

# Exploring the Determinants of Physical and Mental Health among Patients with Non Specific Chronic Low Back Pain and Movement Control Impairment: A Cross-sectional Study

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## ABSTRACT

**Introduction:** Movement Control Impairment (MCI) is a subgroup of Non Specific Chronic Low Back Pain (NSCLBP) which account for lower physical and mental Health-Related Quality of Life (HR-QoL). Subgroup-focused research is considered a way to improve management outcomes. Exploring factors linked to and potentially affecting the quality of life in the most common MCI subgroup is crucial.

**Aim:** To investigate the pain intensity, functional disability and fear of movement relationship, as well as the univariate and multivariate impact on perceived physical and mental HR-QoL among NSCLBP patients with MCI.

**Materials and Methods:** This cross-sectional study was conducted between August 2022 and July 2024 at a rehabilitation institute in India. A total of 66 NSCLBP patients aged 18-45 years with clinically confirmed MCI based on positive prone instability test and Luomajoki MCI tests battery were recruited. The dependent outcome measure of HR-QoL and determinants of pain intensity, functional disability and fear of movement were measured with the 36-item Short Form survey, Numeric Pain Rating Scale, Oswestry Disability Index (ODI), and Fear-Avoidance Beliefs Questionnaire (FABQ), respectively. The

Pearson's correlation test, univariate and multiple linear regression analysis were performed for the outcomes of physical and mental health domains at p-value of <0.05.

**Results:** The mean scores for physical and mental health were  $38.45 \pm 5.91$  and  $39.15 \pm 10.77$ , respectively. Physical health demonstrated a moderate inverse relationship with pain (r-value=-0.401, p-value=0.001), disability (r-value=-0.473, p-value <0.001) and fear (r-value=-0.516, p-value <0.001). Whereas, mental health has a low inverse relationship with pain intensity (r-value=-0.305, p-value=0.013), fear (r-value=-0.364, p-value=0.003) and moderate with disability (r-value=-0.520, p-value <0.001). The multivariate regression analysis indicated a significant change in physical (Adj.  $R^2=32\%$ , p-value <0.001) and mental health (Adj.  $R^2=26\%$ , p-value <0.001) collectively.

**Conclusion:** Pain intensity, functional disability and fear of movement in NSCLBP patients with MCI are inversely related to physical and mental HR-QoL. Relatively, fear of movement had a significant impact on physical health and functional disability had an impact on mental health. Clinicians must be aware of these predictors' which might improve the way NSCLBP patients with MCI are assessed and treated to optimise the overall QoL.

**Keywords:** Disability, Fear of movement, Quality of life, Regression analysis

## INTRODUCTION

Low back pain is the most prevalent musculoskeletal cause of disability, with an estimated 619 million cases globally in 2020 and a projected estimation of 843 million cases by 2025 [1]. The prevalence rate of chronic low back pain in the Indian population has been estimated to be 51% per year and 66% per lifetime [2]. Chronic low back pain that persists for more than 12 weeks poses a significant challenge to healthcare systems, since it not only impacts people's daily lives but also has a significant social and financial impact. People living with low back pain have a higher likelihood of activity limitation, absenteeism from work and poor QoL [3].

A 90% of chronic low back pain is non specific in the absence of any distinct disease or known structural cause explaining the pain [4]. According to O'Sullivan P's validated biopsychosocial framework and classification system, MCI is the largest and most prevalent stratified subgroup of NSCLBP [5]. Patients with MCI are classified by mechanically induced postural LBP and associated psychosocial coping mechanisms, without any deficit in the physiological range of lumbar movement in pain provocative direction [5]. Clinically, individuals with MCI exhibit postural pain confined to the lower back area with clinical lumbar spinal instability and aberrant or maladaptive

uncontrolled lumbar movements. Therefore, abnormal sustained loading and repetitive end-range movements mechanically render the spinal tissues more susceptible to excessive stress and strains among such individuals [5,6]. The interplay of negative psychosocial coping, maladaptive motor control and proprioceptive inputs in response to habitually learnt spinal postures and movement is seen as the underlying mechanism for pain, functional disability and poor QoL among patients with MCI [5,7,8].

