GMR
The Original

ASSOCIATION BETWEEN PAIN SEVERITY AND BODY COMPOSITION CHARACTERISTICS IN INDIVIDUAL WITH NON-SPECIFIC LOW BACK PAIN

Benito V[1], Angeline Rajan[2]*, P Antony Leo Aseer[3], Subbiah K[4], Manisha J[5]

[1] Undergraduate Student, Sri Ramachandra Faculty of Physiotherapy, SRIHER
[2] Assistant Professor, Sri Ramachandra Faculty of Physiotherapy, SRIHER
[3] Principal and Professor, Sri Ramachandra Faculty of Physiotherapy SRIHER
[4] Associate Professor, Sri Ramachandra Faculty of Physiotherapy, SRIHER
[5] Postgraduate Student, Sri Ramachandra Faculty of Physiotherapy, SRIHER
*Corresponding Author: Ms. Angeline R, Email: angelinejobin75@sriramachandra.edu.in ORCID ID: http://orcid.org/0000-0003-2667-5957

ABSTRACT

Background: Low back pain (LBP) is the most common musculoskeletal disorder affecting global health and quality of life. Even though obesity is identified as a risk factor for LBP, the relationship between body composition parameters and pain severity remains unclear. This study aims to explore the association between body composition characteristics and pain severity in individuals with non-specific LBP.

Methods: This observational study was conducted at Sri Ramachandra Hospital, Chennai, with 98 participants aged 35–60 years diagnosed with non-specific LBP. Demographic data, body composition parameters (BMI, body fat percentage, visceral fat, subcutaneous fat, skeletal muscle mass, and fat-free mass), pain intensity (measured using the Visual Analog Scale), and physical function (assessed using the Oswestry Disability Index) were collected. Pearson's correlation analysis was performed to determine relationships between pain severity and body composition indicators.

Results: The study found significant positive correlations between BMI ($P<0.00$, $P<0.00$), waist circumference ($P<0.00$, $P<0.00$), fat mass ($P<0.00$, $P<0.00$), fat mass index ($P<0.00$, $P<0.00$), visceral fat area ($P<0.00$, $P<0.00$) with pain intensity and functional impairment. There was a significant positive correlation between total body percentage and pain intensity ($P<0.00$).

Conclusion: Increased body fat, particularly visceral fat area is significantly associated with greater pain intensity and disability in individuals with chronic non-specific LBP. These findings emphasize the role of body fat distribution in LBP severity and functional impairment, underscoring the need for targeted weight management strategies in LBP treatment.

KEYWORDS: Obesity, Pain severity, BMI, Fat mass, Visceral fat, Waist circumference, Chronic non-specific low back pain.

INTRODUCTION

Low back pain (LBP) is a common musculoskeletal disorder worldwide, that significantly impacts community well-being and quality of life.[1] It is a primary factor contributing to decreased physical activity and job absenteeism,[2] hence imposing a cost on the healthcare system and financial resources.[3]

Low back pain is regarded as complex; thus, evaluating predictors is crucial. Despite a considerable burden of sickness, the majority of back pain episodes possess an ambiguous anatomical origin and are often classified as nonspecific. Risk variables linked to low back pain (LBP) encompass female gender, advanced age, educational attainment, employment, income level, and elevated body weight.[4]

Both LBP and obesity are significant health risks; nevertheless, their interrelationship remains ambiguous and even contentious. Studies concur that a correlation exists, but assert that inactivity, frequently associated with obesity, can serve as a significant independent predictor of LBP.[5] Research has investigated the correlation between obesity and the occurrence of back pain; however, limited studies have explored the association between an increase in body mass index (BMI) and severity of LBP. A deeper comprehension of the possible association between these characteristics might enhance therapeutic care of either ailment and influence research in this field.

Standardised measures for overweight and obesity, including body fat percentage, waist circumference and visceral fat are necessary to evaluate their potential correlation with pain in future research, as BMI fails to account for body fat distribution.[6]

Diverse explanations about the relationship between LBP and overweight or obesity in humans have been suggested. Obesity may elevate mechanical stress on the spine, while adipose tissue, functioning as an endocrine organ, secretes pro-inflammatory signals that might provoke pain.[7-12]

The relationship between pain severity and overweight or obesity in persons with chronic non-specific low back pain remains ambiguous. An accurate assessment of pain severity and body composition in individuals with non-specific LBP and overweight or obesity may enhance the comprehension of the processes connecting pain with excess weight and obesity. BMI serves as an indicator of adiposity; however, it fails to consider the distribution of body fat. Therefore, alternative assessments of body composition, including body fat percentage evaluated through bioimpedance analysis (BIA) warrant examination.

