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Influence of Selected Pain Characteristics on Segmental Spine Range of Motion in Patients with Low-Back Pain

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Abstract

Background and objectives: Pain is an important etiology in the dysfunction and impairment of spinal architecture, biomechanics and function. However, there are conflicting findings in studies investigating the relationship between lumbar spine mobility and pain characteristics in patients with Low-Back Pain (LBP). This study compared cervical, thoracic and lumbar spine Range of Motion (ROM) between patients with Low-Back Pain (LBP) and their age, sex and somatotype-matched healthy controls. The study also investigated the influence of selected pain characteristics (intensity and duration of pain) on spinal range of motion in the patients.

Methods: Two hundred and two participants (101 patients and healthy controls respectively) were purposively recruited from five selected physiotherapy out-patient clinics in South Western, Nigeria. The control participants were recruited from Obafemi Awolowo University (OAU) and OAU Teaching Hospitals Complex, Ile-Ife, Nigeria. ROM and pain intensity were assessed using dual inclinometry technique and Visual Analog Scale (VAS) respectively. Somatotype was determined using the wrist girth measurement and body perception scale respectively. Data were also obtained on demographic and anthropometric variables.

Results: The patients and control group were comparable in age (48.1 ± 15.1 vs. 48.0 ± 15.1yrs; p=0.996). The control group had significantly higher ROM in the cervical (t= -6.82; p= 0.001), thoracic (t= -6.59; p= 0.001) and lumbar (t= -4.36; p= 0.001) spine respectively. There was significant inverse correlation between pain intensity and lumbar ROM in flexion (r = -0.402, p = 0.001) and extension (r = -0.303, p = 0.002) respectively. Pain duration was not significantly correlated with ROM in any of the spinal segments (p>0.05).

Conclusion: Patients with LBP had significantly lower cervical, thoracic and lumbar spine ROM compared with controls. Patients with higher pain intensity had lower lumbar spine ROM in flexion and extension respectively.

Keywords: Segmental spine range of motion; Pain characteristics; Low-back pain

Introduction

Low-Back Pain (LBP) is described as pain, muscle tension or stiffness localized below the costal margin and above the inferior gluteal folds with or without leg pain [1]. LBP is a major public health problem globally [2] with a high economic loss [3] and reduced work productivity [4]. As a result, LBP is considered the medical disaster of the 20th century with its effects reverberating into the new millennium [5]. Epidemiological studies have indicated that about 80% of the population experiences LBP during their active lives [6].

Low-Back Pain is a complicated condition which affects the psychosocial and physiological aspects of the patient [7-10]. Associated physiologic impairment of pain, decrease muscular strength and endurance, functional limitations and loss of spinal range of motion among others are the most common reason for seeking treatment among patients with LBP [11-13]. Loss of spinal range of motion is often considered a cause as well as a consequence of LBP [14]. However, there are conflicting findings in studies investigating lumbar spine mobility in patients with LBP. Some studies have found reduced lumbar spine mobility [15-19] while others reported no difference in spine mobility and alignment of the lumbar spine in patients with LBP [12,20-22]. Conversely, some others reported increased lumbar mobility in patients with LBP [23-25].

Notwithstanding, spinal mobility and alignment are important factors for spinal function [11]. Persons with positive history of frequent episodes of LBP often present with altered spinal mobility at the lumbar spine [16], which may influence movement in other parts of the spine [26]. However, the influence of pain characteristics on the segmental mobility of the spine in patients with LBP seems inconclusive and controvertible. Therefore, this study compared cervical, thoracic and lumbar spine Range of Motion (ROM) of patients with Low-Back Pain (LBP) and their age, sex and somatotype-matched healthy controls. The study also investigated the influence of selected pain characteristics (intensity and duration of pain) on spinal range of motion in the patients.

Materials and Methods

This case control study recruited 202 participants (101 patients with LBP and 101 healthy controls). The participants with LBP were recruited from five government owned physiotherapy outpatient clinics from the South-Western part of Nigeria namely that of the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife, Wesley Guild Hospital, Ilesa, Ladoke Akintola University Teaching Hospital, Osogbo, University College Hospital, Ibadan, and National Orthopaedic Hospital, Igbobi, Lagos.

