RESEARCH ARTICLE

Association of neck pain and low back pain with dysfunctional breathing and stress

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Abstract

Objective: To assess and associate neck pain and low back pain with dysfunctional breathing and stress.

Method: The cross-sectional study was conducted at the Department of Rehabilitation Sciences, Shifa Tameer-e-Millat University and Capital Hospital, Islamabad, Pakistan, from October 2022 to January 2023, and comprised adult patients having neck pain in group A1, and those with back pain in group A2. Healthy age-matched controls were enrolled in groups B1 and B2. Data was collected using the Roland Morris Questionnaire, the Neck Disability Index and the Perceived Stress Scale regarding low back disability, neck disability, and stress levels, respectively. Dysfunctional breathing was measured using the Self-Evaluation Breathing Questionnaire and Contec Spirometer SP-10. Data was analysed using SPSS 22.

Results: Of the 256 subjects, 64(25%) were in each of the four groups. Overall, there were 130(50.8%) males and 126(49.2%) were females, and the age of the subjects ranged aged 18-44 years. Patients in groups A1 and A2 scored higher on the Self-Evaluation Breathing Questionnaire and the Perceived Stress Scale than those in groups B1 and B2 ($p<0.05$). Spirometric measures were significantly lower in groups A1 and A2 than the control groups ($p<0.05$). Self-Evaluation Breathing Questionnaire showed moderate positive correlation with neck disability($p<0.05$), but only a weak correlation with neck and low back pain, while spirometric values were negatively correlated with both pain and disability($p>0.05$).

Conclusion: Dysfunctional breathing was more prevalent in individuals with neck and low back pain than healthy individuals. Furthermore, increased neck pain, low back pain and disability were linked to dysfunctional breathing and stress.

Keywords: Breathing, Cervical pain, Disability, Lumbar pain, Stress. (JPMA 76: 829; 2026)

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Introduction

Neck pain is one of the leading complaints, affecting a substantial portion of the population. In 2019, the age-standardised prevalence rate was recorded at 27.0 cases per 1,000 individuals.[1] Individuals with chronic neck pain commonly exhibit a range of impairments, including diminished neck muscle strength and endurance, restricted range of motion (ROM), compromised proprioception, maladaptive postural habits, and concomitant psychological factors.[2] Lumbosacral pain is a prominent cause behind the rising number of workers' compensation claims, frequent absenteeism from work, and a decline in overall work productivity. Research suggests that low back pain affects up to 18% of the general population, with a lifetime prevalence reaching 39%.[3] The Global Spine Care Initiative has highlighted a significant global surge in chronic lumbar and cervical pain cases, accompanied by associated disability, owing to the aging population over the past 25 years.[4]

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Impairments in the functionality of mobiliser and stabiliser muscles can have implications for the biomechanics of the chest, leading to modifications in force-length curves and adaptive changes in the respiratory muscles.[5] In individuals with chronic neck pain, these alterations can contribute to the development of respiratory dysfunction, which may occur in conjunction with the direct influence of pain on ventilation.[6]

The transversus abdominis and multifidus muscles play a crucial role in spinal stability and postural control. In the presence of pain or following a painful event, there may be alterations in the control strategies of the central nervous system (CNS) for the trunk muscles. Patients with low back pain often experience delayed contraction of the transversus abdominis, and inhibited contraction of the multifidus muscles.[7] The transversus abdominis works in coordination with the diaphragm, and its dysfunction may lead to altered breathing patterns, such as dysfunctional breathing. These motor control deficits are believed to be associated with diminished spinal stability, which may further exacerbate pain. Researchers have investigated these impairments in motor control as a potential underlying factor contributing to the recurring low back pain. Additionally, poor spinal stability and persistent pain can contribute to increased stress levels due to heightened sympathetic nervous system activation.[8]

Breathing is a complex process influenced by various biomechanical, biochemical and psychological factors. Dysfunctional breathing occurs when there is a disruption in any of these factors, leading to an altered breathing pattern or inefficient respiratory function.[9] Dysfunctional breathing has been associated with musculoskeletal impairments, and is commonly observed in individuals with neck and low back pain. Individuals with dysfunctional breathing often exhibit reduced pain tolerance, and encounter challenges related to balance, mobility and motor function.[10]