Overweight and obesity may contribute to heightened nociception in individuals experiencing chronic non-specific LBP.[13-14] The study aims to explore certain body composition characteristics are associated with increased or decreased pain severity in individuals with non-specific LBP.

METHODOLOGY

The observational study was conducted after gaining approval from the Institutional Ethics Committee – CSP-III/24/MAY/05/171.The participants were selected from the Physiotherapy department at Sri Ramachandra Hospital, Chennai, according to the inclusion criteria. The recruiting procedure started in October 2024 and concluded by January 2025. Ninety-eight subjects who satisfied the specified inclusion and exclusion criteria were incorporated into the research. Inclusion criteria: i) Patients aged 35 to 60 years ii) both sexes iii) non-specific low back pain without radiation. Participants were eliminated for having diabetes mellitus, arthritis, disc prolapse, or radiculopathy.

Informed permission was acquired from every participant included in this investigation. To prevent interrater reliability issues, a single examiner was tasked with collecting all data.

Demographic information such as age, gender, occupation ,Height and weight were documented for all individuals who met the inclusion criteria. The severity of pain was assessed using a Visual Analogue Scale (VAS). Subsequent to assessing the pain intensity, the examiner quantifies the distance in millimetres from the zero point to the point indicative of pain, and the pain degree is documented.[15] The reliability of the Visual Analogue Scale (VAS) for evaluating chronic musculoskeletal pain varied from moderate to good.[16]

A physical functioning assessment was conducted utilising the Oswestry Disability index (ODI). It is a reliable tool for assessing disability in LBP patients, with Cronbach's alpha values of 0.86–0.90 showing high internal consistency. The test-retest reliability (ICC: 0.83–0.99) has shown stable results over time.[17]

Body composition measurements were performed using the Mediana i35 Body Composition Analyzer, which utilizes multi-frequency bioelectrical impedance analysis (BIA) through an 8-point tetrapolar electrode system. Participants stood barefoot on the Body Composition analyzer's footplate, aligning their feet with the embedded electrodes. They were instructed to hold the hand electrodes firmly, with arms extended downward and slightly away from the torso to avoid skin contact between limbs. All measurements were guided and supervised by a physiotherapist present at the participant's side to ensure correct posture and full contact with electrodes . The device automatically calculated the parameters including body mass index, total body fat percentage, visceral fat area, total body water, skeletal muscle, abdominal fat ratio, muscle mass, waist circumference, fat-free mass and fat mass .

Sample size calculation

The sample size was determined using software the G-POWER 3.0.10, considering a 95% confidence level and 80% statistical power, with an alpha error of 0.05, resulted in a computed sample size of 98 patients.

Continuous variables were described using means and standard deviation. Pearson correlation was used to measure the degree of association between quantitative variables. The 0.05 level or below was used as the cutoff value for statistical significance.

RESULTS

For all the 98 participants, a comprehensive history, physical examination, clinical data, and outcome assessments were gathered at baseline. The outcome is displayed as mean ± standard deviation in when applicable. Table 1, which delineates the characteristics of the individuals. Pearson's correlation (r) was performed to determine the relationship between pain severity and body composition parameters (table 2).

Table 1: Characteristics of participants

	Mean ± SD
Age	49.13 ± 6.34
Gender (male/female)	28/70
Height	158.09 ± 8.46
Weight	65.81 ± 13.64
BMI	26.26 ± 4.50
Pain Severity	5.62 ± 1.22
ODI	12.66 ± 4.41
Waist Circumference, cm	85.36 ± 10.90
Total Body Water, L	30.08 ± 6.56
Fat Mass, kg	25.01 ± 9.07
Fat Mass Index, kg/m2	10.10 ± 3.65
Fat Free Mass, kg	40.80 ± 8.80
Fat Free Mas Index, kg/m2	16.15 ± 2.23
Total Body Fat Percentage	37.41 ± 8.96
Visceral Fat Area, cm	92.91 ± 32.56

Abdominal Fat Ratio	0.88 ± 0.06
Muscle Mass, kg	38.17 ± 8.53
Skeletal Muscle, kg	21.24 ± 6.03

Table 2: Relation between pain intensity and physical function with Body Composition Parameters

