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Correlation between pain, functional disability, and core endurance in individuals with chronic low back pain according to Saliba's Postural Classification System

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ABSTRACT

This study aimed to investigate the correlation of the pain intensity, function disability and core endurance in patients with chronic mechanical low back pain (CMLBP) classified according to Saliba's postural classification system (SPCS). A total of 60 patients with age ranged from 20-50 years with CMLBP were recruited and randomized into one of the six postural classification groups (10 patients per group). The visual analog scale (VAS) and Oswestry disability index (ODI) were used to measure pain severity and functional disability respectively. Core endurance tests were used to measure core muscles endurance. Pain intensity significantly correlated with function disability in vertical/posterior and anterior/anterior group ($r=0.724$, $p<0.05$), while negative correlation existed between pain and core endurance in vertical /posterior group ($p<0.05$). Furthermore, among CMLBP patients, there were significant positive correlations between pain and function disability ($p<0.05$), and negative correlations between pain and core endurance ($p<0.05$), as well as functional disability and core endurance ($p<0.05$). Pain and functional disability seemed to be highly correlated in vertical/posterior group and negative correlation existed between pain and core endurance in the same group. While among CMLBP patients, pain is strongly associated with functional disability,

while both pain and functional disability are inversely related to core endurance, particularly in the vertical/posterior group.

KEYWORDS

Core Endurance; Mechanical Low Back Pain; Functional Disability; Saliba's Postural Classification System

1. INTRODUCTION

Chronic mechanical low back pain (CMLBP) is a complex condition that poses one of the most significant healthcare concerns in modern society (Buchbinder et al., 2013). It is the second common cause of disability and impairment globally in adults (Hoy et al., 2010). In some situations, alterations in spinal alignment may be the reason (Van Dillen et al., 2009; Sorensen et al., 2015). According to Dolphens et al. (2012), global postural alignment variables are associated with low back, neck, and thoracic discomfort. There are many objective instrument-based assessments of posture (Wong et al., 2007; Van Niekerk et al., 2008), including motion analysis systems and 3-D posture analysis can give valid and reliable assessments of posture (Fortin et al., 2011), but they are rarely used outside of a laboratory setting and are frequently measured under artificial conditions (Cramer et al., 2018).

The Saliba Postural Classification System (SPCS) is a valid and reliable method that provides doctors with a practical and relevant method of evaluating posture and its impact on pain and function. It is composed of six postural categories that depend on the visual assessment of the angulation of the thoracic block (thoracic spine, rib cage and sternum) in the sagittal plane as well as its vertical alignment with regard to the pelvic block (pelvis, sacrum, and coccyx) (Collins et al., 2016). It is a ratio comprising two components. The first component refers to the thoracic spine position over the pelvis, while the second refers to its angulation. The six SPCS are Vertical/Vertical (V/V), Vertical/Posterior (V/P), Posterior/Posterior (P/P), Posterior/Anterior (P/P), Anterior/Posterior (A/P), and Anterior/Anterior (A/A) (Collins et al., 2016).

Evidence suggests that patients with CMLBP have dysfunction of the core muscles, particularly the multifidus and transversus abdominus muscles (Brumitt et al., 2013). To the greatest extent of the knowledge of the authors, no previous investigations have found an association between this disability and different postural categories. Although the interaction between posture, function, and pain is widely understood in motion disciplines, some research investigations have failed to

detect it due to a lack of an established and clinically appropriate postural categorization approach. The lack of conclusive findings in this area may contribute to the current existing inconsistencies regarding whether or not this association exists (Sahrmann et al., 2002). Furthermore, while the association between posture, function, and pain is widely accepted in motion sciences, other studies have shown no such relationship (Raine & Twomey, 1994). No previous research has been undertaken to explore the association between pain, function disability, and core muscular endurance in CMLBP defined by postural category. Consequently, the aim of this study is to determine the association between pain, functional impairment, and core endurance in chronic low back pain using Saliba's postural classification system.

2. METHODS

2.1. Design and Participants

This study was a cross-sectional, observational analysis conducted at the Physical Therapy Department of Desouk General Hospital, Egypt, between May 2023 and March 2024. The study was given permission by the Research Ethics Committee of the Faculty of Physical Therapy, Cairo University [No: P.T.REC/012/003644] before starting study procedure.

Patients diagnosed with CMLBP referred from orthopedic surgeons were recruited. Potentially eligible consecutive patients presenting to the physical therapy department were screened for inclusion and exclusion criteria during their physical therapy evaluation. If they met the criteria, they were then invited to participate and sign informed consent to protect their rights prior to participation. The following were the criteria for inclusion: (1) Patients of both sexes who have been diagnosed with CMLBP for over three months, (2) Age ranged from 20-50 years, and (3) BMI (18.5-24.9). Patients who had CMLBP were not eligible for this research study if they had any of the following: (1) Lumbar canal stenosis, (2) History of vertebral fractures, (3) Neurological deficits such as altered sensation, (4) Spinal surgery or failed back surgery, and (5) Cardiovascular/ pulmonary disorder.

