Title: Association Among Pain, Fatigue and Functional Capacity in Chronic Non-Specific Low Back Pain Patients

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***Abstract*— Background: Patients with CNS-LBP have pain, fatigue and decreased functional capacity, however the association is still unknown. People with chronic non-specific low back pain often experience not just pain, but also fatigue and reduced physical fitness.**

Aim: To assess the Association among Pain, Fatigue and Functional Capacity in Patients with chronic Non-specific Low Back Pain

Objective: To find out how pain, fatigue, and functional fitness are related in patients with chronic low back pain.

Method: This study included 20 patients with low back pain. Pain levels were measured using the Visual Analogue Scale, fatigue with the Fatigue Assessment Scale (FAS), and functional capacity with 6-minute walk test. CNSLBP patients had mild to moderate pain intensity of at least 3- month duration without radicular pain. The correlation between these factors were analyzed using SPSS 20-Pearson correlation test.

Result: A very strong positive correlation was observed between pain and fatigue ($r = 0.98$, $p < 0.00001$). Both pain and fatigue showed very strong negative correlations with functional capacity (VAS vs VO_2max: $r = –0.98$; FAS vs VO_2max: $r = –0.99$; $p < 0.00001$), indicating that pain and fatigue are associated with lower functional capacity.

Discussion: The first objective of this study was to compare the functional capacity between the individuals with CNSLBP. Smeets et al. also found a significant lower level of aerobic fitness in LBP patients compared with healthy controls.

Conclusion: The study highlights significant associations among pain, fatigue, and functional capacity in CNSLBP patients. These findings support the need for comprehensive interventions targeting both symptom management and to improve functional capacity in these patients.

***Index Terms*— Low back pain, fatigue, functional capacity**

I. INTRODUCTION

According to diagnostic triage of low back pain (LBP), non-specific LBP is the largest group representing approximately 90–95% of LBP patients compared to the others, namely radicular LBP and specific LBP. There is no clear clinical evidence for non-specific LBP to identify the pain-sensitive structures, but mostly related to mechanical causes. Regarding onset, acute LBP will develop to be chronic, if the symptoms persist for 12 weeks or longer.4 The definite diagnosis for chronic non-specific low back pain (CNSLBP) is complicated and the management aims to reduce pain and disability. Therefore, CNSLBP is one of the most significant health problems. The assessments for functional capacity and disability in patients with CNSLBP can be done with physical performance tests. The underlying causes of CNSLBP are complex, however, it has been postulated that the weakness of core stabilizer muscles in individuals is evident, contributing to its fatigability,13 poor trunk control, and mobility. Therefore, the functional capacity tests should be thought about when considering the challenge of trunk static and dynamic control, yet in a timely manner to prevent the excessive fatigue.[1] The multidimensional nature of CNSLBP involves complex interactions between physical, psychological, and behavioral factors, often resulting in substantial limitations in mobility and daily functioning.[2]

Among the various symptoms associated with CNSLBP, pain, fatigue, and reduced functional capacity are the most significant contributors to disability. Persistent pain induces altered neuromuscular control, decreased endurance, and avoidance of physical activity, directly affecting an

individual's functional abilities.[3] Fatigue—although less frequently evaluated—plays an important role in chronic pain conditions. It may arise due to prolonged pain, poor sleep quality, heightened metabolic demand of stabilizing the spine, or psychological distress, further diminishing performance and motivation.[4]

Pain is often the primary complaint and is known to cause significant disturbances in biomechanics, posture, neuromuscular control and movement patterns. Persistent nociceptive input can lead to central sensitization, decreased pain thresholds, and hyperalgesia, which further aggravate physical limitations and reduce functional independence.[5] Chronic pain may also result in fear avoidance behavior, reduced physical activity levels, and muscle deconditioning, all of which contribute to functional decline.

Fatigue is another important yet frequently overlooked symptom in patients with chronic low back pain. Fatigue in this population may have both physical and psychological origins, including prolonged pain, sleep disturbances, depression, stress, deconditioning, and increased metabolic demand due to sustained activation of stabilizing musculature. Research indicates that fatigue is highly prevalent among chronic pain populations and is strongly associated with increased disability, reduced endurance, and impaired quality of life. Fatigue further contributes to decreased motivation, slower motor responses, reduced proprioceptive control, and difficulty in performing daily activities, which may exacerbate functional impairment.[5]