Stress and anxiety can lead to increased sympathetic activity, resulting in changes in breathing patterns, such as increased frequency and depth, and heightened respiratory muscles fatigue. This enhanced sympathetic activity may contribute to the higher prevalence of despair and anxiety observed in individuals with neck and low back pain. The body's response to stress involves muscle tightening as a protective mechanism against pain and injury, with muscles tensing, and subsequently relaxing after the stressor subsides. However, chronic stress can lead to persistent muscle tension and potentially exacerbate stress-related disorders.[11] Anxiety, influenced by the release of adrenaline during stressful situations, can directly impact respiratory function, causing hyperventilation and a subsequent decrease in carbon dioxide partial pressure ($PaCO_2$).[12]

A 2022 cross-sectional study looking to explore the association among stress, dysfunctional breathing and neck pain in 49 participants with neck pain and 49 age- and gender-matched controls concluded that participants with neck pain showed respiratory impairment which correlated positively with neck pain and disability.[6]

The current study was planned to assess and associate neck pain and low back pain with dysfunctional breathing and stress.

Patients and Methods

The cross-sectional study was conducted at the Department of Rehabilitation Sciences, Shifa Tameer-e-Millat University and Capital Hospital, Islamabad, Pakistan, from October 2022 to January 2023. After approval from the institutional ethics review board and the ethics review committee of Shifa International Hospital, Islamabad, the sample size was calculated using G*Power calculator.[13] A two-tailed test was selected with effect size (d) 0.5, significance level (α) 0.05, and statistical power (1–β) 0.80.[5] The sample was raised using non-probability convenience sampling method. Those included were adults of either gender experiencing chronic neck or low back pain for >6 months, with pain occurring at least once a week. Those with any neck or low back injury, prior abdominal or spinal surgeries, or any other diagnosed medical condition that could affect pain perception, breathing function or stress levels were excluded. Also excluded were individuals with a history of smoking. Patients having neck pain were placed in group A1, and those with back pain in group A2. Healthy age-matched controls were enrolled from the community in groups B1 and B2.

The data-collection process involved validated assessment tools, including the Numeric Pain Rating Scale (NPRS) that had high test reliability with an intraclass correlation coefficient (ICC) 0.95 and construct validity 0.86-0.95,[14] the Neck Disability Index (NDI) having outstanding reliability with ICC 0.88 and construct validity 0.63-0.95[15] and the Roland Morris Disability Questionnaire (RMQ) having high internal consistency reliability with Cronbach's alpha >0.80 and test-retest reliability with ICC >0.70.[16] The Self-Evaluation of Breathing Questionnaire (SEBQ), having strong test-retest correlation with ICC 0.88 and 95% confidence interval (CI) 0.84-0.91,[17] was used to measure breathing pattern disorders, The 10-item Perceived Stress Scale (PSS-10), having average Cronbach's alpha value of >0.70[18] and spirometric tests were used to analyse pulmonary function.

Data was collected after taking written informed consent from the participants. Spirometry, including forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and peak expiratory flow rate (PEFR), was performed using an electronic handheld spirometer (SP-10; Contec Medical Systems Co., Ltd., Qinhuangdao, China) and the device was used in accordance with the manufacture's operational guidelines. To minimise inter-rater reliability, all measurements were conducted by a single trained assessor. The two control groups underwent the SEBQ, PSS and spirometry assessments. During spirometry, the participants were asked to relax and assume a seated position, taking deep, steady breaths through their nose, and exhaling forcefully into the mouthpiece of the spirometer (Contec SP-10). Three readings were obtained, and the mean value was recorded. Standardised instructions were provided to minimise bias across the sample.

Data was analysed using SPSS 22. The groups were compared for demographics, including age, height and body mass index (BMI). Data was expressed either mean +/- standard deviation, or as frequencies and percentages. Data normality was assessed using the Shapiro-Wilk test. Independent sample *t*-test was used for comparison, while the Pearson correlation coefficient was applied to examine the associations between the variables. Correlations of r≥0.3 were considered moderate, while *r*≥0.5 were considered large, following Cohen's guidelines.[19] P<0.05 was considered statistically significant.

Results

Of the 256 subjects, 64(25%) were in each of the four groups. Overall, there were 130(50.8%) males and 126(49.2%) were females, and the age of the subjects ranged aged 18-44 years (Table 1). Patients in groups A1 and A2 scored higher on the SEBQ and PSS than those in groups B1 and B2 ($p<0.05$). Spirometric measures were significantly lower in groups A1 and A2 than the control groups (Table1).