2.2. Randomization

Sixty consented participants with CMLBP were allocated by the physical therapist to one of the six postural groups according to Saliba's postural categories. Then the pain intensity, function disability and core endurance were measured. The participants were assigned to groups based on their posture analysis which was performed by capturing the participants' posture using a digital camera

then the captured photos were analyzed using Kinovea software. A stratified random sampling method was used until 10 participants were allocated to each group.

2.3. Instrumentation

2.3.1. Digital Camera

To capture patients' photos for postural analysis and group assignment, a digital camera (Canon; model: SD 1200 IS, made in China) with the following specifications was used: (1) Resolution: 10 megapixels, (2) Magnification: 3x zoom of~ 6.2-18.6 mm, and (3) Shutter Speed: 15-1/1500 sec. Long Shutter operates with noise reduction when manually set at 1.3-15 sec.

2.3.2. Kinovea - 0.8.15 software

This software was used to analyze digitized photos and to measure angles and lengths. The Kinovea software is a valid and reliable (ICC=1) tool (Puig-Diví et al., 2019).

2.4. Procedure and Measurements

At baseline, patients were tested for pain severity, functional impairment, and core endurance. Patients were then directed to stand in their habitual posture, looking ahead, and were shot from the sagittal plane while wearing a short (males) and thin clothes (females). The photos were used to subjectively classify the patients into one of the 6 postural classification groups (G1, G2, G3, G4, G5, G6). Later, photos entered by the physical therapist to Kinovea software for more objective confirmation of the classification.

2.4.1. Pain intensity

A unidimensional visual analog scale (VAS) which is a well-known valid and reliable test of pain was used. The continuous scale is made up of ten-centimeter horizontal line. The scores for "worst imaginable pain" (10) and "no pain" (0) serve as the scale's anchors. Higher scores imply more severe pain (Hawker et al., 2011).

2.4.2. Functional disability

The Arabic version of the Oswestry Disability Index (ODI) was utilized. ODI evaluated how the pain in the back affects everyday activities. The final result is calculated by adding each value provided for every one of the ten questions individually and is used to determine a disability as light or no disability (0-20%), moderate disability (21%-40%), severe disability (41%-60%), lack of capacity (61%-80%), and bedridden (81%-100%) (Algarni et al., 2014).

2.4.3. Core muscles endurance

To measure Core muscles endurance, the following tests were used:

1. *Trunk flexion test (McGill's test):*

The patient was in a sit-up position with his back supported against a jig angled 60 degrees from the floor. The legs and hips were bent 90 degrees, the arms were crossed across the chest, hands resting on the opposite shoulders, and the feet were fixed to the bed using cotton bandage. To begin, the therapist pushed the jig 10 cm backward and ordered the patient to hold the isometric position for as long as possible, while recording the duration. Lack of ability is judged when an area of the individual's back meets the surface of the jig. (McGill et al., 1999).

2. *Sorenson test (Trunk extension test):*

The patient was instructed to lie prone on bed with the upper part of the body outside the bed (pelvis, knees, and hips fastened to the bed). The upper part of the body could be rested on a chair before starting the test. The patient was directed to maintain a horizontal position of the body with arms folded across the chest and hands lying on the shoulders and move away from the chair at the onset of the test, and the therapist timed how long patients could hold the upper part of their bodies straight.

3. *Side plank test (Right and left sides):*

The test started with patient lying on the side then the therapist asked him to lift the body on the elbow, forearm, and feet stacked creating a straight line from head to toe and recorded as long as he held his body and hip off the floor.

4. *Prone plank test:*

The patient was in prone position and then therapist asks them to lift their upper body off the floor using their forearms and elbows and take the weight on their toes with the legs straight. This is the first step of the exam. The body forms a perfect straight line from the head to the toes when the hip is raised off the floor. Once the patient was properly positioned, the therapist started to record the time of holding the position (Tong et al., 2014).

2.5. Statistical Analyses

All data were analyzed using Windows version 27 of the statistical software for social studies (SPSS) (IBM SPSS, Chicago, IL, USA). Descriptive statistics and ANOVA test were carried out for assessment of the mean ± standard deviation of age (years), weight (Kg), height (cm), and BMI

(kg/m^2) of the six groups. The normality of the data was examined using the Shapiro-Wilk statistical test. The Pearson correlation coefficient was calculated to examine the correlation between pain intensity, functional disability and core endurance in CMLBP according to SPCS. The alpha level was set at $p \leq 0.05$ for all analyses.