Variables	PAIN INTENSITY		PHYSICAL FUNCTION	
	r value	**p value**	**r value**	**p value**
BMI, kg/m2	0.85	0.00*	0.50	0.00*
Waist Circumference, cm	0.61	0.00*	0.32	0.00*
Total Body Water, L	0.29	0.00*	0.06	0.56
Fat Mass, kg	0.79	0.00*	0.47	0.00*
Fat Mass Index, kg/m2	0.77	0.00*	0.50	0.00*
Fat Free Mass, kg	0.27	0.00*	0.23	0.77
Fat Free Mas Index, kg/m2	0.44	0.00*	0.18	0.08
Total Body Fat Percentage	0.57	0.00*	0.41	0.00*
Visceral Fat Area, cm	0.63	0.00*	0.44	0.00*
Abdominal Fat Ratio	0.29	0.00*	0.27	0.00*
Muscle Mass, kg	0.26	0.01*	0.00	1
Skeletal Muscle, kg	0.29	0.00*	0.07	0.49

P<0.05* (Pearsons corelation)

DISCUSSION

LBP affects nearly two-thirds of the world's population. Nevertheless, the exact reason remains unclear, as symptoms do not always correlate with imaging findings and may not be attributed to a specific pathoanatomical diagnosis. While previous research has suggested a link between obesity, increased fat mass, and a higher risk of LBP, the evidence remains inconclusive.[18] Given this uncertainty, this study aimed to explore the relationship between body composition parameters and intensity in non-specific LBP. Additionally, this study examines how physical function correlate with body composition in individuals with Non-specific LBP.

Previous studies have examined the association between BMI and LBP and found that being overweight or obese raises the risk of developing LBP. This association is attributed to biomechanical changes in the spine, particularly alterations in the angles of the lumbosacral spine.[19-20] Our study's findings, which indicate a substantial positive correlation between BMI and LBP and a moderate positive with physical function which consistent with those of other research that revealed a causal relationship between high BMI and the risk of LBP.[21-23]

Regardless of BMI, research on waist circumference found that a larger waist circumference raises the intensity of chronic lower back pain and is linked to other forms of chronic pain. Previous studies have demonstrated a positive correlation between chronic pain and waist size in both men and women.[24] Furthermore, it seems that obesity impairs functional ability and mobility, which accelerates the development of impairment.[25] The results of this study are consistent with the previous studies, demonstrating a positive correlation between pain intensity and waist circumference, as well as physical function.

Studies have reported that fat mass and fat mass index were associated with LBP and pain intensity through various mechanisms, in over weight and obese subjects there is excess fat resulting in increased load on the spine; the adipose tissue is known to be metabolically active and secretes pro-inflammatory molecules.[26-27] This affects the nutrition to the intervertebral disc through atherosclerosis this in turn decreases the blood supply to the lumbar region, in the vertebrae and surrounding muscles.[28] However, all these studies show inconsistent correlation between fat free mass and LBP. A recent cohort study showed that fat percentage and fat mass were positively associated with pain intensity and disability. Fat free mass was found to be negatively associated with pain intensity in women only and the intensity reduced in a linear manner in relation to increasing sex-specific quartiles of fat-free mass.[29] Our study found a significant positive correlation between fat mass and fat mass index with pain intensity and physical function in low back pain patients.

A recent study found an association between the loss of intervertebral disc height and the amount of visceral, subcutaneous, and total fat volume at all lumbar levels.[30] A study examined the relationships among central sensitization (CS), chronic LBP, and visceral fat area in patients with lumbar spinal stenosis. Based on the Central Sensitization Inventory (CSI) ratings, participants were split into high and low CS groups. These findings imply that, in patients with stenosis, higher visceral fat is linked to more intense pain and CS.[31] Our study results were consistent with the previous study and found a significant increase in the pain intensity and disability with increased visceral fat area. Individuals with LBP had a higher body fat percentage than asymptomatic controls.[32] This study also showed a significant positive correlation between total body fat percentage with pain intensity and physical function.

Recent study investigated the association between skeletal muscle mass and fat mass—and chronic pain in older adults. This study found that patients with non-specific LBP had a significantly lower Skeletal muscle mass index and higher body fat percentage compared to the control group.[33] Our study demonstrated a very weak positive correlation between skeletal muscle mass with pain intensity and physical function and this can be considered negligible and is not practically significant.

Abdominal fat accumulation has been linked to increased intensity of low back pain (LBP). Studies have demonstrated that higher fat mass and central fat distribution are associated with greater LBP intensity and disability, suggesting that systemic metabolic factors related to adiposity play a significant role in LBP pathogenesis.[29] This study also showed a significant positive correlation between abdominal fat ratio with pain intensity and physical function.