In terms of inferential statistics, groups A1 participants scored higher on SEBQ, PSS, and for spirometric volume compared to those in group B1 ($p<0.05$). Individuals in group A2 exhibited higher SEBQ and lower spirometric volume scores than those in group B2 ($p<0.05$), while the difference in PSS scores was not significant ($p>0.05$)
(Table 2).

SEBQ was positively correlated with neck and low back pain and disability, while FVC, FEV1 and PEFR were negatively correlated with pain and disability. Also, PSS showed positive correlations with pain and disability, though mostly weak (Table 3).

The correlation between measures of pulmonary function and PSS for groups A1 and A2 were also noted (Table 4).

Discussion

The present study revealed notable differences in respiratory parameters between the controls and the cases. FVC, FEV1 and PEFR were significantly reduced in individuals with neck and low back pain. Individuals with chronic neck or low back pain exhibited reduced pulmonary function and higher dysfunctional breathing scores compared to healthy controls. Weak to moderate associations were observed between pain, disability and respiratory parameters, while stress showed weak correlations. A study in 2020 demonstrated a negative correlation between neck disability and both chest expansion and maximum voluntary ventilation, highlighting the impact of forward head posture on FEV1, FVC and forced expiratory flow (FEF) in patients with neck pain.[20] In the present study, the values of FVC, FEV1 and

Table-1: Descriptive statistics.

	Cervical			Lumbar	
	Cases group (n=64)	Control group (n=64)		Cases group (n=64)	Control group (n=64)
Measures	Mean±SD	Mean±SD	Measures	Mean±SD	Mean±SD
Age (years)	26.80±5.9	25.90±5.9	**Age** (years)	26.18±6.10	26.89±6.42
Pain—NPRS	5.30±1.3	0	**Pain—NPRS**	4.89±1.49	0
Neck disability	28.20±12.3	0	**Back disability**	44.33±17.94	0
SEBQ	17.80±11.5	7.18±3.97	**SEBQ**	14.81±10.23	7.21±3.87
FVC (%)	48.80±11.8	65.20±14.49	**FVC** (%)	50.66±11.45	64.26±11.14
FEV1(%)	38.90±11.8	61.14±18.18	**FEV1** (%)	39.95±13.08	59.40±15.63
PEFR (%)	23.7±9.8	49.92±24.9	**PEF** (%)	24.53±12.48	44.53±20.88
Stress—PSS	20.00±6.1	17.20±5.49	**Stress—PSS**	20.43±5.87	18.57±5.53

NPRS: Numeric pain rating scale; SEBQ: Self-evaluation breathing questionnaire; FVC: Forced vital capacity, FEV1: Forced expiratory volume; PEFR: Peak expiratory flow rate; PSS: Perceived stress scale, SD: Standard deviation.

Table-2: Inferential analysis.

	Neck Pain Cases and Controls			Low Back pain Cases and Controls		
Measures	Cases group (n=64) Mean±SD	Control Group (n=64) Mean±SD	Independent sample *t*-test *p*–value sig. (2-tailed)	Cases group (n=64) Mean±SD	Control Group (n=64) Mean±SD	Independent sample *t*-test *p*-value sig. (2-tailed
SEBQ	17.8±11.54	7.18±3.97	0	14.8±10.23	7.20±3.87	0
FVC (%)	48.80±11.81	65.2±11.49	0	50.60±11.45	64.20±11.14	0
FEV1 (%)	39.0±11.88	61.14±18.18	0	39.95±13.08	59.40±15.63	0
PEF (%)	23.7±9.8	49.92±24.91	0	24.53±12.4	44.53±20.88	0
PSS	20.0±6.10	17.2±5.49	0	20.40±5.87	18.57±5.53	0.06

SEBQ: Self-evaluation breathing questionnaire; FVC: Forced vital capacity, FEV1: Forced expiratory volume; PEFR: Peak expiratory flow rate; PSS: Perceived stress scale, SD: Standard deviation.

Table-3: Correlational analysis in the patient groups. s.