HR-QoL is a broad and multifaceted concept [9]. The WHO defines QoL as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" [10]. According to Grabovac I and Dörner TE, NSCLBP is linked to a significant burden on both individuals and society, which can significantly affect a person's QoL [11].

Studies aimed at determining the variables that affect NSCLBP patients' QoL indicate a strong correlation with increased pain and disability, poorer HR-QoL, a worse prognosis and notable physical restrictions [12]. However, the lack of such studies specifically for a homogenous MCI subgroup, makes it imperative to explore predictors of QoL in the concerned population. Considering the heterogeneity of the LBP population and its global burden on the healthcare system,

there is an urgent need to explore QoL predictors for an unexplored MCI subgroup of the NSCLBP population. This study might help to address the unique challenges faced by individuals within this specific subgroup regarding the complex constructs of physical and mental HR-QoL. By identifying key predictors of QoL, more effective and personalised treatment strategies can be developed to improve management outcomes and enhance the overall wellbeing of those affected.

The primary objective of this study was to investigate the relationship of pain intensity, functional disability and fear of movement with physical and mental HR-QoL in patients with MCI. Further, the secondary objectives of the study were to examine the univariate and multivariate impact of pain intensity, functional disability and fear of movement on physical and mental health, and to identify the most significant predictors of physical and mental HR-QoL among NSCLBP patients with MCI.

Therefore, the study was undertaken to test the alternative hypothesis, assuming that there would be a significant relationship and impact of pain intensity, functional disability and fear of movement on the physical and mental HR-QoL among NSCLBP patients with MCI. This was compared to the null hypothesis, which assuming that there would be no such relationship and impact.

## MATERIALS AND METHODS

This cross-sectional observational study was a secondary analysis of the baseline data of study participants who took part in the original clinical trial. The original trial was conducted at the outpatient physiotherapy department of a national rehabilitation institute from August 2022 to July 2024 as a PhD research project. The primary clinical trial was prospectively registered with the Clinical Experiment Registry India (Reg. No. CTRI/2022/06/043209). The cross-sectional observational study in concern is reported following the STROBE checklist [13].

Ethical approval was obtained from the Ethics Committee for Human Research of the affiliating university (Reg. No.: EC/2022-23/014) as well as from the Institutional Research Ethics Committee of the study centre (Reg. No.: IEC10/2022/RP2). Prior to data collection, patients were requested to sign an informed consent form. This study was conducted following the Declaration of Helsinki, 1964 [14].

**Participants and study eligibility criteria:** The statistical power of this study was based on the rule of thumb of 10-20 subjects per variable [15]. Considering the intention to include six determinants (3 potential predictors: pain intensity, functional disability and fear of movement and three confounders: BMI, pain duration and smoking), 10 subjects per variable suggested a minimum sample size of 60 in this association model, based on 10 subjects per variable.

The patients with complaints of CLBP who visited the OPD setting of the study centre were evaluated to identify those with the MCI subgroup of NSCLBP according to the defined eligibility criteria, as shown in [Table/Fig-1].

**Study recruitment procedure:** A visiting orthopaedic specialist conducted a screening of CLBP patients who sought care at the assessment clinic of the rehabilitation institute in New Delhi. Potential patients were advised about the trial with subsequently referral to the outpatient physiotherapy department.

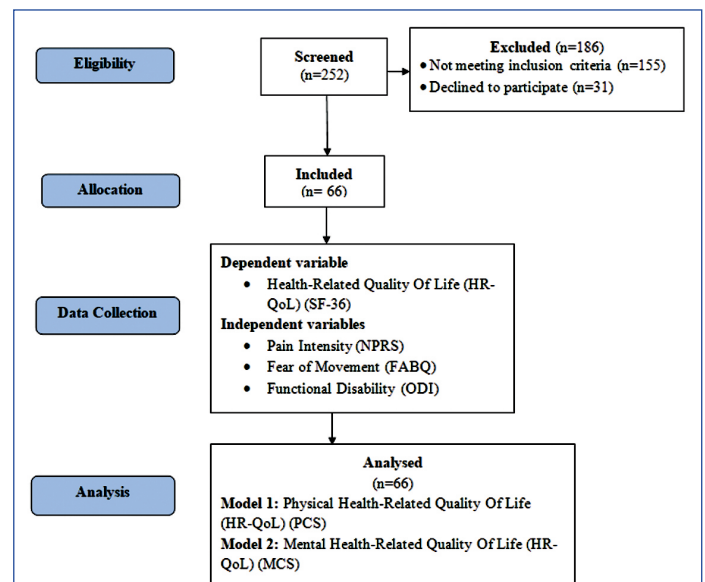
The referred patient for trial had their eligibility checked by the Principal Investigator (PI). After ascertaining eligibility, the PI provided the patient with the study information sheet before having the signed consent form. The patients who consented to participate in the study were further assessed by an independent, experienced physiotherapist investigator for outcomes of interest. Investigators obtained the basic demographics and information, related to education status, marital status and smoking status. Patients were provided with self-reported questionnaires in their