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The inclusion criteria for recruitment for the patient group were clinical diagnosis of mechanical LBP with no radiating pain to the lower extremities, individuals without any obvious deformities affecting the trunk and were within the age bracket of 20 to 65years. Eligible participants with reported lumbar disc hernia or severe osteoporosis or spine fracture, individuals with recent back surgery, known malignant disease and who were pregnant were excluded from the study. The age, sex and somatotype-matched apparently healthy controls comprised of students and staffs of the Obafemi Awolowo University, Ile-Ife and OAUTHC respectively. Aside age, sex and somatotyping for the controls, a self-report of no recent episode of LBP within the last 6 months before the study was used as part of the eligibility criteria.

Procedure

Ethical approval for the study was obtained from the Ethics and Research Committee of OAUTHC. Informed consent of the participants was obtained after explaining the research procedure. Also, permission of the clinical heads of the selected physiotherapy clinics was obtained. Data were obtained on participants' demographic variables of age, sex, occupation and marital status. Anthropometric and clinical variables of body composition, weight, height, Body Mass Index (BMI), pain intensity, pain duration and spine range of motion were obtained.

Anthropometric variables

Height and weight were measured to the nearest 0.1cm and 0.5kg respectively using a stadiometer (SECA Corporation, Hamburg, Germany) with the participant in erect standing position with shoes off with the heels, back and occiput touching the stadiometer while looking straight ahead. BMI was computed by dividing the weight in kilograms by the height in meters squared [27].

Clinical variables

Spine range of motion: The spine range of motion was assessed using double inclinometry method as described by Loebl (1967). Two Empire magnetic polycast inclinometers (WI 5314, Empire Mfg Corp, Wisconsin, USA), calibrated from 0 to 360 degrees were used to assess spine range of motion in the cervical, thoracic and lumbar spine in forward flexion and back extension based on guidelines provided in the American Medical Association (AMA) guides [28,29].

Cervical range of motion (CROM): Cervical range of motion was assessed by asking the participant to assume standing position after which the upper inclinometer was placed in the middle of the head in a saggital plane and the lower inclinometer placed at the spinous process of C7 vertebrae. Readings on the inclinometers were taken at rest, in forward flexion and back extension. The true CROM was obtained by subtraction of the readings of the lower inclinometer from the upper one [29,30].

Thoracic range of motion (THROM): Thoracic range of motion was assessed by asking participants to assume standing position. The upper inclinometer was placed at the spinous process of the T1 vertebrae and the lower inclinometer was placed on the sagittal plane of the spinous process of T12 vertebrea. Readings were taking at rest, forward flexion and back extension respectively [29, 30].

Lumbar range of motion (LROM): Lumbar range of motion was assessed by asking participants to assume standing position. The anatomical land marks for measurements were palpated at the spinous processes of T12 and S1 vertebrae. The upper inclinometer was placed on the skin overlying the spinous process of T12 while the lower inclinometer was placed on the spinous process of the S1 vertebra. Readings were taken at rest, forward flexion and back extension [31, 30].

Somatotype-matching

Somatotype-matching for both groups was carried out using wrist girth measurement and body image perception scale respectively. Wrist girth somatotype assessment involved wrist circumference measurement using a tape measure around the radial styloid process [32]. It was expressed as the wrist circumference divided by height of the participants [33]. This was later categorized into the three major body types; Endomorph: Male (11.75-12.25), Female (10.25- 10.75), Mesomorph: Male (10.75-11.25), Female (9.75-10.25), Ectomorph: Male (8.75-9.25), Female [32].

Body image perception scale adapted from Stunkard et.al [34] was employed as a subjective measure to determine the perceived body shape by choosing an image that corresponds to the figure of the participants on a scale ranging from 1 to 9,with 1 being the thinnest body type and 9 being the largest most obese type [35]. There was a significant direct correlation between the wrist girth somatotyping method and body image perception scale (r=0.90; p=0.001).

Pain characteristics

Pain intensity and duration: Visual Analogue Scale was used to assess pain intensity using a 10cm horizontal line anchored on the left "no pain" and the right "worst pain" [36]. Level of pain was categorized into mild (1-3), moderate (4-6) and severe pain (7-10). Pain duration was classified based on reported onset as acute (less than 3 months) or chronic (from above 3 months) pain.