	Cervical				Lumbar			
Measures	NPRS		NDI		NPRS		RMQ	
	r-value	*p*-value	*r*-value	*p*-value	*r*-value	*p*-value	*r*-value	*p*-value
SEBQ	+0.22	0.07	+0.44	<.00	0.20	0.10	0.23	0.06
FVC (%)	-0.18	0.13	-0.14	0.26	-0.10	0.96	-0.11	0.38
FEV1 (%)	-0.14	0.26	-0.07	0.55	0.14	0.26	-0.13	0.30
PEFR (%)	+0.08	0.51	+0.04	0.72	0.22	0.07	-0.17	0.15
PSS	+0.01	0.89	+0.10	0.39	0.18	0.14	0.17	0.16

NPRS: Numeric pain rating scale; NDI: Neck disability index; RMQ: Roland Morris disability questionnaire; SEBQ: Self-evaluation breathing questionnaire; FVC: Forced vital capacity; FEV1: Forced expiratory volume; PEFR: Peak expiratory flow rate; PSS: Perceived stress scale.

Table-4: Correlational analysis between measures of dysfunctional breathing and perceived stress.

	Cervical				Lumbar			
	PSS							
Measures	Cases group		Control group		Cases group		Control group	
	r-value	*p*-value	*r*-value	*p*-value	*r*-value	*p*-value	*r*-value	*p*-value
SEBQ	+0.21	0.08	+0.19	0.12	0.34	<0.00	0.22	0.06
FVC (%)	-0.13	0.27	+0.05	0.64	-0.30	<0.01	0.08	0.51
FEV1 (%)	-0.13	0.29	+0.09	0.46	-0.20	0.10	0.09	0.45
PEFR (%)	-0.17	0.17	+0.20	0.10	-0.15	0.21	0.21	0.09

SEBQ: Self-evaluation breathing questionnaire; FVC: Forced vital capacity; FEV1: Forced expiratory volume; PEFR: Peak expiratory flow rate; PSS: Perceived stress scale.

PEFR were measured in percentage (%), rather than litres, for better comparability and interpretation of results.

The present findings revealed that those with chronic low back pain exhibited significantly reduced values of FVC), FEV1 and PEFR compared to those without low back pain. These findings corroborated earlier research, underscoring the deleterious impact of chronic low back pain on respiratory function, as evidenced by reduced pulmonary volumes and impaired respiratory parameters.[21] Furthermore, a study in 2019 showed additional respiratory impairments in individuals with chronic low back pain, including lower mean maximum voluntary ventilation (MVV) and elevated mean partial pressure of end-tidal carbon dioxide (PETCO2) and respiratory rate.[22]

In contrast to previous literature, the current findings showed no correlation between stress and cervical discomfort, and only a weak correlation between stress and cervical impairment. This may be explained by the mild to moderate pain severity reported by most participants, allowing them to use coping or adaptation mechanisms that reduce psychological impact. Individuals with more severe or high degrees of neck discomfort are more susceptible to experiencing symptoms of depression and anxiety. Notably, the present study indicated no significant differences in stress level between participants with and without low back pain. In line with the present findings, earlier results indicated that stress is a prevalent psychological issue that affected two-thirds of the study participants, but the study found no significant association between the presence of musculoskeletal disorders and the level of stress.[23]

The finding of impaired pulmonary function and disordered breathing in people with neck and low back pain has substantial physiotherapy implications. Diaphragmatic breathing, posture correction and personalised breathing retraining exercises can all assist improve respiratory function and minimise musculoskeletal discomfort. Physiotherapists may consider including these examinations and activities in the rehabilitation regimens of patients suffering from persistent neck or low back pain.

The current study has several limitations. First, the participants encountered difficulty in understanding the spirometry process, which might have affected the accuracy of respiratory measurements. Additionally, owing to limited resources, the utilisation of more advanced and direct methods to measure respiratory values could not be used. Furthermore, the research was conducted only in the twin cities of Rawalpindi and Islamabad, and limited to the Physiotherapy Department, potentially restricting the generalisability of the findings. Finally, the absence of respiratory rate measurement affected the assessment of respiratory function, potentially leaving out important insights into participants' breathing patterns.

Conclusion

Individuals with neck and low back pain exhibited reduced pulmonary functions and higher dysfunctional breathing scores. Also, moderate positive correlations were observed between dysfunctional breathing and neck disability, while other correlations, including stress, were weak.

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AR: Concept, design, data acquisition, analysis, interpretation, drafting, revision and agreement to be accountable for all aspects of the work.

FB: Concept, design, data acquisition, analysis, interpretation, drafting, revision, final approval and agreement to be accountable for all aspects of the work.

HS & FB: Concept, design, data acquisition, analysis, interpretation and agreement to be accountable for all aspects of the work.