Inclusion criteria	Exclusion criteria
1) Subjects, both male and female, aged 18 to 45 years, suffering LBP for more than 12 weeks without any identifiable pathology.	1) Back discomfort that is constant or severe, as determined by clinical criteria, due to nerve root irritation caused by a specific pathology.
2) $\geq 2$ on NPRS.	2) Any spinal surgery or major surgery within the past years.
3) Positive prone instability test.	3) Current pregnancy or postpartum period <6 months and a multiparous woman who has given birth more than twice.
4) $\geq 2$ positive test findings on Luomajoki MCI tests battery as well as MCI specific complaints of pain elicitation in static postures.	4) BMI $\geq 30$ or presence of co-morbidity (e.g., history of angina, shortness of breath, uncontrolled hypertension), which may limit exercise performance.
5) $\geq 20\%$ on the Oswestry Disability Index version 2.1a.	5) SLR $< 50^\circ$ or positive SI pain provocation tests.
	6) Score of $\geq 72$ on OMSQ-12 to avoid confounding by psychosocial factors.

**[Table/Fig-1]:** Eligibility criteria of study participants.

LBP: Low back pain; NPRS: Numeric pain rating scale; MCI: Movement control impairment; BMI: Body mass index; SLR: Straight leg raise test; OMSQ-12: Orebro musculoskeletal screening questionnaire-12

preferred language, either Hindi or English. Without interference or influence from the supervising therapist, recruited study participants completed all patient-reported questionnaires. The study flowchart and process are described in [Table/Fig-2]. A total of 252 patients were examined. After excluding 186 patients due to eligibility criteria or refusal to participate, 66 patients were finally included in the study.



**[Table/Fig-2]:** Study flowchart.

**Outcome measures:** Two individual models were created to explore the variance in physical and mental health. According to Koipysheva EA et al., physical health is a dynamic state of complete wellbeing that preserving and develops biological, physiological and mental functions; optimal work capacity; and social activity, along with maximum life expectancy [16]. Conversely, the WHO has defined mental health as a state of complete wellbeing in which an individual realises their abilities, can cope with the normal stresses of life, can work productively and can contribute to their community [17].

### Physical and Mental Health-Related Quality of Life (HR-QoL):

The outcome measures of physical and mental health were measured with the standardised 36-item Short Form Survey (SF-36) version 2, which assesses the patient's physical and mental HR-QoL constructs across eight health domains: Mental Health (MH), Role Emotional (RE), Social Functioning (SF), Role Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT) and Physical Functioning (PF). According to component analyses, the SF-36 measures two different concepts: a mental dimension, represented by the Mental Component Summary (MCS) and a physical dimension, represented by the Physical Component Summary (PCS), to measure self-perceived physical and mental health, respectively [18-20].

The free user licence of the validated (India) Hindi and English versions of the original SF-36v2, along with PRO CoRE Software access for scale scoring, was granted under the non commercial licence agreement by Quality Metric Incorporated, LLC, US. The raw response scores for the Physical Component Summary (PCS) and Mental Component Summary (MCS) were converted into a 0-100 level range using the quality metric incorporated PRO CoRE Software, LLC, US. Higher scores indicate better health and a higher QoL for the corresponding PCS or MCS constructs [18].

Determinants

**Pain intensity:** The NPRS was used to quantify the intensity of pain. The 11-point NPRS is a valid and reliable tool for measuring the degree of pain in individuals with LBP. It has a score range of 0 to 10, with 0 denoting no pain, 1-3 mild, 4-6 moderate pain, and 7-10 categorising as severe pain [21,22].