3. RESULTS

A total of 60 patients with CMLBP completed the study. The Sharipo-Wilk test revealed normally distributed data. Table 1 shows the correlations between pain intensity, functional disability, and core endurance among patients with chronic mechanical low back pain (CMLBP) across different positional groups.

Table 1. Correlation between pain, function disability, and core endurance

	Measured variables		ODI	Core endurance				
				TFT	TET	Right SPT	Left SPT	PPT
Group (V/V)	**Pain**	r- value	0.159	-0.191	-0.394	0.011	-0.034	-0.071
	ODI	r- value		-0.273	0.148	0.118	-0.147	0.128
Group (V/P)	**Pain**	r- value	0.724*	-0.703*	-0.798*	-0.767*	-0.678*	-0.438
	ODI	r- value		-0.600	-0.549	-0.558	-0.536	-0.454
Group (P/P)	**Pain**	r- value	0.556	-0.240	0.103	0.073	0.002	-0.129
	ODI	r- value		-0.530	-0.261	-0.326	-0.497	-0.525
Group (P/A)	**Pain**	r- value	0.449	-0.326	-0.371	-0.507	-0.691*	-0.131
	ODI	r- value		-0.857*	-0.589	-0.618	-0.632	-0.757*
Group (A/P)	**Pain**	r- value	0.538	-0.180	-0.312	0.040	0.214	0.108
	ODI	r- value		-0.379	-0.379	0.107	0.092	0.079
Group (A/A)	**Pain**	r- value	0.688*	0.019	-0.282	-0.429	-0.381	0.064
	ODI	r- value		-0.519	-0.735*	-0.670*	-0.660*	-0.618
All groups	**Pain**	r- value	0.545*	-0.337*	-0.458*	-0.336*	-0.359*	-0.143
	ODI	r- value		-0.561*	-0.441*	-0.397*	-0.458*	-0.418*

Note. *ODI: Oswestry disability index, TFT: trunk flexion test, TEF: trunk extension test, SPT: side plank test, PPT: prone plank test*

**Correlation is significant at p-value ≤ 0.05.*

Pearson correlation coefficient for groups analysis revealed pain intensity was correlated with function disability in vertical/posterior and anterior/anterior group (respectively, r=0.724, 0.688), while negative correlation exists between pain and core endurance in vertical /posterior group (Table 1). There was no significant correlation between pain, function disability and endurance in vertical/vertical, posterior/posterior and anterior/anterior groups (p>.05). Furthermore, among CMLBP patients, there were significant positive associations between pain and function impairment, and a negative relationship between pain and core endurance, as well as functional disability and core endurance (Table 1).

4. DISCUSSION

This study evaluated the association between pain, function disability, and core endurance in CMLBP classified according to SPCS. The result showed a significant strong correlation between pain intensity, function disability, and core endurance according to the postural category. The results revealed a statistically significant positive relationship between pain and function disability in the vertical/posterior and anterior/anterior groups, and a negative correlation between pain and core endurance in the vertical/posterior group (Table 1). Where relationships were observed, it appears likely that pain intensity and function disability and pain and core endurance are highly associated.

To our knowledge, this is the first study to look at the relationship between pain, function disability, and core endurance in CMLBP classified according to their postural category, limiting our ability to make comparisons with other literature.

The results of the current study are in agreement with the findings of a study reported that there was a strong correlation between pain and disability in patients with low back pain, ($p=0,000$, $p<0.05$) and $r= 0,663$ (Saragih et al., 2020). Additionally, the findings within V/P group come in agreement with previous studies which showed that patients with lumbar hyperlordosis have decreased core stability because of the distortion of the lumbopelvic ring (Page et al., 2010).

There was no significant relationship between pain, function, and core endurance in the vertical/vertical, posterior/posterior, and anterior/anterior groups. This may stem from many reasons. Firstly, the small sample size for groups and secondly the fact that patients with specific postural categories had different characteristics, which may impact over time on the responses of pain, function disability, and core endurance in CMLBP or by their ability to perform well under pressure. For instance, posterior/posterior group had sway back which is accompanied with lumbar hyperlordosis that may affect one's core muscular endurance measures (Fallahasady et al., 2022).

Whereas anterior/ anterior group's posture is mostly characterized by a decrease in the lumbar lordosis angle, a backward tilt, of the pelvis and instability of the lumbar spine (Yoo, 2013). This pays attention to focus on restoring core muscles balance during rehabilitation according to postural category which has an influential role on performance.

5. LIMITATIONS

The findings of the current study should be interpreted in light of its limitations. The limited sample size may have led to the lack of correlation among the outcome variables and restricted generalization of the results, diminishing the study's external validity.

6. CONCLUSIONS

Participants in the vertical/posterior group demonstrated a strong positive association between pain and function disability, but a negative correlation between pain and core endurance. While there is a strong positive association between pain and functional impairment in all CMLBP individuals. There is a negative relationship between pain and core endurance, as well as functional disability and core endurance.

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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