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# Impact of Back Muscle Functions, Spinal Range of Motion and Fear Avoidance Beliefs on Disability in Chronic Non-Specific Low Back Pain

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***ABSTRACT***

***Background:*** *Non-specific LBP is one of the most common conditions for which individuals seek the advice of a physiotherapist. Physical Therapists must be able to identify those attributes that contribute to Functional disability in patients with non specific LBP and recognize interventions that prevent or minimize the progression to chronicity.*

***Methodology:*** *63 subjects (32 males and 31 females) suffering from non-specific chronic LBP were assessed for trunk extensor muscle endurance (using the modified Biering-Sorensen Test); trunk extensor muscle strength (using the back-and leg dynamometer); back muscle flexibility (using the sit and reach test); spinal range-of-motion (using the universal goniometer and tape measure), Fear avoidance beliefs for physical activity & work ( Fear-Avoidance Beliefs Questionnaire) and functional disability (Revised Oswestry Low Back Pain Disability Questionnaire).*

***Result and conclusion:*** *Decreasing trunk extensor muscle endurance (r= -0.65, p= 0.0001), muscle strength (r= -0.44, p= 0.0004) and back muscle flexibility (r= -0.68, p= 0.0001) are significant factors leading to functional disability in LBA. Psychological factors i.e. fear-avoidance belief for physical activity (r=0.25, p= 0.0467) and fear-avoidance belief for work (r=0.31, p= 0.0140) were also found to be one of the major factors for increasing disability in non-specific low back pain. However, impact of spinal range-of-motion on disability was not significant.*

***Key Words:*** *Deconditioning, Endurance, Strength, Flexibility, Range-of-motion, Disability, Non-specific low back pain*

## INTRODUCTION

Low Back Pain (LBP) is an important clinical, social, economic, and public health problem affecting the population indiscriminately. The term low back pain refers to pain in the lumbosacral area of the spine encompassing the distance from the 1st lumbar vertebra to the 1st sacral vertebra (Kravitz *et al.,* 1995). Non-specific low back pain is defined as low back pain not attributed to recognisable, known specific pathology. It includes common diagnoses (in 85-90% of all individuals seeking care), such as lumbago, myofascial syndromes, muscle spasms, mechanical LBP, back sprain, and back strain.

Back pain causes major medical and economic problems in Western industrialized countries (Van Tudler *et al.*, 1997). It ranks high as a cause of disability and inability to work, and as an interference with the quality of life. Low back pain is considered the most prevalent pain complaint affecting the general population, with a reported lifetime prevalence of up to 75% (one-year prevalence 15% to 45%, adult incidence 5% per year). At any one time, 1 in 5 adults will report symptoms of LBP (Harreby *et al.*, 1996; Hillman *et al.,* 1996). Philips and Grant (1991) have described that between 30% and 40% of patients suffering from LBP never completely recover and, on the contrary, later develop permanent chronic LBP symptoms. LBP is the leading cause of limiting activity and is the second leading cause of absenteeism from work (Deyo and Tsui-Wu, 1987). This condition therefore causes a very significant economic burden for individuals, families, communities, industry and governments (Hoy *et al.*, 2010).

Disability often accompanies LBP, varies in extent and may be temporary or even permanent (Deyo *et al.,* 1998). It seems to be one of the most important determinants for seeking healthcare in patients with LBP. The "deconditioning" process has been held responsible for the development and persistence of low back pain associated disability. It was hypothesized that, due to Chronic Low Back Pain (CLBP), patients diminish normal activities and develop, besides societal and emotional problems, physiological deconditioning signs such as loss of muscle strength and decreased cardiovascular endurance as well as reduced aerobic capacity (Mayer and Gatchel, 1988; Verbunt *et al*., 2003). Deconditioning due to low back pain is related to a number of factors including trunk muscle endurance, trunk muscle strength, back muscle flexibility, mobility of the joints and fear of pain and avoidance behaviour.

Avoidance and fear about moving after the onset of an episode of LBP are common. Reports indicate that up to 40% of those with LBP have reduced leisure activities as a result of their symptoms (Jensen *et al*., 2009). Low back pain, which precipitates as decreased activity and fear avoidance beliefs, may lead to an actual or perceived decline in conditioning. Therefore, the impact of physical activity or conditioning on disability in LBP must be understood. It is necessary to find out the most important factor of deconditioning leading to reduced function in low back pain.

