The relationship between strength and static endurance of trunk muscles in patients with chronic low back pain

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Abstract— *Chronic Low Back Pain (CLBP) contributes to majority of musculoskeletal conditions and a major cause of disability which affects the performance at work and general well-being. In Sri Lanka, CLBP is one of the frequent reasons for medical consultation. It also leads to an increasing global health concern. Researchers have extensively investigated the mechanical factors of patients with CLBP. Yet, controversy exists regarding what factors might contribute to CLBP. Currently, there is inadequate research examining the strength and endurance of trunk muscles simultaneously. Therefore a descriptive cross-sectional study was conducted, with 200 CLBP patients within the age of 20-60 at the Department of Rheumatology and Rehabilitation, National Hospital of Sri Lanka. Qualitative and quantitative data were obtained using pre-validated questionnaires. Oswestry Disability Index (ODI) was used to measure the level of disability. Modified Sphygmomanometer was used to measure the isometric strength of trunk muscles. Static endurance of trunk extensors tested using Biering –Sorensen test and McGill's test was used to measure the endurance of trunk flexors. Results of the Pearson's correlation test exhibit statistically significant positive relationship between strength and static endurance of trunk flexors and extensors ($p < 0.05$) with the strength of trunk flexors and extensors having the highest correlation ($r = 0.61$). Hence, it is recommended to include both strengthening and endurance exercises in the rehabilitation programs.*

Keywords— **Chronic low back pain, Strength of trunk flexors, Strength of trunk extensors, Endurance of trunk flexors, Endurance of trunk extensors.**

I. INTRODUCTION

Chronic low back pain (CLBP) is a widespread health problem throughout the world and a major cause of disability. As estimated, CLBP is a leading musculoskeletal disorder that causes long term disability for more than 30 million of the world's population. CLBP affects work performance and general well-being and is a major reason for medical consultation.

Many environmental and personal factors influence the onset and cause of CLBP. Reduced endurance and strength of the trunk muscles are important factors in CLBP. In general,trunk muscles are constantly activated throughout the day, but pain and inactivity may alter the function of these muscles. This can result in fatigue, in normal daily activities (Karunanayake *et al.*, 2013). Several studies have reported that a significant reduction of muscle endurance and strength cause muscular fatigue and overload of soft tissue and passive structures, resulting CLBP (Manchikanti *et al.,* 2000; Nourbakhsh *et al.,* 2002; O'Sullivan *et al.,* 2006; Sung *et al.,* 2009).

Most of the studies have been proceeded to evaluate the strength and endurance of both trunk muscle groups independently. However, analyzing both strength and endurance of trunk muscles (flexors and extensors) in the same cohort of CLBP patients may provide a better evaluation of this condition and thereby in-depth undressing of the underlying mechanisms.

The aim of this study was to examine the relationship between the strength and static endurance of trunk flexor and trunk extensor muscles in patients with CLBP. Currently, there is limited evidence for the relationship between the strength and static endurance of trunk muscles in patients with CLBP in Sri Lanka. The knowledge about anatomical and physiological factors and the mechanism of the impaired function of trunk muscles is essential for planning rehabilitation programs for CLBP. Though there are several rehabilitation programs are currently ongoing for CLBP, it is still becoming a major problem that reduces the Quality of Life (QOL) and the limitations of Activities of Daily Living (ADL). The findings of this study might provide important insights into designing novel physiotherapy interventions and treatments for CLBP patient

2. METHODOLOGY

A descriptive cross-sectional study was carried out with 200 CLBP patients who had been diagnosed with mechanical chronic (more than 12 weeks) low back pain by a Consultant Rheumatologist and attended for the physiotherapy treatments in the Department of

Rheumatology and Rehabilitation (General) National hospital of Sri Lanka using consecutive sampling technique.

All consecutive patients who fulfilled the eligibility criteria and consented to participate during the period of 2 months were included in the study.

Male and female patients between 20-60 years, patients who were diagnosed with Chronic Low Back Pain (more than 12 weeks) by a consultant Rheumatologist and confirmed as mechanical low back pain by the senior physiotherapist and patients who had given informed written consent to participate in the study were used as inclusion criteria. Exclusion criteria included History of systemic/ localized neurological/ muscular disorders, any disease related to the genitourinary system, fractures in spine, pelvis and the lower extremities, trunk, pelvis hip and lower limb deformities, history of spinal or abdominal surgery, continuing pregnancy, presence of rheumatoid arthritis, tuberculosis, kidney failure, liver failure, spinal infections, presence of leg length discrepancy of more than 10mm, intolerable pain during the measurement gaining procedures, history of osteoarthritis in any joint, history of osteoporosis, patients who are engaged in sports activities and patients presented with muscle injuries.