A previous study showed no significant correlation between the pain intensity and total body water; in contrast this study found a positive correlation between total body water and pain intensity and physical function in low back pain patients. The differences in the results of the present study speculates that the ethnic difference may have contributed to the relationship between low back pain and body composition.[34]

CONCLUSION

This study identified a significant positive association between various body composition parameters (body mass index, fat mass, fat mass index, waist circumference, and visceral fat area) with pain intensity and physical disability in individuals with chronic non-specific LBP. These findings highlight the contribution of excess adiposity, especially central fat accumulation, to the severity of pain and functional limitation in this population. The results underscore the importance of incorporating body composition assessment into the clinical evaluation of non-specific LBP.

REFERENCES

1. Hoy D, Bain C, Williams G, et al. A systematic review of the global prevalence of low back pain. Arthritis Rheum. 2012; 64(6): 2028-37. doi: 10.1002/art.34347.
2. Driscoll T, Jacklyn G, Orchard J, et al. The global burden of occupationally related low back pain: estimates from the Global Burden of Disease 2010 study. Ann Rheum Dis. 2014; 73(6): 975-81. doi: 10.1136/annrheumdis-2013-204631.
3. Hartvigsen J, Hancock MJ, Kongsted A, et al. What low back pain is and why we need to pay attention. Lancet. 2018; 391(10137): 2356-67. doi: 10.1016/S0140-6736(18)30480-X.
4. Mukasa D, Sung J. A prediction model of low back pain risk: a population based cohort study in Korea. Korean J Pain. 2020; 33(2): 153-65. doi: 10.3344/kjp.2020.33.2.153.
5. Shiri R, Karppinen J, Leino-Arjas P, et al. The association between obesity and low back pain: a meta-analysis. Am J Epidemiol. 2010; 171(2): 135-54. doi: 10.1093/aje/kwp356.
6. Ho-Pham LT, Lai TQ, Nguyen MT, Nguyen TV. Relationship between body mass index and percent body fat in Vietnamese: implications for the diagnosis of obesity. PLoS One. 2015; 10(5): e0127198. doi: 10.1371/journal.pone.0127198.
7. Wong CK, Mak RY, Kwok TS, et al. Prevalence, incidence, and factors associated with non-specific chronic low back pain in community-dwelling older adults aged 60 years and older: a systematic review and meta-analysis. J Pain. 2022; 23(4): 509-34. doi: 10.1016/j.jpain.2021.07.012.
8. Ghezelbash F, Shirazi-Adl A, Plamondon A, et al. Obesity and obesity shape markedly influence spine biomechanics: a subject-specific risk assessment model. Ann Biomed Eng. 2017; 45(10): 2373-82. doi: 10.1007/s10439-017-1868-7.
9. Peiris WL, Cicuttini FM, Hussain SM, et al. Is adiposity associated with back and lower limb pain? A systematic review. PLoS One. 2021; 16(9): e0256720. doi: 10.1371/journal.pone.0256720.
10. Cao H. Adipocytokines in obesity and metabolic disease. J Endocrinol. 2014; 220(2): T47-59. doi: 10.1530/JOE-13-0339.
11. Briggs MS, Givens DL, Schmitt LC, Taylor CA. Relations of C-reactive protein and obesity to the prevalence and the odds of reporting low back pain. Arch Phys Med Rehabil. 2013; 94(4): 745-52. doi: 10.1016/j.apmr.2012.11.026.
12. Coppack SW. Pro-inflammatory cytokines and adipose tissue. Proc Nutr Soc. 2001; 60(3): 349-56. doi: 10.1079/pns2001110.
13. Dario AB, Ferreira ML, Refshauge K, et al. Are obesity and body fat distribution associated with low back pain in women? A population-based study of 1128 Spanish twins. Eur Spine J. 2016; 25(4): 1188-95. doi: 10.1007/s00586-015-4055-2.
14. Mirtz TA, Greene L. Is obesity a risk factor for low back pain? An example of using the evidence to answer a clinical question. Chiropr Osteopat. 2005; 13(1): 2. doi: 10.1186/1746-1340-13-2.
15. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). Arthritis Care Res. 2011; 63 Suppl 11: S240-52. doi: 10.1002/acr.20543.
16. Boonstra AM, Schiphorst Preuper HR, Reneman MF, et al. Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. Int J Rehabil Res. 2008; 31(2): 165-9. doi: 10.1097/MRR.0b013e3282fc0f93.
17. Vianin M. Psychometric properties and clinical usefulness of the Oswestry Disability Index. J Chiropr Med. 2008; 7(4): 161-3. doi: 10.1016/j.jcm.2008.07.001.
18. Shim JG, Ryu KH, Cho EA, et al. Association between body composition and chronic low back pain in Korean adults aged over 50 years: The Korea National Health and Nutrition Examination Survey (KNHANES) 2010-2011. Med Princ Pract. 2023; 32(4-5): 281-7. doi: 10.1159/000533354.
19. Dunlevy C, MacLellan GA, O'Malley E, et al. Does changing weight change pain? Retrospective data analysis from a national multidisciplinary weight management service. Eur J Pain. 2019; 23(8): 1403-15. doi: 10.1002/ejp.1397.