**METHODOLOGY**

Sixty three individuals (both male and female) with mean age of 40.22 years, diagnosed with a history of chronic non-specific low back pain (episode of LBP not more than 2 years) were included. None of them was involved in any specific athletic activities.

Subjects with history of trauma, cardiovascular disease, spinal surgery, rheumatoid arthritis, neurological disorders like multiple sclerosis, and congenital deformities of spine like scoliosis were excluded. Also pregnant individuals, subjects diagnosed with acute low back pain, and specific low back pain were excluded.

**Measurement for trunk extensor muscle endurance**:

The trunk muscle endurance was measured using the Modified Biering-Sorensen Test as explained by Moreau *et al.,* 2001. The subject lying prone at the edge on the examination table were asked to maintain an unsupported trunk (from the upper border of the iliac crest) horizontally until he/she could no longer hold a horizontal position or for a maximum of 240 seconds. The buttocks and legs are fixed to the table with three, three inch canvas straps and the arms at the sides of the head. A pad placed under the ankles prevented subjects

from bracing against the table with their feet. The time is recorded (in seconds) for maintaining the horizontal position.

For physically active LBP subjects, the test-retest reliability of the Modified Sorensen test for those studies reporting intraclass correlation coefficients (ICCs) ranged from 0.82 to 0.96 (Moffroid et al., 1994 ; Simmonds et al., 1998); inactive LBP subjects demonstrated an ICC of 0.39 (Moffroid et al., 1994).

**Measurement of trunk extensor muscle strength**:

Isometric trunk extensor muscle strength was measured using the back and leg dynamometer (Heyward, 2006). Each individual was instructed to stand on the platform with knees fully extended and head and trunk erect. The participant grasped the hand bar using an alternating grip and the hand bar was positioned across the thighs. The participant was instructed to pull the hand bar straight upward using the back muscles and to roll the shoulders backward during the pull, without leaning backward. The pointer on the dial indicated the force exerted in pounds. Each pull lasted approximately 3 seconds. Three trials were administered with a 1-minute recovery period between each.

The back-and leg dynamometer has been found to be of high validity and reliability (0.85-0.99). The test-retest reliability has been found to be significant and acceptable (ICC=0.94-0.99) (Hannibal et al., 2006).

**Measurement of Back muscle Flexibility:**

Back muscle Flexibility was measured using the Sit-and-Reach test (Baltaci *et al.,* 2003). The participants sat on the examination table with shoes removed, and fully extended the two legs so that the sole of the feet were flat against the end of the sit-and-reach box. They extended their arms forward, placing one hand on top of the other. With palms down, they reached forward sling hands along the measuring scale as far as possible without bending the knees. The score (in centimetres) was determined by the furthest position they reached with their middle fingertips on the scale. Three trials were performed. The average of the three trials was used for subsequent analyses.

The Sit and Reach board, a wooden device with the following dimensions: length of base 35cm, width 45cm, height 32cm and length 55cm was used in the study to measure the back muscle flexibility (Cornbleet and Woolsty, 1996). Studies have shown the Sit-and Reach Test as highly reliable ($0.96 < R < 0.99$) and the validity coefficients for the test ranged from 0.64 to 0.88 (Jackson & Baker, 1986).

**Measurement of Spinal Range of Motion:**

Spinal Range of Motion was measured by the method explained by Norkin and White, 2003. The flexible measuring tape was used to measure the forward flexion, extension and lateral flexion of the spine. The universal goniometer was used to measure spinal rotation.

The reliability of joint position and ROM using the universal goniometer has been found to be good to excellent (Norkin and White, 2003).

**Measurement of Disability:**

Revised Oswestry Low Back Pain Disability Questionnaire (Hudson-Cook *et al.,* 1989) was used to measure the disability. It is a 10-item self-report instrument that evaluates perceived disability in 10 sections: pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life, travelling and changing degree of pain. The scoring is done on an ordinal scale. Each section has 6 possible answers. Statement 1 is graded as 0 points; statement 6 is graded as 5 points. The total score is obtained by summing up the scores of all

sections, giving a maximum of 50 points. The final score is expressed as a percentage with the following formula: (total score/ (5 × number of questions answered) × 100%.