**Functional disability:** The associated functional disability was assessed using a self-administered, standardised ODI (version 2.1a) questionnaire. Each of its 10 components receives a score ranging from 0 to 5, with the overall score falling between 0 and 100. A higher score indicates a higher degree of disability. One can interpret the ODI score can be interpreted as follows: 0-20% for minimum disability, 21-40% for moderate disability, 41-60% for severe disability, 61-80% for crippled, and 81-100% for bedridden or exhibiting exaggerated symptoms. The MAPI Research Trust granted a free user licence for the validated Hindi and English (India) (PROQoLIDTM, 2022) ODI v2.1a measures [23-25].

**Fear of movement:** Fear of movement was measured using the 16-item self-reported FABQ, which has a maximum score of 96. Greater fear of movement or work loss because of back discomfort is associated with higher scores. The work subscale (FABQ-W) and the physical activity subscale (FABQ-PA) are the two subscales of FABQ. This study used the sum of the scores on both subscales. FABQ versions of both English and Hindi are valid and reliable in CLBP [26-28].

STATISTICAL ANALYSIS

The Statistical Package for the Social Sciences (SPSS) software version 25.0 (IBM Corp., USA) was used to analyse the study data. Descriptive statistics computed both the mean and standard deviation, as well as frequencies and percentages, to describe demographic characteristics and other quantitative measures. The normality of data was verified with the Shapiro-Wilk test, Q-Q plots, skewness and histograms. The strength and direction of the correlation of the physical and mental health domain with functional disability, pain intensity and fear-avoidance beliefs were assessed using Pearson's correlation test. Variables with significant linear correlation were further regressed using both simple univariate and multiple linear regression analysis. Furthermore, based on the theoretical relevance, three risk factors-BMI [1,29], pain duration [30,31] and smoking [1,30] were considered as potential confounders to have a simple multivariable model with sufficient explanatory power. Two separate models were created and analysed for both physical and mental HR-QoL. The level of significance was considered as p-value of <0.05. The explained variance of the models was defined as the adjusted R<sup>2</sup> value, which indicated the goodness of fit.

RESULTS

Both the mental and physical HR-QoL domains had mean scores of 38.45±5.91 and 39.15±10.77, respectively. There were 33 (50%) female patients in total, and the mean age and BMI of the included patients were 28.67±6.73 years and 24.20±3.65 kg/m<sup>2</sup>, respectively. The mean pain intensity and duration of low back pain symptoms were 6.36±1.00 and 20.89±9.70 months, respectively. The mean functional disability score for MCI patients was

41.41±9.69%, indicating a moderate to severe level of disability. Details regarding patient demographics and other characteristics are given in [Table/Fig-3].

Characteristics	M±SD/n (%)
<b>Gender</b>	
Female	33 (50)
Male	33 (50)
Age (years)	28.67±6.73
Height (m)	1.63±0.10
Weight (kg)	65.32±13.23
BMI (kg/m <sup>2</sup> )	24.20±3.65
Pain duration (months)	20.89±9.70
<b>Educational status</b>	
Primary	3 (4.5)
Secondary	9 (13.6)
Senior secondary	7 (10.6)
Undergraduate	37 (56.1)
Postgraduate	10 (15.2)
<b>Marital status</b>	
Unmarried	35 (53)
Married	29 (43.9)
Divorced	2 (3)
<b>Smoking status</b>	
Non-smokers	59 (89.4)
Smokers	7 (10.6)
<b>Pain intensity</b>	
NPRS	6.36±1.00
<b>Functional disability</b>	
ODI (%)	41.41±9.69
<b>Fear of movement</b>	
FABQ (Sum) Score	43.47±8.58
<b>Health-Related Quality of Life (HR-QoL)</b>	
Physical Health (PCS)	38.45±5.91
Mental Health (MCS)	39.15±10.77