Statistical Analysis

Descriptive Statistics of percentage, mean and standard deviation were used to summarize data. Independent t-test was used to compare segmental spine ROM (CROM, THROM and LROM) between the patients and the control group. Spearman's correlation analysis was used to determine the relationship between spine ROM and pain characteristics among the patients group. Data analysis was carried out using SPSS 16.0 version software (SPSS Inc., Chicago, Illinois, USA). Alpha level was set at p=0.05.

Results

The physical characteristics of all the participants are presented in Table 1. From the result, both groups were comparable (p>0.05) in their physical characteristics except, for the BMI that was significantly higher in the patient group (p<0.05). Independent t-test comparison of the CROM, THROM and LROM between the patients and control group is presented in Table 2. The result showed that the controls group had significantly higher CROM, THROM and LROM values (p<0.05).

The pain profile of the patients group revealed that a majority (60.4%) had moderate pain intensity (4 – 7) while 23.7% had severe pain (8 – 10). It was also shown that a majority (64%) of the patients had chronic LBP (Table 3). Spearman's correlation analysis revealed a significant inverse relationship between LROM and pain intensity both in flexion (p=001, r = -0.402) and extension (p=002, r = -0.303) respectively (Table 4). However, there were no significant relationships between each of CROM and THROM and pain intensity (p>0.05) (Table 4). Furthermore, pain duration was not significantly correlated with each of CROM, THROM and LROM values (p>0.05) (Table 5).

Variables		Minimum	Maximum	Range	Mean ± S.D.	t-cal	P-value
Age(years)	LBP(n=101)	20.00	65.00	45.00	48.05 ±15.14	-0.005	0.996
Height(m)	Control(n=101) LBP (n=101) Control(n=101)	20.00 1.50 1.54	65.00 1.84 1.82	45.00 0.34 0.28	48.05 ±15.14 1.64 ± 0.07 1.67 ± 0.11	-1.726	0.086
Weight(Kg)	LBP (n=101) Control(n=101)	48.00 50.00	115.00 105.00	67.00 55.00	74.95 ±13.44 71.85 ±11.21	1.77	0.078
BMI (Kg/m^2)	LBP (n=101) Control(n=101)	21.33 21.08	33.96 31.69	12.63 10.61	27.85 ± 5.71 25.76±4.61	2.37	0.019*

Key: BMI = Body mass Index
* Significant, P<0.05
Table 1: Independent T-test Comparison of Demographics of LBP subjects and healthy controls.

Variables	LBP (n-101) X ± 5.1)	Healthy Controls (n=101) X ± S.D)	t-cal	P-value
Cervical CROM CROM FLX	24.7 ± 8.70	31.7 ± 5.50	- 6.82	0.001*
CROM EXT	13.8 ± 6.20	21.0 ± 4.60	- 9.22	0.001*
THROM FLX	18.7 ± 4.40	22.0 ± 2.30	- 6.59	0.001*
THROM EXT	12.4 ± 4.60	17.0 ± 2.60	- 8.72	0.001*
LROM FLX	43.5 ± 13.30	50.6 ± 9.60	- 4.36	0.001*
LROM EXT	21.6 ± 8.50	31.9 ± 5.60	- 10.0	0.001*

CROM FLX = Cervical Range of Motion in Flexion; CROM EXT = Cervical Range of Motion in Extension; THROM FLX = Thoracic Range of Motion in Flexion; THROM EXT = Thoracic Range of Motion in Extension; LROM FLX = Lumbar Range of Motion in Flexion; LROM EXT = Lumbar Range of Motion in Extension

Significant, P* < 0.05

Table: 2: Independent t-test Comparison of Spine Range of Motion of Low-back Pain (LBP) subjects and Healthy Controls.

Variables	Frequency	Percentage
Pain Intensity		
Mild (1 – 3)	16	15.84%
Moderate (4 – 7)	61	60.40%
Severe (8 – 10)	24	23.76%
Pain Duration		
Acute (≤ 3months)	36	35.65%
Chronic (> 3 months)	65	64.35%

Table 3: Pain profile of low-back pain subjects.