The questionnaire has good construct validity, pointed out by internal consistency (alpha: 0.71 to 0.87), responsiveness (AUC= 0.94) and reliability (ICC=0.90; 95% CI= 0.78 –0.96) (Fritz and Irrgang, 2001).

**Measurement of Fear – avoidance Beliefs:**

To measure the fear-avoidance beliefs the Fear- Avoidance Belief Questionnaire (FABQ) was used (Waddell *et al.,* 1993). The questionnaire is divided into subscales for physical activity (FABQ-PA) and work (FABQ-W). It consists of 16 items and patients rate their agreement with each statement on a 7-point Likert scale (0 = completely disagree, 6 = completely agree).

The FABQ has been demonstrated to be valid and reliable in a chronic LBP population. The internal consistency (alpha) has been found to be 0.88 for FABQ-W and 0.77 for FABQ-PA (Waddel et al., 1993).

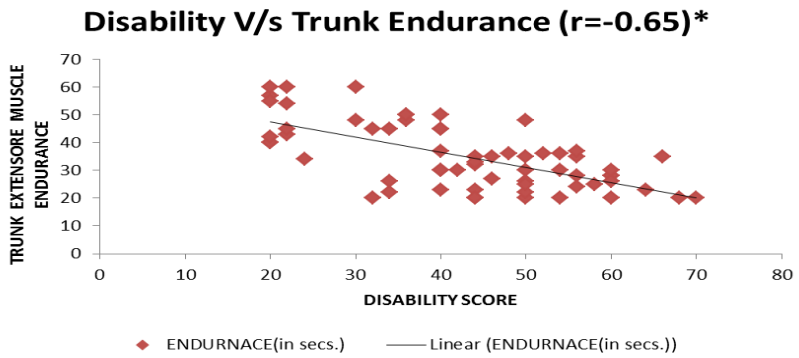
## RESULTS AND ANALYSIS

Coefficient of correlation was used to establish relationship between disability and other parameters including endurance, strength, flexibility, spinal range-of-motion and fear-avoidance beliefs. The level of significance was set at $P < 0.05$.

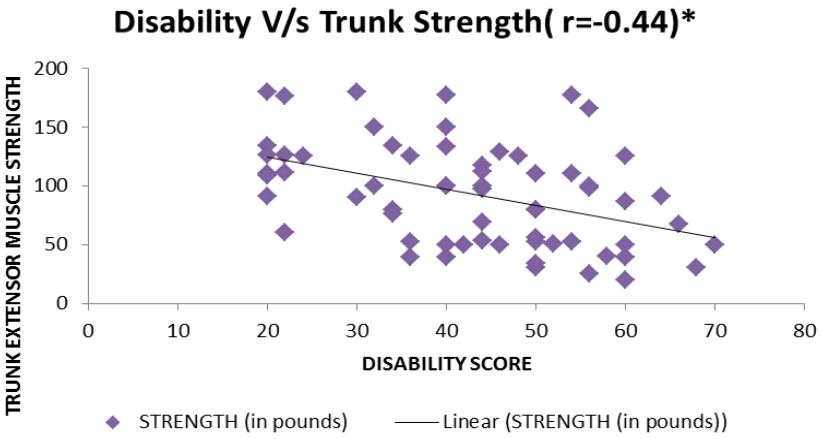
**Table 1: Correlation of endurance, strength and back muscle flexibility with disability**

| | **r** | **P** |
|---|---|---|
| Disability Vs Trunk extensor muscle endurance | -0.65324 | p≤0.05 |
| Disability Vs Trunk extensor muscle Strength | -0.43556 | p≤0.05 |
| Disability Vs Back muscle Flexibility | -0.68015 | p≤0.05 |

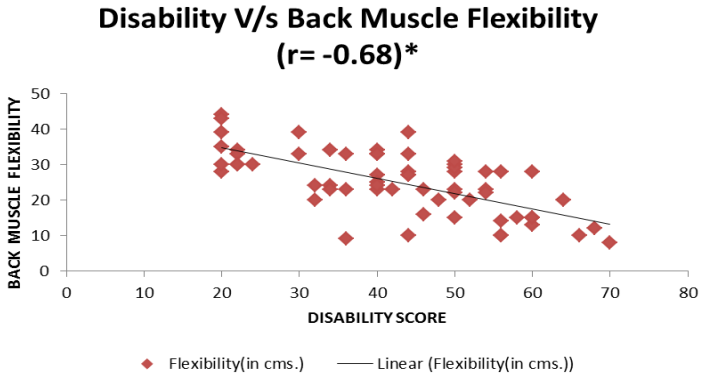
The values for Pearson's Correlation coefficient(r) obtained from the analysis for relation of disability with trunk extensor muscle endurance (-0.65), strength (-0.435) and flexibility (-0.68) were found to be greater than its critical values at p≤0.05. This shows that there exists negative significant correlation between these parameters and disability.




