

Association of Body Mass Index and Physical Activity Level with Functional Disability among Undergraduate Students with Mechanical Low Back Pain

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Abstract: ***Background:** Mechanical low back pain (LBP) is common among university students, and body mass index (BMI) and physical activity may be related to associated functional limitations. **Objective:** To examine the associations of BMI category with physical activity level, measured by the International Physical Activity Questionnaire–Short Form (IPAQ-SF), and with functional disability, measured by the Oswestry Disability Index (ODI), among undergraduate students with mechanical LBP. **Methods:** This cross-sectional analytical study included 130 undergraduate students with mechanical LBP. BMI was calculated from measured height and weight. Associations of BMI category with activity category and with disability category were assessed using chi-square tests, supplemented by exact tests because some expected cell counts were small. **Results:** Normal BMI was observed in 50.0% of participants, 48.5% had high physical activity, and 49.2% had minimal disability. BMI category was not significantly associated with physical activity category ($p = 0.057$), whereas a significant association was observed between BMI category and disability category ($p = 0.001$). **Conclusion:** BMI category was associated with functional disability but not with physical activity category in this sample. The cross-sectional design does not establish causality, and the obese subgroup was very small. Further studies using larger samples and adjustment for potential confounding factors are needed to clarify these relationships.*

Keywords: Low back pain; Body Mass Index; Physical activity; Undergraduate students; International Physical Activity Questionnaire; Oswestry Disability Index

1. Introduction

Low back pain continues to rank among the leading causes of restricted daily function and diminished quality of life across age groups, and university students form a group increasingly flagged as vulnerable because of long hours of seated study, heavy bag-carrying habits, and inconsistent exercise routines.¹⁻³ The large majority of low back pain seen in this age bracket is described as mechanical, or non-specific, arising from cumulative strain on spinal musculoskeletal structures rather than from an identifiable disease process such as disc herniation, vertebral fracture, or systemic illness.⁴ Because mechanical low back pain is shaped largely by lifestyle and biomechanical factors that can be modified, it offers a meaningful target for preventive and rehabilitative programs aimed at students.²

Body composition is one of the modifiable factors most frequently examined in relation to low back pain. Carrying excess body mass raises the mechanical load passing through the lumbar spine, and elevated BMI has been linked in several student cohorts to greater pain intensity and functional limitation.⁵ Physical activity, in contrast, appears to hold a more layered relationship with back pain: regular activity is thought to preserve core and paraspinal muscular strength and spinal mobility, whereas prolonged inactivity as well as poorly conditioned, excessive activity have both been tied to worsening back symptoms in different studies.^{6,7} The literature on these relationships within student populations

remains mixed: some investigations report a clear link between BMI and disability while others do not, and several find no meaningful connection between activity level and either the presence or severity of low back pain.^{8,9} Some of this inconsistency may trace back to studying BMI and activity level in isolation, to the use of differing disability measures, or to drawing samples from a single academic discipline.

The present analysis was designed to address this gap by examining BMI in relation to both physical activity level and disability severity within a single, clearly defined sample of undergraduate students who had already been identified as experiencing mechanical low back pain, using two well-validated instruments: the IPAQ-SF for activity level and the ODI for functional disability. The working hypothesis was that a higher BMI category would correspond with greater functional disability, and that this relationship would be examined alongside- though not necessarily explained by the students reported activity level.^{6,7}

2. Methods

2.1 Study Design and Setting

This was a cross-sectional study. Data were gathered from undergraduate students at different colleges in Tirupati over the period June to August 2026 and written informed consent was obtained from each participant prior to data collection.

2.2 Participants

One hundred and thirty undergraduate students who self-reported mechanical (non-specific) low back pain were enrolled through purposive sampling. Students were eligible if they were (i) currently enrolled undergraduates within the age range 18–25 years; (ii) experiencing self-reported mechanical low back pain for at least two weeks with no identifiable specific pathology; and (iii) willing to give informed consent. Students were excluded if their low back pain had a known specific cause (disc herniation, vertebral fracture, spondylolisthesis, malignancy, or infection), if they had a history of spinal surgery, a diagnosed neurological or systemic condition affecting the spine, or were pregnant, or if their questionnaire responses were incomplete. Mechanical low back pain and the exclusion conditions were screened by mechanical low back pain and the exclusion conditions were screened using a structured Google Form completed by participants prior to enrolment. The form collected information regarding the characteristics and duration of low back pain, previous spinal conditions or surgery, neurological or systemic conditions, pregnancy, and other relevant medical history. Participants who met any of the exclusion criteria were excluded from the study. Thus, the classification of low back pain as mechanical/non-specific was based on self-reported history and screening responses rather than imaging or specialist examination so the classification of pain as mechanical rested on self-reported history rather than on imaging or specialist examination.