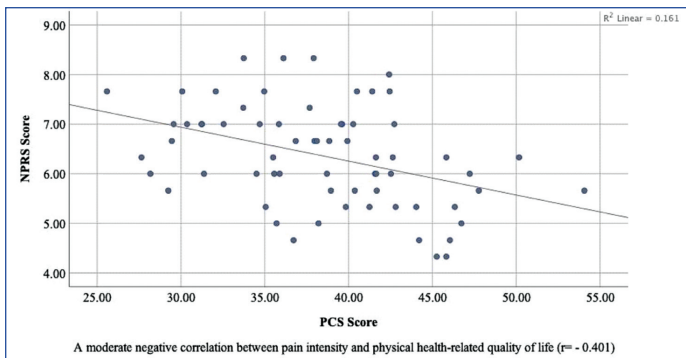
**[Table/Fig-3]:** Overview of the characteristics of the included patients (N=66). SD: Standard deviation; BMI: Body mass index; NPRS: Numeric pain rating scale; ODI: Oswestry disability index (V2.1a); FABQ (SUM): Fear-avoidance behaviour questionnaire (Sum Score); HR-QoL: Health-related quality of life; PCS: Physical component summary; MCS: Mental component summary

The findings of the bivariate Pearson's correlation test presented in [Table/Fig-4] and depicted in [Table/Fig-5a-f] suggest a negative correlation of physical and mental HR-QoL with pain intensity, functional disability and fear of movement, respectively. Results indicate a significant moderate negative correlation of pain intensity (r-value=-0.401, p-value=0.001), functional disability (r-value=-0.473, p-value <0.001), and fear of movement (r-value=-0.516, p-value <0.001) with physical HR-QoL. While mental HR-QoL was found to have a moderate negative correlation with functional disability (r-value=-0.520, p-value <0.001) and low with pain intensity (r-value=-0.305, p-value=0.013) and fear of movement (r-value=-0.364, p-value=0.003).

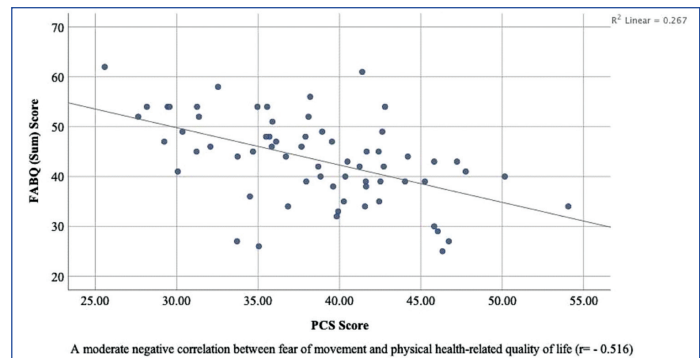
HR-QoL domains		NPRS	ODI	FABQ (SUM)
Physical health (PCS)	r-value	-0.401	-0.473	-0.516
	p-value	0.001*	<0.001*	<0.001*
Mental health (MCS)	r-value	-0.305	-0.520	-0.364
	p-value	0.013*	<0.001*	0.003*

**[Table/Fig-4]:** Pearson correlation of determinants with physical and mental health-related QoL. NPRS: Numeric pain rating scale; ODI: Oswestry disability index (V2.1a); FABQ (SUM): Fear-avoidance behaviour questionnaire (Sum Score); HR-QoL: Health-related quality of life; PCS: Physical component summary; MCS: Mental component summary; \*p<0.05