Graph 1: Correlation between the Disability and Trunk extensor muscle endurance




Graph 2: Correlation between the Disability and trunk extensor muscle strength

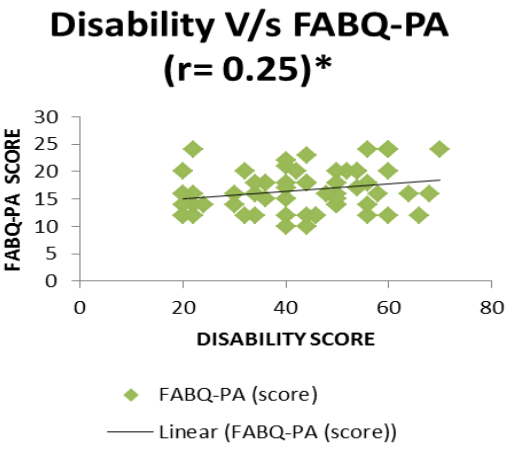



Graph 3: Correlation between disability and back muscle flexibility

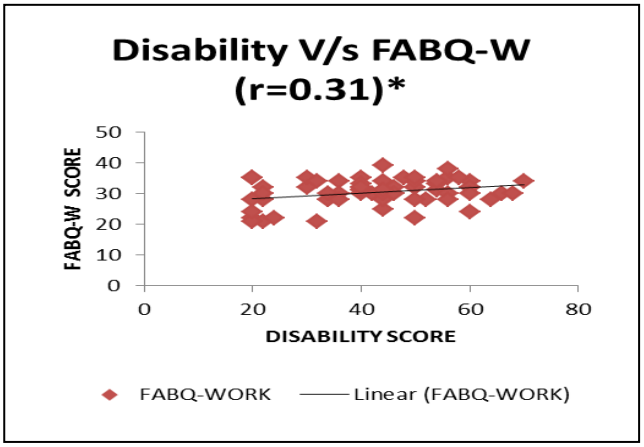
**Table 2: Correlation analysis between disability and spinal range-of-motion (ROM)**

| | **r** | **P** |
|---|---|---|
| Disability Vs Forward Flexion | -0.14279 | p≥0.05 |
| Disability Vs Extension | -0.17782 | p≥0.05 |
| Disability Vs Lateral Flexion(right) | -0.16471 | p≥0.05 |
| Disability Vs Lateral Flexion(left) | -0.12206 | p≥0.05 |
| Disability Vs Rotation (right) | -0.12482 | p≥0.05 |
| Disability Vs Rotation (left) | -0.15125 | p≥0.05 |

The value of 'r' was found to be less than its critical value at p≤0.05, for all spinal movements (Table 2). It is concluded that there exists statistically non-significant relationship between disability and spinal ROM.




Graph 4: Correlation between disability and Fear-avoidance belief-physical activity




Graph 5: Correlation between disability and FABQ-W

**Table 3: Correlation between disability and Fear avoidance belief for physical activity and work**

| | r | P |
|---|---|---|
| Disability Vs FABQ-PA | 0.25155 | p≤0.05 |
| Disability Vs FABQ-W | 0.308039 | p≤0.05 |

The Pearson's Correlation coefficient(r) obtained from the analysis to study the relationship between disability with fear-avoidance belief for physical activity and fear-avoidance belief for work was found to be greater than its critical value at p≤0.05. Thus it is concluded that it is not a chance finding and that the correlation is statistically significant.

**DISCUSSION**

Results of the study suggested that deconditioning of the trunk muscles i.e. reduced muscle endurance, muscle strength and flexibility have a significant impact on functional disabilities in patients with low back ache. Functional disability increases significantly with decrease in the muscle endurance, strength, and flexibility of trunk muscles. This can be attributed to physical deconditioning in the postural muscles. Inactivity in chronic LBP pain patients causes changes such as decrease in muscle mass and composition. In micro-gravity simulation models, postural muscles that normally counteract the effects of gravity have been reported to become atrophic to a greater extent than fast contracting locomotor muscles (St.-Pierre and Gardiner, 1987).