The social demographic data sheet was used to collect socio-demographic factors. Oswestry Disability questionnaire, whichis considered as the 'gold standard' of low back functional outcome tools (Fairbank and Pynsent., 2000) was used to measure the level of disability.

Cuff method of the modified sphygmomanometer was used and adapted as suggested by Souza *et al*. (2014) to measure the strength of trunk muscles. Endurance of trunk flexors was tested using McGill's trunk flexor endurance test and test procedures were performed according to previously published methods (McGill, 1999). Endurance of trunk extensors was tested using Biering – Sorenson test. The procedure was carried out according to the original method brought forward by Biering-Sorensen in 1984.

Statistical Package for Social Sciences (SPSS) version 23.0 software was used for data analysis. Sample characteristics were analyzed using descriptive statistics. The relationship between the strength and endurance of trunk muscles was detected using Pearson correlation. Variables were expressed in means and standard deviations with the significant level set at 0.05.

3. RESULTS

Mean age of the sample was 49 (SD±11). Majority of the subjects were female (n = 140, 70%).

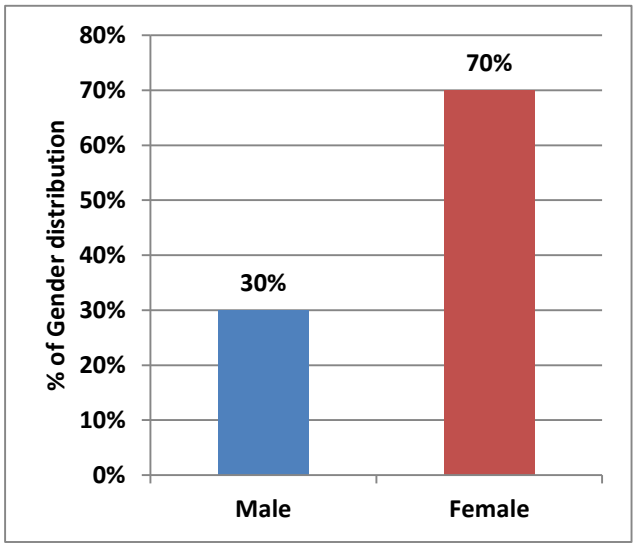

Figure 1. Gender distribution

Greater proportion of CLBP patients were women. Further states that individuals over 40 years have three to four times higher prevalence compared to younger individuals.

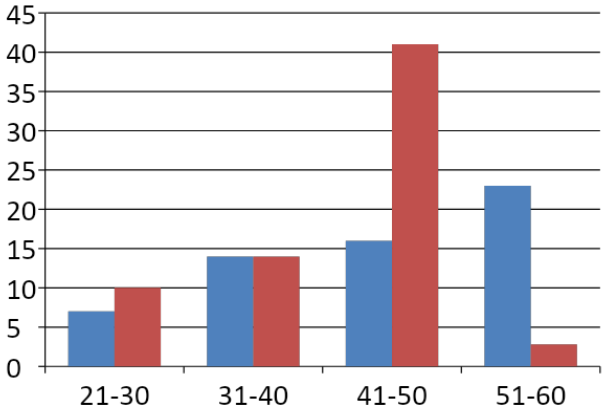

Figure 2. Distribution of age category

The mean strength and endurance of trunk flexors and extensors are summarized in table 1. Strength is higher in extensors, but endurance is greater in flexors.

Table 1.Descriptive statistics of strength and endurance measurements

	Mean	SD
Strength of trunk flexors (kPa)	18.32	4.37
Strength of trunk extensors (kPa)	24.28	6.30
Endurance of trunk flexors (s)	33.39	19.25
Endurance of trunk extensors (s)	24.85	19.18

The strength of trunk flexor muscles and extensor muscles had a positive linear relationship which was moderate, (r = 0.61, p <0.001).