2.3 Outcome Measures

2.3.1 Body Mass Index

Height and weight were recorded with a stadiometer and a calibrated digital scale, with participants measured in light clothing and without footwear. BMI was computed as weight in kilograms divided by the square of height in metres (kg/m^2) and grouped into four bands according to the WHO classification: underweight (< 18.5), normal weight (18.5–24.9), overweight (25.0–29.9), and obese, Class I (30.0–34.9).¹⁰

2.3.2 Physical Activity Level

Habitual activity was captured with the International Physical Activity Questionnaire–Short Form (IPAQ-SF), a validated self-report tool that derives weekly energy expenditure (MET-minutes/week) from time spent in vigorous activity, moderate activity, and walking, alongside reported sitting

time.¹¹ Applying the official IPAQ scoring guidelines, participants were sorted into three activity tiers: low, moderate, and high.¹²

2.3.3 Functional Disability

Disability attributed to low back pain was measured with the Oswestry Disability Index (ODI), a ten-item self-administered questionnaire covering pain intensity and its impact on personal care, lifting, walking, sitting, standing, sleep, sexual activity, social participation, and travel.¹³ Each item is scored from 0 to 5, the scores summed, and the total expressed as a percentage of the maximum achievable score (or of the maximum obtainable score for the items actually completed, where relevant). The resulting percentage was grouped into minimal (0–20%), moderate (21–40%), or severe (41% and above) disability, following the standard ODI scoring and interpretation scheme.¹⁴

2.4 Procedure

Each participant completed the protocol in a single session. After informed consent, participants filled in a brief demographic form, followed by the IPAQ-SF and the ODI; height and weight were then measured for BMI calculation. Completed questionnaires were reviewed for missing responses at the point of collection.

2.5 Statistical Analysis

Data were processed using SPSS version 25. Descriptive statistics- frequencies and percentages- were used to summarize the sample's BMI category, IPAQ activity tier, and ODI disability tier. The chi-square test of independence was applied to two specific relationships: (i) BMI category against IPAQ activity tier, and (ii) BMI category against ODI disability tier. Expected cell frequencies were examined for both cross-tabulations; because more than 20% of cells had expected counts below 5 (the obese subgroup contained only five participants), the Pearson chi-square result was supplemented by the Fisher–Freeman–Halton exact test. A p-value below 0.05 was treated as statistically significant.

3. Results

All 130 enrolled students completed the study protocol in full. Descriptive and inferential findings are reported in the sections that follow.

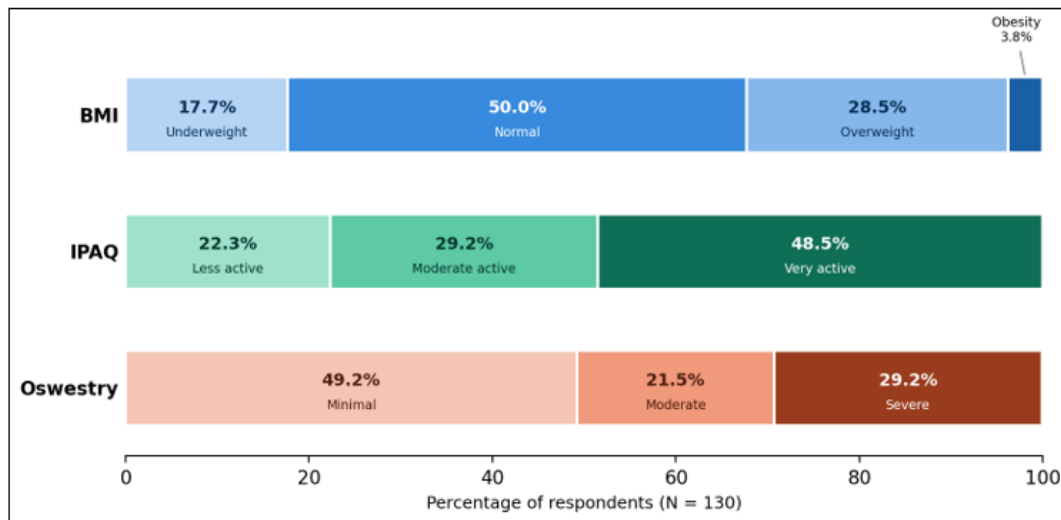


Figure 1: Percentage distribution of respondents by BMI category, IPAQ Activity Level and Oswestry Disability Index

Interpretation: Of the 130 participants, half (50%) had a normal BMI, while 32.3% were overweight or obese. Nearly half (48.5%) were very active, with 22.3% less active. Most had minimal disability (49.2%), while 29.2% had severe and 21.5% moderate disability due to low back pain.