20. Onyemaechi NO, Anyanwu GE, Obikili EN, et al. Impact of overweight and obesity on the musculoskeletal system using lumbosacral angles. Patient Prefer Adherence. 2016; 10: 291-6. doi: 10.2147/PPA.S90967.
21. Higgins DM, Buta E, Heapy AA, et al. The relationship between body mass index and pain intensity among veterans with musculoskeletal disorders: findings from the MSD cohort study. Pain Med. 2020; 21(10): 2563-72. doi: 10.1093/pm/pnaa043.
22. Croft PR, Papageorgiou AC, Thomas E, et al. Short-term physical risk factors for new episodes of low back pain. Prospective evidence from the South Manchester Back Pain Study. Spine. 1999; 24(15): 1556-61. doi: 10.1097/00007632-199908010-00009.
23. Yip YB, Ho SC, Chan SG. Tall stature, overweight and the prevalence of low back pain in Chinese middle-aged women. Int J Obes Relat Metab Disord. 2001; 25(6): 887-92. doi: 10.1038/sj.ijo.0801557.
24. Xu T, Jin F, Yu Y, et al. Association between waist circumference and chronic pain: insights from observational study and two-sample Mendelian randomization. Front Nutr. 2024; 11: 1415208. doi: 10.3389/fnut.2024.1415208.
25. Bayartai ME, Luomajoki H, De Micheli R, et al. Changes in the Oswestry Disability Index after a 3-week in-patient multidisciplinary body weight reduction program in adults with obesity. J Clin Med. 2022; 11(11): 3175. doi: 10.3390/jcm11113175.
26. Cao H. Adipocytokines in obesity and metabolic disease. J Endocrinol. 2014;220(2):T47–T59. doi:10.1530/JOE-13-0339.
27. Peiris WL, Cicuttini FM, Hussain SM, Estee MM, Romero L, Ranger TA, et al. Is adiposity associated with back and lower limb pain? A systematic review. PLoS One. 2021;16(9):e0256720. doi:10.1371/journal.pone.0256720.
28. Kauppila LI. Atherosclerosis and disc degeneration/low-back pain--a systematic review. Eur J Vasc Endovasc Surg. 2009; 37(6): 661-70. doi: 10.1016/j.ejvs.2009.02.006.
29. Hussain SM, Urquhart DM, Wang Y, et al. Fat mass and fat distribution are associated with low back pain intensity and disability: results from a cohort study. Arthritis Res Ther. 2017; 19(1): 26. doi: 10.1186/s13075-017-1242-z.
30. Kilinc RM, Can FI. The effect of intraabdominal visceral and subcutaneous adipose volume and muscle volume on lumbar vertebrae degeneration. Cureus. 2023; 15(3): e35940. doi: 10.7759/cureus.35940.
31. Toda Y, Segal N, Toda T, et al. Lean body mass and body fat distribution in participants with chronic low back pain. Arch Intern Med. 2000; 160(21): 3265-9. doi: 10.1001/archinte.160.21.3265.
32. Walsh TP, Arnold JB, Evans AM, et al. The association between body fat and musculoskeletal pain: a systematic review and meta-analysis. BMC Musculoskelet Disord. 2018; 19(1): 233. doi: 10.1186/s12891-018-2137-0.
33. Sakai Y, Watanabe T, Wakao N, et al. Skeletal muscle and fat mass reflect chronic pain in older adult. Gerontol Geriatr Med. 2023; 9: 23337214231190146. doi: 10.1177/23337214231190146.
34. Iizuka Y, Iizuka H, Mieda T, et al. Association between neck and shoulder pain, back pain, low back pain and body composition parameters among the Japanese general population. BMC Musculoskelet Disord. 2015; 16: 333. doi: 10.1186/s12891-015-0759-z.