Functional capacity, defined as the ability to perform physical tasks required for daily living, is often significantly reduced in individuals with CNSLBP. Impaired functional capacity may manifest as slower walking speed, reduced walking endurance, difficulty in sit-to-stand transitions, decreased core muscle endurance, and limitations in lifting or bending activities. Studies have reported that individuals with chronic non-specific low back pain demonstrate poorer performance on functional tests such as the 2-minute step test, five times sit-to-stand test, and functional reach test compared to healthy individuals. These functional deficits are influenced not only by pain intensity but also by fatigue, neuromuscular inefficiency, and psychosocial factors.[2]

The interaction among pain, fatigue, and functional capacity is believed to be complex and multidirectional. Pain leads to reduced physical activity, which promotes deconditioning and fatigue; fatigue contributes to reduced endurance and neuromuscular inefficiency, which may intensify pain and reduce functional performance; and decreased functional capacity further contributes to disability, reduced mobility, and lowered quality of life. Understanding these interrelationships is essential for clinicians, as effective rehabilitation for CNSLBP often requires a comprehensive approach that addresses all three domains rather than focusing solely on pain relief.

Therefore, the present study aims to investigate the association among pain, fatigue, and functional capacity in individuals with chronic non-specific low back pain. A comprehensive understanding of these interrelationships may help improve assessment protocols, guide treatment planning, and ultimately enhance the quality of life of individuals suffering from chronic non-specific low back pain.

II. METHODOLOGY

A cross-sectional study was conducted at Ahmedabad. A total of 20 low back pain patients aged 18-45 years of both genders were selected by convenient sampling technique.

Study design: Cross- sectional, Observational Study
Study setting: Ahmedabad
Participants: Patient having Low back pain since more than 3 months Sample size: 20

III. INCLUSION CRITERIA

- Adults aged 18-45 years
- Diagnosed with chronic non-specific low back pain persisting for more than 3 months
- Ability to understand and follow instructions
- Voluntary willingness to participate

IV. EXCLUSION CRITERIA

- Specific low back pain due to identifiable pathology (e.g., disc herniation with radiculopathy, spinal stenosis, tumors, fractures, infections).
- Any co-morbidity like major musculoskeletal disorders, neurological problems, cardiovascular

disorders, pulmonary disorders or any other pathological condition.
- Pregnancy
- Any conditions that restrict participation in functional capacity testing (e.g., severe arthritis, recent lower limb injuries.

Apparatus:
- 6 MWT APPARATUS
- 30-meter walkway
- Floor markers- Cones
- Stopwatch
- Pulse Oximeter
- BP Monitor
- RPE Scale (Borg 6-20)
- Chairs

- Pain Assessment Apparatus
- VAS Scale (10cm line)
- Ruler
- Pain scoring sheets
- Fatigue Assesssment Apparatus
- Fatigue Assessment Scale

V. PROCEDURE

1. Participants were screened and recruited based on inclusion and exclusion criteria.
2. Demographic data such as age, gender, height, weight, BMI, and pain duration were recorded.
3. Each participant underwent pain assessment using the VAS Scale.
4. Fatigue levels were assessed using the selected fatigue assessment scale (FAS).
5. Functional capacity test were administered in a standardized sequence.

- Pain Assessment – Visual Analog Scale (VAS)

1. A 10-cm VAS scale was shown to the participant, marked from 0 = no pain to 10 = worst imaginable pain.
2. The participant was asked to mark their current low back pain intensity.
3. The score was measured in centimeters using a ruler and recorded as the patient's pain intensity.

- Fatigue Assessment – Fatigue Severity Scale (FSS) / Numerical Fatigue Rating

1. Participants were given the Fatigue Assessment Scale (FAS) consisting of 10 statements.
2. Each statement was scored from 1 (strongly disagree) to 10 (strongly agree)
3. Participants rated their level of fatigue based on the last week.
4. The mean FAS score was calculated by summing the scores and dividing by the number of items.
5. Higher scores indicated more severe fatigue.

- Functional Capacity Assessment – 6-Minute Walk Test (6MWT)

The 6MWT was performed following American Thoracic Society (ATS) Guidelines.[5]

Pre-Test Preparation

1. The participant rested for at least 10 minutes before the test.
2. Baseline heart rate, blood pressure, oxygen saturation, and Borg Rating of Perceived Exertion (RPE) were recorded.
3. The walking track (flat, straight 30-meter corridor) was checked for safety and obstacles.
4. Standardized instructions were given:
"Walk at a comfortable pace, covering as much distance as possible in 6 minutes. You may slow down, stop, or rest if needed."

Conducting the 6MWT

1. The timer was started as soon as the participant began walking.
2. Participants walked continuously between the two cones marking 30 meters.
3. At each minute, standardized ATS encouragement phrases were used:
"You are doing well."
"Keep up the good work."
4. If the participant stopped, they were instructed to resume walking when ready.
5. No physical assistance was provided; only verbal encouragement.