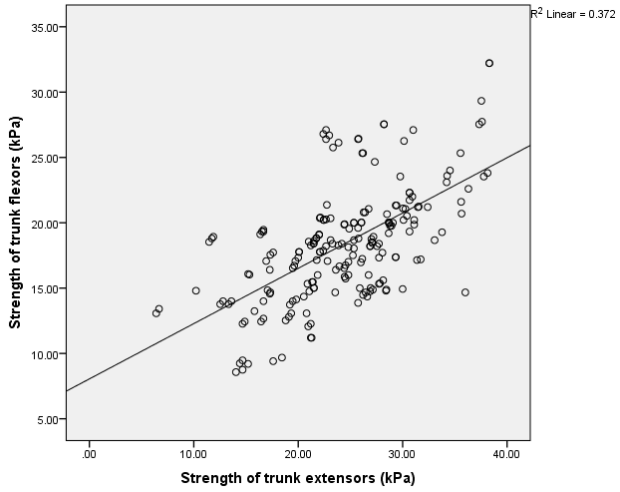

Figure 3.Correlation of strength between trunk flexors and extensors

The correlation between static endurance of trunk flexor muscles and extensor muscles was linear and positive but weak in magnitude (r = 0.37, p <0.001).

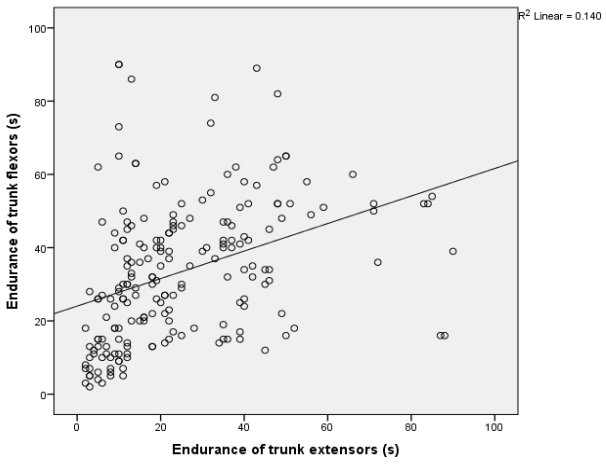

Figure 4. Correlation between endurance of trunk muscles

4. DISCUSSION

In line with our study, in prior studies also a greater proportion of CLBP patients have been women. Prior studies have reported the decreased trunk muscle strength is strongly associated with CLBP (Cho *et al*., 2014; Bayramoglu *et al*., 2001). Also, there is evidence that the strength of trunk flexors is lower than that of extensors. In consistent with these studies, we observed that trunk flexors have lower strength than extensors. This imbalance is caused by the failure of antagonist muscles to produce enough strength to decelerate the action of agonist.

In contrast to strength, endurance was lower in trunk extensor muscles, compared to flexors. Current study results have shown a reduction of the endurance of trunk extensors than the endurance of trunk flexors, which in corroboration with the findings of Lewis *et al*. (2013). Higher levels of endurance of trunk flexor muscles might represent a compensatory mechanism to improve the spinal stability while holding the increased pressureonlumbar spine due to compressive loading forces (Perry et al., 2009).

Hence, there is a statistically significant relationship between the strength and static endurance of trunk flexors and extensors in patients with CLBP. But, there is no corroborative evidence since this is the first study that has been conducted to investigate the values of strength and static endurance of both trunk flexors and extensors within a single study. However,Khant and Kokni. (2015) carried out a study to find out the relationship between trunk muscle strength and endurance in well-functioning young individuals and suggested that there is a positive correlation between the strength and endurance of trunk flexors and extensors.

At present, most of the clinical rehabilitation protocols are designed focusing on improving the strength of back muscles in patients with mechanical CLBP. A remarkable extraction of this study has emerged that improving endurance is essential as well the strength. It is also important to prevent the occurrence of mechanical CLBP due to the imbalance of trunk muscles.

5. CONCLUSION

There is a positive linear relationship between the strength and static endurance of trunk flexor and trunk extensor muscles in chronic lower back pain patients. Therefore our findings provide important knowledge that enhancing both strength and endurance of trunk muscles will result in added benefits to CLBP patients

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Abbreviations

LBP : Low Back Pain

CLBP : Chronic Low Back Pain

MST : Modified Sphygmomanometer Test

QOL : Quality Of Life

ADL : Activities of Daily Living

BMI : Body Mass Index

ODI : Oswestry Disability Index

SD : Standard Deviation

Df : Degree Of Freedom

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