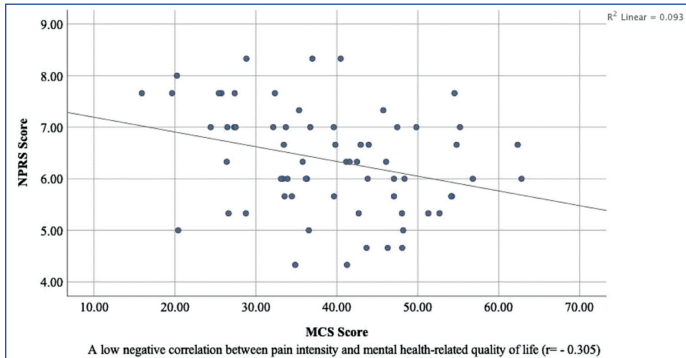




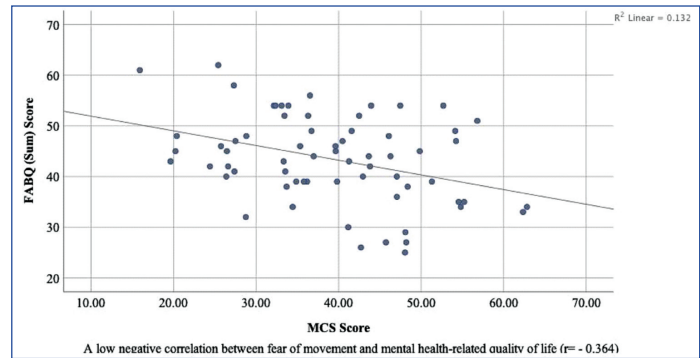
[Table/Fig-5a]: Correlation between pain intensity and physical health.



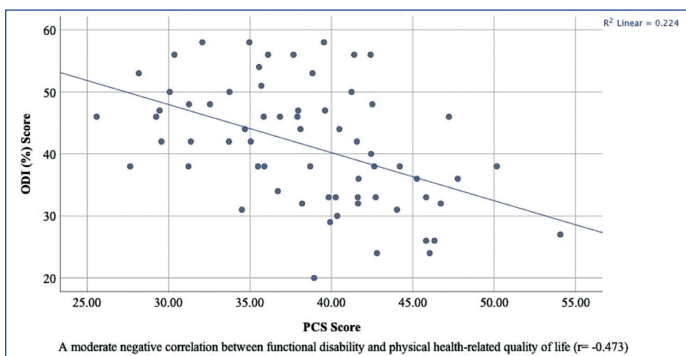
[Table/Fig-5e]: Correlation between fear of movement and physical health.



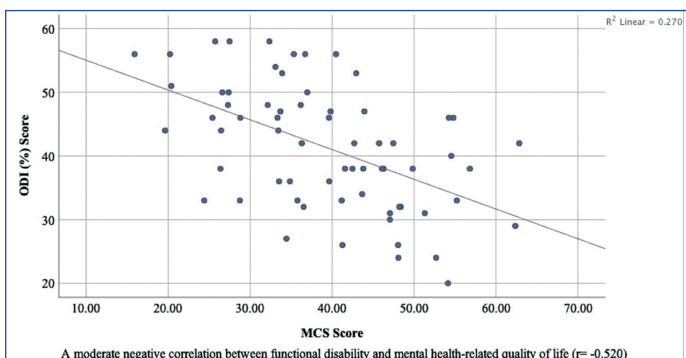
[Table/Fig-5b]: Correlation between pain intensity and mental health.



[Table/Fig-5f]: Correlation between fear of movement and mental health.



[Table/Fig-5c]: Correlation between functional disability and physical health.



[Table/Fig-5d]: Correlation between functional disability and mental health.

Furthermore, as shown in [Table/Fig-6], the results of univariate simple regression analysis also suggested the significant negative impact of all three potential determinants with both the domains of QoL ( $p$ -value  $< 0.05$ ), although the confounder variables of BMI, pain duration and smoking were not found to explain variance in any of the domains of QoL.

Multivariate regression analysis was employed to individually regress both physical and mental health on all three potential predictor variables of interest, along with confounders, despite the non significant univariate association of confounding variables. The results presented in [Table/Fig-7] suggest a significant collective impact on both physical (Adj.  $R^2=32\%$ ,  $p$ -value  $< 0.001$ ) and mental (Adj.  $R^2=26\%$ ,  $p$ -value  $< 0.001$ ) HR-QoL domains. Whereas, keeping all other variables constant, fear of movement alone was found to have a significant impact on physical health ( $\beta=-0.38$ ,  $p$ -value  $= 0.001$ ), while functional disability alone impacts mental health ( $\beta=-0.47$ ,  $p$ -value  $= 0.002$ ). However, once again, the confounders of BMI, pain duration and smoking did not impact QoL.