3.1 Association between BMI Category and Physical Activity Level

Table 1: Cross-tabulation of BMI category and IPAQ activity tier

BMI Category	Low n (%)	Moderate n (%)	High n (%)	Total	Row %
Underweight	3 (2.3)	9 (6.9)	11 (8.5)	23	17.7
Normal weight	11 (8.5)	15 (11.5)	39 (30.0)	65	50.0
Overweight	14 (10.8)	12 (9.2)	11 (8.5)	37	28.5
Obese, Class I	1 (0.8)	2 (1.5)	2 (1.5)	5	3.8
Total	29 (22.3)	38 (29.2)	63 (48.5)	130	100.0

$\chi^2 = 12.224$, $df = 6$, $p = 0.057$; Fisher–Freeman–Halton exact $p = 0.052$. Expected count < 5 in 3 of 12 cells (25.0%); minimum expected count = 1.12.

BMI category was not significantly associated with IPAQ activity tier, and the result was close to the 0.05 significance threshold. Because 25.0% of cells had expected counts below 5, the exact test was also computed and gave a consistent result ($p = 0.052$). Descriptively, overweight students were somewhat more concentrated in the low-activity tier than their normal-weight peers, while normal-weight students were disproportionately represented in the high-activity tier- a pattern suggestive of a trend rather than a confirmed statistical relationship.

3.2 Association between BMI Category and Functional Disability

Table 2: Cross-tabulation of BMI category and ODI disability tier

BMI Category	Minimal n (%)	Moderate n (%)	Severe n (%)	Total	Row %
Underweight	12 (9.2)	5 (3.8)	6 (4.6)	23	17.7
Normal weight	43 (33.1)	11 (8.5)	11 (8.5)	65	50
Overweight	8 (6.2)	10 (7.7)	19 (14.6)	37	28.5
Obese, Class I	1 (0.8)	2 (1.5)	2 (1.5)	5	3.8
Total	64 (49.2)	28 (21.5)	38 (29.2)	130	100

$\chi^2 = 22.209$, $df = 6$, $p = 0.001$; Fisher–Freeman–Halton exact $p = 0.001$. Expected count < 5 in 4 of 12 cells (33.3%); minimum expected count = 1.08.

BMI category was significantly associated with disability category. Severe disability was most frequent in the overweight subgroup (51.4%, 19/37), compared with 16.9% (11/65) of normal-weight, 26.1% (6/23) of underweight, and 40.0% (2/5) of obese Class I students. The proportion with severe disability therefore did not rise uniformly across all four BMI categories, and the obese subgroup ($n = 5$) is too small for firm descriptive conclusions. Because 33.3% of cells had expected counts below 5, the exact test was also computed and gave the same result.

4. Discussion

This analysis set out to examine how BMI category relates to physical activity level and to functional disability among undergraduate students already experiencing mechanical low back pain. The clearest finding was a significant association between BMI category and disability category, with severe disability particularly well represented among overweight students (51.4%). Because the proportion with severe disability did not increase across every BMI category and the obese subgroup was very small ($n = 5$), the data do not support a dose–response interpretation. The association is compatible with the biomechanical explanation that additional body mass raises compressive and shear forces on the lumbar spine, and it is in line with prior work in comparably aged samples in which BMI tracked with pain and disability scores.³ It is also broadly consistent with observations among Turkish university students, where higher baseline BMI accompanied higher pain and Oswestry disability scores, even where the effect size involved was modest.⁵

The absence of a statistically significant link between BMI and IPAQ-reported activity level, despite a trend that approached significance, matches reports from other student cohorts that likewise failed to establish a clear statistical connection between weight status and activity classification⁶. This suggests that, in this population, body composition may shape disability through pathways other than simply lowering how physically active a student is — for instance, through

direct mechanical loading on the spine, or through the type and posture of activity performed, details that a single overall IPAQ tier does not capture.^{1,4,8}

Physical activity level was not tested here as a direct predictor of disability severity in its own right, but the descriptive picture is instructive: nearly half the sample was already classified as highly active, yet close to 30% still reported severe disability. This tempers any assumption that a high self-reported activity level is protective by itself. The pattern aligns with an Indonesian study of medical students that found no significant correlation between IPAQ-assessed activity and Oswestry-assessed disability,¹⁵ and with a Brazilian study of physiotherapy and other health-science students in which engaging in physical activity did not determine functional disability outcomes even though pain remained common among active students.⁹ Taken together with the present results, this reinforces the view that the relationship between physical activity and low back pain-related disability in young, largely healthy student populations is unlikely to be a simple inverse one.