Spine ROM Variables	Correlation Co-efficient (r)	P – Value
CROM FLX	- 0.014	0.888
CROM EXT	- 0.086	0.392
THROM FLX	- 0.069	0.494
THROM EXT	- 0.172	0.085
LROM FLX	- 0.402	0.001*
LROM EXT	- 0.303	0.002*
Significant at P* < 0.05 alpha level		

Table 4: Spearman's Rank Correlation between Pain intensity and Spine Range of Motion (ROM) in Low-back pain (LBP) Subjects.

Spine ROM Variables	Correlation Co-efficient (r)	P – Value
CROM FLX	- 0.136	0.176
CROM EXT	- 0.077	0.446
THROM FLX	- 0.093	0.353
THROM EXT	- 0.44	0.659
LROM FLX	- 0.184	0.965
LROM EXT	- 0.173	0.083

Table 5: Spearman's Rank Correlation between Pain Duration and Spine Range of Motion (ROM) in Low-back Pain (LBP) subjects.

Discussion

This case-control study compared cervical, thoracic and lumbar spine ROM of patients with LBP with their age, sex and somatotype-matched healthy controls. The study also investigated the influence of pain intensity and duration on segmental ROM in patients with LBP. From the result, the groups were comparable in their physical characteristics except for BMI. Physical characteristics comprising age and anthropometric variables are important predictors of spine ROM [37- 40]. Comparability in physical characteristics in a case control studies may strengthen an assumption that the outcome of study's finding may be the result of pain on the functional abilities and its implication on spine ROM in patients with LBP. However, the patient group in this study had a significant higher BMI. Previous studies have reported higher BMI among patients with LBP compared with the healthy controls [41, 42]. Higher BMI level in patients with LBP has been implicated in reduced functional ability with resultant physiologic changes in the muscle mass, body weight and the resting metabolic rate [43].The Higher BMI among the patients group in this study may be a cofounder to the outcome of the study.

From this study, non-impaired individuals had significantly higher CROM, THROM and LROM compared with those with LBP. This is consistent with the study by Troup et al (1987), Burton et al (1989) and Battie et al (1990) who reported lesser ROM in patients with LBP. The associated loss and reduced spine ROM may be as a result of reduced functional abilities which have been reported to be associated with LBP. Burton et al (1989) reported that persons who report current back pain or a history of frequent episodes of back pain often present with altered spinal mobility at the lumbar which may influence movement in other parts of the spine. Pain-related fear has been associated with avoidance behavior and increased risk for chronic low-back pain [44]. LBP causes patients to avoid daily activities which may lead to physical deconditioning which may result in even more pain and disability and also contribute to the chronicity of LBP [45,46]. The result of this study

showed that patients with LBP does not only have reduced lumbar ROM but have reduced thoracic and cervical spine ROM compared to apparently healthy controls. This finding agrees with a previous study by Jones et al (2005) which found that altered lumbar spine mobility may influence movement in other parts of the spine. Conversely, Ng et al. [21] reported no significant difference in the spine mobility between patients with LBP and healthy controls. The result of this study revealed that majority of the patient had moderate and chronic pain characteristics (Table 2). This agrees with the study by Von Korff et al. (1976) which reported a higher occurrence of chronic pain in patients with LBP.

The result of this study also revealed that pain intensity negatively impact lumbar spine ROM in flexion and extension. The result showed that increase in pain intensity was correlated with poorer lumbar spine mobility in flexion and extension respectively. This pattern of correlation was similar to some earlier reports [16,19,26] which stated that presence of persistent LBP causes patients to avoid daily activities which may lead to physical deconditioning.

Contrarily, Lindsay and Horton [23], Vergara and Page [24] and Burnet et al., [25] have reported increased lumbar spine mobility among patients with LBP. Furthermore, the result of this study showed no significant relationship between pain duration and spinal ROM.

Clinical implication of the findings

From this study, it can be inferred that pain at the lower back does not only affect the biomechanics of the lumbar spine, it has its effects on other parts of the spine thus requiring careful assessment and management. Therefore, management of patients with pain in the lumbar region should not just involve pain management but should promote improved functional abilities and spine mobility.

Patients with LBP had significantly lower cervical, thoracic and lumbar spine range of motion compared with controls. The higher the intensity of LBP the lower the lumbar spine ranges of motion in flexion and extension respectively.

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