## DISCUSSION

The purpose of this study was to examine the correlation and cause-effect impact of pain intensity, functional disability and fear of movement on QoL in a stratified MCI subgroup of NSCLBP. The study's findings show a moderate negative correlation between physical health and functional disability, pain intensity and fear of movement. However, study findings also revealed a moderate

Effects	Physical health						Mental health					
	R <sup>2</sup>	Estimate	SE	95% CI		p-value	R <sup>2</sup>	Estimate	SE	95% CI		p-value
				LL	UL					LL	UL	
Pain intensity (NPRS)	0.16	-2.35	0.67	-3.69	-1.01	0.001*	0.09	-3.26	1.27	-5.8	-0.72	0.013*
Functional disability (ODI)	0.22	-0.29	0.07	-0.42	-0.15	<0.001*	0.27	-0.58	0.12	-0.82	-0.34	<0.001*
Fear of movement (FABQ)	0.27	-0.36	0.07	-0.5	-0.21	<0.001*	0.13	-0.46	0.15	-0.75	-0.16	0.003*
BMI (Kg/m <sup>2</sup> )	0	-0.11	0.2	-0.51	0.3	0.597	0.02	0.38	0.37	-0.35	1.11	0.307
Pain duration (months)	0	0	0.08	-0.15	0.16	0.952	0	-0.04	0.14	-0.32	0.23	0.761
Smoking (Smokers vs. Non-smokers)	0	-0.79	2.38	-5.55	3.97	0.741	0.02	-4.96	4.3	-13.55	3.62	0.252

[Table/Fig-6]: Linear regression analysis: Univariable associations of the determinants with physical and mental health-related QoL (N=66).

N=66; CI: Confidence interval; UL: Upper limit; LL: Lower limit; \* $p < 0.05$

Effects	Physical health							Mental health						
	Estimate	SE	$\beta$	95% CI		t value	p-value	Estimate	SE	$\beta$	95% CI		t value	p-value
				LL	UL						LL	UL		
Intercept	66.63	6.22		54.19	79.07	10.71	<0.001	65.56	11.82		41.92	89.21	5.55	<0.001
Pain intensity (NPRS)	-0.93	0.77	-0.16	-2.47	0.61	-1.21	0.231	0.37	1.46	0.04	-2.56	3.3	0.26	0.799
Functional disability (ODI)	-0.15	0.08	-0.24	-0.32	0.02	-1.74	0.087	-0.52	0.16	-0.47	-0.84	-0.2	-3.23	0.002*
Fear of movement (FABQ)	-0.26	0.08	-0.38	-0.42	-0.11	-3.37	0.001*	-0.22	0.15	-0.17	-0.51	0.08	-1.47	0.148
BMI (Kg/m <sup>2</sup> )	-0.20	0.17	-0.13	-0.54	0.13	-1.22	0.228	0.17	0.32	0.06	-0.47	0.81	0.52	0.605
Pain Duration (months)	0.01	0.07	0.02	-0.12	0.14	0.17	0.864	-0.06	0.12	-0.06	-0.31	0.19	-0.51	0.614
Smoking (Smokers vs. Non-smokers)	-0.49	2.00	-0.03	-4.50	3.52	-0.24	0.808	-5.99	3.81	-0.17	-13.6	1.63	-1.57	0.121

**[Table/Fig-7]:** Linear regression analysis: multivariable associations of the determinants with physical and mental health-related QoL (N=66).

Physical health: F (6,66)=6.12; p<0.001; adj. R<sup>2</sup>=0.32; Mental Health: F (6,66)=4.81; p<0.001; adj. R<sup>2</sup>=0.26; CI: Confidence interval; UL: Upper limit; LL: Lower limit; \*p<0.05

negative correlation between mental health and functional disability, along with a low negative correlation with pain intensity and fear of movement. Since there is a lack of observational studies that focus on the MCI subgroup, the results are discussed in the context of unclassified NSCLBP.

The inverse correlation of pain intensity and functional disability correlation with physical and mental health is in line with the previous studies [32,33], as is the fear of movement [34,35]. Further, the results of univariate regression analysis demonstrated a significant negative association of all three potential predictors individually with both domains of QoL. Furthermore, univariate findings of present study are in line with previous studies, wherein functional disability, pain intensity [12,30,34,36] and fear of movement [34] were found to be inversely associated with significant impact on QoL domains.