From a practical standpoint, these results suggest that student health services and physiotherapy-led prevention efforts might benefit from weighting weight-management strategies and biomechanically informed exercise prescription at least as heavily as general encouragement to be more active,¹⁶ when the goal is reducing low back pain-related disability in undergraduate populations.

4.1 Limitations

Several limitations merit consideration. The cross-sectional design rules out any causal interpretation of the relationships identified. Physical activity was captured through a self-report instrument (IPAQ-SF), which carries a risk of recall and social-desirability bias and does not register the type, posture, or technique of exercise undertaken. The sample was drawn through purposive, single- (or limited-) institution sampling, which may constrain how far the findings generalize to other student groups. Classifying low back pain as strictly 'mechanical' relied on self-report. The obese subgroup contained only five participants and several cells had small expected counts, which limits the reliability of the chi-square approximation and of any conclusions about that category. Associations were examined with unadjusted bivariate tests only, so confounding could not be controlled. This analysis was also deliberately scoped to BMI-centred relationships, so other potentially relevant factors- psychological stress, sleep quality, ergonomic conditions, and the duration or chronicity of low back pain- were not evaluated in the present analysis.

5. Conclusion

Among undergraduate students with mechanical low back pain, BMI category was significantly associated with functional disability category, whereas its association with physical activity category was not statistically significant. These findings indicate a relationship between BMI and disability in this sample, but the cross-sectional design does not establish causality. Larger studies incorporating relevant

clinical and lifestyle factors are recommended to clarify this association.

References

- [1] Feleke M, Getachew T, Shewangizaw M, Gebremickael, et al. Prevalence of low back pain and associated factors among medical students in Wachemo University, Southern Ethiopia. *Sci Rep*. 2024;14:23518.
- [2] Bałoniak A, Stępką J, Woźna J, et al. Low back pain among medical students: a cross-sectional study from Poland. *Arch Med Sci*. 2025;21(6):2450-8.
- [3] Alshehri MM, Alqhtani AM, Gharawi SH, et al. Prevalence of lower back pain and its associations with lifestyle behaviors among college students in Saudi Arabia. *BMC Musculoskeletal Disord*. 2023;24:646.
- [4] Falavigna A, Teles AR, Mazzocchin T, et al. Increased prevalence of low back pain among physiotherapy students compared to medical students. *Eur Spine J*. 2011;20(3):500-5.
- [5] Mutlu AU, Aydın B, Ecertaştan Ö, et al. Evaluation of physical exercise's effects on low back pain among university students with Short Form-36 and Oswestry Disability Index. *Turk Med Stud J*. 2020;7(2):77-83.
- [6] Telli H, Özel Çakır F. Effects of physical activity level and sedentary behavior on the musculoskeletal system in young adults. *Genel Tıp Derg*. 2024;34(5):637-49.
- [7] Lenková R, Škrečková G, Lukáčová E. Level of physical activity among university students. In: *Education and New Developments 2024*. Lisbon: inScience Press; 2024. p. 501-4.
- [8] Yasmin N, Sudaryanto WT. Physical activity, sedentary lifestyle, and lumbar flexibility in young adults: a cross-sectional study. *Maj Ilm Fisioter Indones*. 2025;13(1):48-53.
- [9] Callou Filho CR, Sobreira Pereira AH, Bandeira Vasconcelos A. Use of the Oswestry index on the influence of pain, practice of physical activity, age and smoking on low back pain in university students. *Rev Interdiscip Encontro Ciênc*. 2018;1(2):176-86.
- [10] World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO Consultation. WHO Technical Report Series No. 894. Geneva: WHO; 2000.
- [11] Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*. 2003;35(8):1381-95.
- [12] IPAQ Research Committee. Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ) – short and long forms [Internet]. 2005 [cited 2026 Oct 5]. Available from: <https://sites.google.com/view/ipaq/score>
- [13] Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry low back pain disability questionnaire. *Physiotherapy*. 1980;66(8):271-3.
- [14] Fairbank JC, Pynsent PB. The Oswestry Disability Index. *Spine (Phila Pa 1976)*. 2000;25(22):2940-52.
- [15] Febiningrum F, Ghazali DA, Munawaroh S, Hastami Y. Physical activity and low back pain in medical student. *Ahmad Dahlan Med J*. 2021;2(2):58-66.
- [16] World Health Organization. Physical activity [Internet]. Geneva: WHO; 2020 [cited 2026 Sep 29]. Available from: <https://www.who.int/news-room/fact-sheets/detail/physical-activity>