Decreased trunk strength and endurance associated with a cyclical pattern of deconditioning through pain, avoidance and inactivity have been noted as defining characteristics in LBP (Biering-Sørensen, 1984; Mayer and Gatchel, 1988). Moreover, lack of adequate muscle length leads to difficulty in sitting, walking, standing, and sleeping which may further add to the disability. Decreased flexibility of the hamstrings muscle and the back has been thought to contribute to the development of LBP and progression of chronic LBP and disability.

The findings of the present study are in agreement with the study done by Kazunori *et al.* (2004) who investigated the relationship of functional disability with isokinetic trunk muscle strength in wrestlers. The author found significant correlation between disability levels of LBP with isokinetic trunk extensor muscle strength in subjects who didn't have any radiological abnormality.

A significant relationship between disability and fear-avoidance belief for physical activity and fear-avoidance belief for work is also observed .The findings are in agreement with the study done by Crombez *et al.* (1999) who found the FABQ to correlate with measure of disability and with another measure of fear-avoidance (Tampa Scale of Kinesiophobia) in patients with chronic low back pain. The FABQ-W was related to length of time off work. The pain-related fear and the fear of movement leads to disabling low back pain. Reductions in fear avoidance beliefs about work and physical activity, as well as increased perceptions of control over pain, have been associated with reductions in disability.Waddell *et al.* (1993) found a strong association between low back–related disability and fear-avoidance beliefs, or the extent to which patients avoid activity based on the anticipation of pain.

George *et al.* (2003) in their study found that those individuals who participated in a fear avoidance treatment program had a significant improvement in fear avoidance beliefs; subsequently, low back pain and fear avoidance beliefs about physical activity were significantly lower than the standard care group at 4 weeks and 6 months after treatment. There are many considerations when managing patients with an episode of LBP, and practitioner must consider the fear avoidance beliefs of the patient. Some practitioners approach the management of LBP conservatively, which includes recommendations of bed rest, sick leave from work, or perhaps decreasing daily activities. These beliefs may contribute to the disabling nature of LBP.

Educating patients on the natural course of LBP and recommending the continuation of tolerable physical activity can have a significant impact on the course of LBP. Patients with chronic LBP may be managed successfully with an approach that includes information for patients about the nature of the problem that is designed to reduce fear. The benefits of maintaining customary activity levels should be told to the patients with LBP. Van Tulder *et al.* (1997) have indicated to review the psychosocial factors, and reassess those patients who are not resolving in few weeks, or those who are on a worsening course.

A statistically non significant relationship was found between all four spinal movements, i.e., forward flexion, extension, lateral flexion, rotation and disability. The fact that the performance of activities of Daily Living (ADLs) uses only the functional range of motion (ROM) could be attributed for these findings of the study. Mobility tests of the lumbar spine have been weakly correlated with disability (Deardorff *et al.,* 1991; Burton *et al.*, 1995). Therapists interested in documenting changes in a patient's disability with treatment should probably not restrict their observations to changes in the patient's active ROM impairment, rather include all the components leading to deconditioning and disability in their evaluation and treatment programs.

Conversely many researchers have pointed out that normal spinal mobility is an important goal in the rehabilitation of back pain disability (Mellin, 1995; Atya, 2012). However, mobilizing exercises have not been as successful as treatments of a less mobilizing nature (McDonough *et al.,* 2010). The relation between lumbar range of motion measures and functional ability was found to be nonexistent (Parks *et al.,* 2003).

## CONCLUSION

From the observations made in the study it can be suggested that deconditioning syndrome as a factor contributing to the chronicity should form the basis of intensive physical rehabilitation for chronic low back pain. Incorporation of endurance and strength exercises for the trunk and back flexibility exercise will prevent the disability due to back pain and expedite the recovery process in low back pain patients. Educating patients on the natural course of Low Back Pain and recommending the continuation of tolerable physical activity should be incorporated as well.

Further studies investigating occupation, level of stress and low back pain should be conducted. Another consideration should be comparison of the postural changes with the work load in men and women and determine the effect of gender on these components.

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