Additionally, multivariate regression analysis revealed that the collective contribution of all predictors explained 32% and 26% of the variance in physical and mental health, respectively, leaving 68% of physical health and 74% of mental health unexplained. The results of the physical health prediction model indicate that, while accounting for all other variables, fear of movement alone is a significant predictor influencing physical health. This finding aligns with the previous studies done on unclassified NSCLBP subjects, wherein fear of movement as reported to be the predictor of both the physical health component summary and mental health summary of QoL, assessed using SF-36 [37]. A longitudinal study also revealed that a high level of fear of movement predicts negative changes in QoL and positive changes in disability and pain [38].

In contrast to the physical health prediction model, the mental health prediction model's findings show that, after controlling for all other factors, functional disability is the only significant predictor of mental health. The findings regarding the significant impact of functional disability on mental health are consistent with the previous studies indicating greater and more significant functional disability contribution to poor QoL outcomes [12], especially to mental HR-QoL [39]. Functional disability, as a patient's difficulty in performing daily activities, might influence mental HR-QoL through mediation or indirect effects of pain intensity, fear of movement and other psychosocial constructs, such as distress, depression, anxiety, greater isolation and less motivation or catastrophising behaviour [40,41]. It suggests that physical interventions, combined with cognitive behavioural and psychosocial therapies, may have an impact on mental health by modifying maladaptive pain perceptions and emotional responses to pain in patients with MCI.

The study found no significant association between QoL and confounders like BMI, pain duration, or smoking. These findings may be attributed to the characteristics of the sample, including ambient mood state, personal beliefs and cultural contexts [41,42]. Additionally, the presence of a normal healthy BMI and lower prevalence of smoking among study participants might explain non significant findings.

According to the study's results, fear of movement impacts physical health, whereas functional disability affects mental health. This indicates that limitations in daily activities can lead to psychological distress, while fear of physical activity or movements can hinder one's overall physical wellbeing. Therefore, rehabilitation strategies focusing on improving physical activities and overcoming the fear of movement through education are essential for improving physical HR-QoL. On the other hand, NSCLBP individuals with functional disability often face anxiety and depression, adversely affecting their mental health [41]. Therapeutic measures to enhance physical activity and functioning, to reduce functional disability consequently can be seen as crucial to enhancing mental HR-QoL [43].

Evidence indicates a strong, mutually influencing link between physical and mental health [44]. Integrating cognitive-behavioural education with physical rehabilitation programmes can enhance recovery outcomes and improve the QoL for NSCLBP patients with MCI facing interconnected mental and physical health concerns. Future longitudinal case-control studies on a larger sample may unveil the complex concept of QoL among MCI subgroups. Identified variables based on the biopsychosocial framework can provide further insight into their causal impact on QoL.

The study used a step-by-step approach to identify possible correlation between outcome variables and other variables (using Pearson's correlation), examine the individual associations between each predictor and outcome (via univariate regression) and establish a more robust and accurate causal association between predictors and outcomes (through multivariate regression). The study focused on a homogeneous MCI subgroup of NSCLBP, allowing for more accurate findings to reduce confounding variables. The findings of this study revealed predictors for both physical and mental HR-QoL individually, which is a significant contribution to the field in informing the development of targeted interventions.

### Limitation(s)

The findings of the study cannot be generalised due to the limited inclusion of confounding factors, so they may not be a true representative of the larger population. The findings of the study may be limited to the MCI subgroup. Other than that, the study design does not allow for the establishment of a temporal relationship between variables. Therefore, longitudinal studies with larger sample sizes can provide more insight into causal relationships.

In addition, biases in measurement tools, such as patient-reported outcome measures, might affect the study findings. Despite controlling for gender with equal recruitment of male and female patients and exclusion of patients with co-morbidities, several other factors such as age, depression, anxiety, sleep quality, alcohol intake and educational status of study participants might confound the

results of this study with biased estimate possibilities. Nonetheless, there might still be numerous other confounding variables that could impact the results, as the original study sample size limited the selection of predictors and confounders. The study established the causal relationship, but it cannot provide insight into the underlying mechanisms driving these relationships.

## CONCLUSION(S)

Pain intensity, functional disability and fear of movement among NSCLBP patients with MCI are inversely correlated with physical and mental HR-QoL. All determinants revealed significant contributions to variance in both domains of QoL. Physical health is predicted by fear of movement while mental health, is predicted by functional disability. Clinicians should be aware of these predictors to improve patient assessment and treatment protocols for patients with MCI.

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