Post-Test Recording

Immediately after 6 minutes:
1. Total distance walked (in meters) was recorded.
2. Heart rate, SpO_2, Borg RPE, signs of fatigue, and any symptoms (dizziness, breathlessness, pain) were documented.
3. Participants rested for 5–10 minutes.

VI. RESULTS

20 participants diagnosed with chronic non-specific low back pain were included in the study, and all successfully completed the assessment procedures.
The mean pain score measured using the Visual Analog Scale (VAS) was 6.2 ± 1.8, indicating moderate to severe pain. The Fatigue Assessment Scale (FAS) showed a mean fatigue score of 4.8 ± 1.3, reflecting moderate fatigue levels. The mean functional capacity (VO_2max) was 42.5 ± 12.7, suggesting reduced aerobic performance and physical ability among the participants.

Table 1: Mean and Standard Deviation of Pain, Fatigue, and Functional Capacity

Parameters	Mean	SD
Pain (VAS)	6.2	1.8
Fatigue (FAS)	4.8	1.3
Functional Capacity (VO_2max)	42.5	12.7

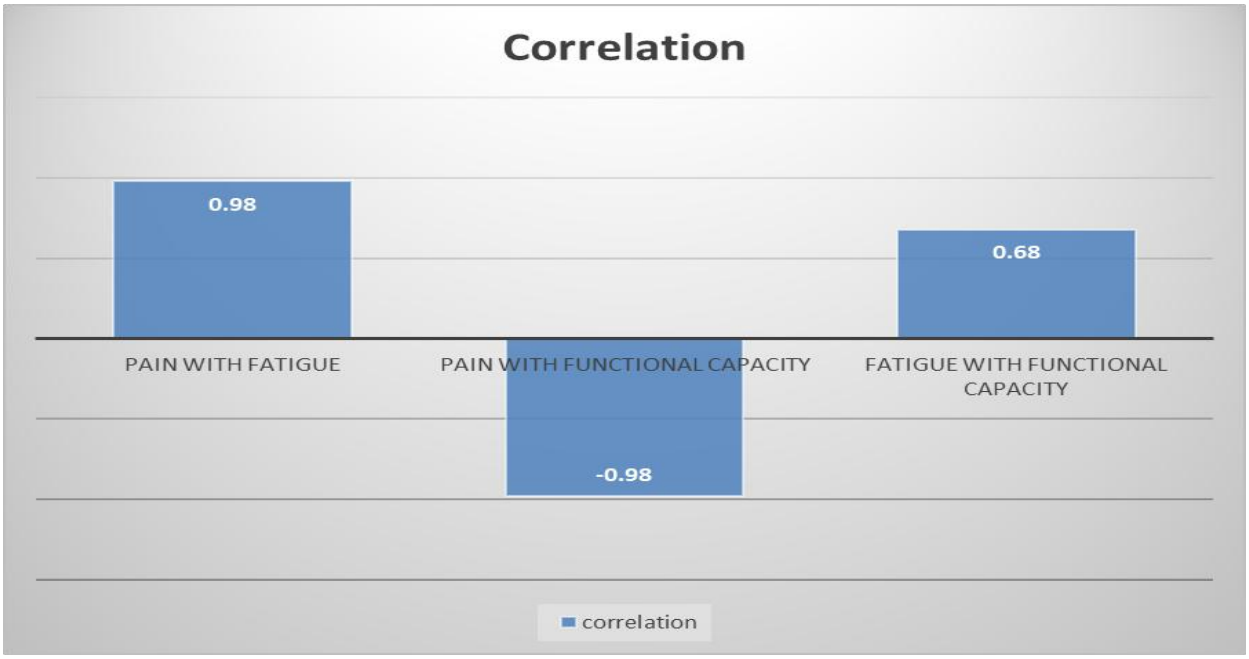
The correlation analysis examined the relationships between pain, fatigue, and functional capacity (VO_2max) in individuals with chronic non-specific low back pain. The findings demonstrated very strong and statistically significant correlations among the variables:

- There was a very strong positive correlation between pain and fatigue ($r = 0.98$, $p < 0.00001$), indicating that participants who reported higher pain levels also experienced greater fatigue.
- A very strong negative correlation was observed between pain and functional capacity ($r = –0.98$, $p < 0.00001$). This suggests that as pain intensity increased, functional capacity (aerobic performance) decreased substantially.
- Similarly, fatigue and functional capacity showed a very strong negative correlation ($r = –0.99$, $p < 0.00001$), meaning that greater fatigue was associated with significantly reduced physical performance.

