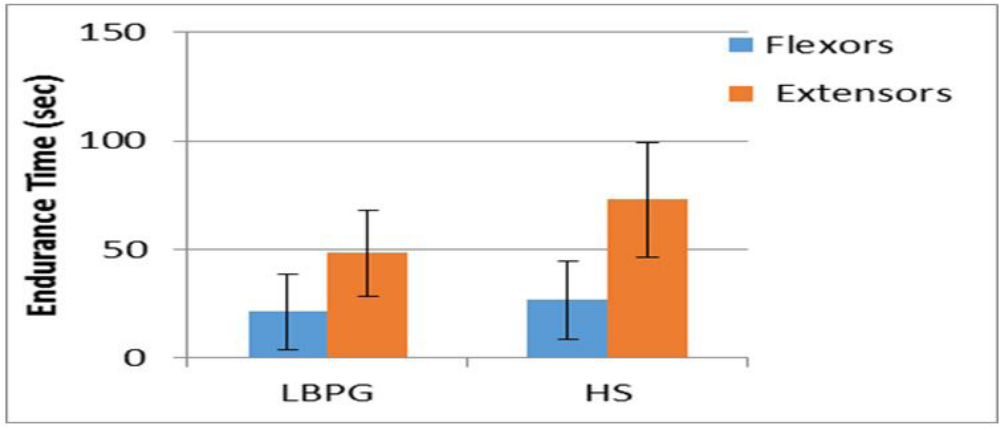

Fig 2. Performance time (seconds) of male subjects during trunk muscle endurance test

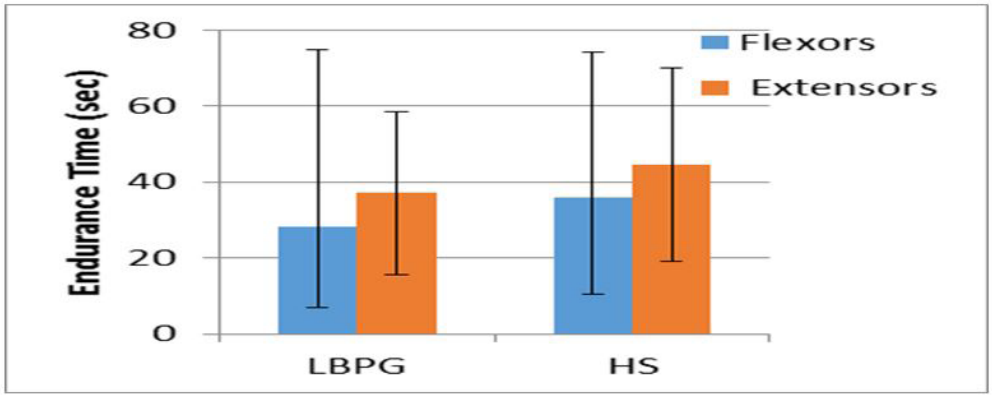

Fig 3. Performance time (seconds) of Female subjects during trunk muscle endurance test

4 DISCUSSION

The major aim of this study is to compare the trunk endurance times and the low back flexibility of Medical Laboratory Technicians between the Healthy Subjects and LBP group. The tests conducted in the study have shown high reliability and reproducibility were proven

with test-retest correlation [9].

In the present study, mean endurance times and flexibility of Medical Laboratory Technicians with low back pain was significantly much lesser in comparison to Healthy Subjects for trunk flexor and extensor test. A 1-year prospective study showed that good isometric endurance of the back muscles might prevent occurrence of low back trouble [3]. Nicholaisen and Jorgensen (1985) evaluated the back muscle endurance with the Sorensen test [17]. They pointed out that the isometric endurance of the patients with severe low-back pain was significantly less than that of the normal controls and the patients with a slight low-back pain. Similar results were obtained by using the Sorensen test in other studies [10, 16]. This study reported significant differences in the back extensor endurance times across the gender. Different studies have reported markedly different values for endurance times; particularly between males and females. It has been demonstrated previously that females have significantly greater erector spinae endurance than males [4, 13]. This longer endurance time has been attributed to a greater presence of type I fibres in the lumbar region of females [14]. However, this may not be the only reason for an extended endurance time; instead the back may be receiving support from the biceps femoris and gluteus maximus [1] which are key stabilizers of the trunk.

5 CONCLUSION

This paper has described the measures of trunk flexor and trunk extensor endurance and low back flexibility specifically as they relate to individuals with chronic LBP. This study also showed that trunk muscles in Medical Laboratory Technicians with LBP were more easily fatigued, compared with trunk muscles in Healthy Subjects. Training has been shown to improve measured endurance characteristics of the trunk muscles, but diverse intervention programs over several months of duration appear to be the most successful in improving the endurance level.

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