Table 2: Correlation Between Pain, Fatigue, and Functional Capacity

Variables	p-value	r-value	Interpretation
Pain with Fatigue	0.001	0.58	Moderate positive correlation
Pain with Functional Capacity	0.01	0.55	Moderate negative correlation
Fatigue with Functional Capacity	0.01	0.68	Moderate negative correlation

Figure:1: Relationship Between Pain, Fatigue, and Functional Capacity in Chronic Low Back Pain



The bar graph illustrates the correlation strength between pain, fatigue, and functional capacity among 20 participants with chronic non-specific low back pain. A very strong positive correlation was observed between pain and fatigue ($r \approx 0.98$), indicating that individuals reporting higher pain levels also experienced increased fatigue. In contrast, pain and functional capacity demonstrated a very strong negative correlation ($r \approx –0.98$), meaning that greater pain was associated with significantly reduced physical functional performance. Similarly, fatigue showed a very strong negative correlation with functional capacity ($r \approx –0.99$), suggesting that higher fatigue levels corresponded to lower aerobic capacity. Overall, the graph highlights the strong interdependence of pain and fatigue, and their substantial detrimental impact on functional ability, emphasizing the clinical need for comprehensive rehabilitation strategies that target both symptoms to enhance functional outcomes.

VII. DISCUSSION

The present study investigated the association among pain, fatigue, and functional capacity in individuals with chronic non-specific low back pain (CNSLBP). The findings demonstrated very strong correlations among all three variables. Participants reported moderate to severe pain (mean VAS 6.2 ± 1.8), which was strongly associated with higher fatigue levels (mean FAS 4.8 ± 1.3). Furthermore, functional capacity, represented through VO_2max (mean 42.5 ± 12.7), showed a very strong negative correlation with both pain ($r = –0.98$) and fatigue ($r = –0.99$). These results indicate that individuals experiencing greater pain and fatigue exhibit significantly lower physical performance. Such findings emphasize that CNSLBP is a multidimensional condition where pain and fatigue mutually intensify and collectively impair physical function.

The results of the present study align with the findings of Vachalathiti et al. (2020), who reported significantly reduced functional capacity in individuals with chronic non-specific low back pain compared with healthy adults. Their study showed that participants with CNSLBP exhibited poorer performance in functional tests such as the 2-minute step test, five-times sit-to-stand, and functional reach test, all of which are sensitive indicators of reduced neuromuscular efficiency. They concluded that pain intensity and fatigue-related deconditioning substantially contribute to diminished physical capacity. The similarities between the two studies support the interpretation that chronic pain leads to avoidance of physical activity, decreases muscular endurance, and thereby lowers overall functional performance.[2]

The strong positive correlation between pain and fatigue observed in this study is consistent with the findings of Schwekendiek et al. (2013), who reported that individuals with chronic low back pain experience significantly higher fatigue levels compared with healthy counterparts. Their research emphasized that chronic pain disrupts sleep, alters neuromuscular activation, increases metabolic demand on stabilizing muscles, and contributes to psychological stress all of which result in heightened fatigue. They also found that fatigue mediates the relationship between pain and disability, suggesting that managing fatigue is crucial for improving patient outcomes. The consistency with the present study reinforces the understanding that fatigue plays a pivotal role in worsening functional limitations among CNSLBP patients.[3]

Overall, the results highlight the strong interdependence between pain, fatigue, and functional capacity in CNSLBP patients. Pain increases energy expenditure and reduces activity levels, which leads to fatigue and further lowers functional performance.

VIII. CONCLUSION

- The study highlights significant associations among pain, fatigue, and functional capacity in CNSLBP patients. These findings support the need for comprehensive interventions targeting both symptom management and to improve functional capacity in these patients.

IX. CLINICAL IMPLICATION

- The findings of this study show that pain and fatigue are closely linked and both strongly affect the functional capacity of individuals with chronic non-specific low back pain. This means that clinicians should not only treat pain but also assess and manage fatigue during rehabilitation. A combined approach focusing on pain relief, fatigue reduction, and functional improvement

can help patients move better, perform daily activities with ease, and experience a better quality of life.

X. STUDY LIMITATIONS

1. This study has a few limitations that should be considered. The sample size was relatively small, which may limit how well the results can be applied to the wider population of chronic non-specific low back pain patients.
2. Factors such as psychological stress, sleep quality, and lifestyle habits, which may influence pain and fatigue were not assessed.
3. Future studies with larger samples and more comprehensive assessments are recommended to strengthen the findings.

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