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Original Article

Role of Spinal X Ray in Obese and Non-Obese Patients Presenting with Backache Between the Ages of 18-35 Years Old in Pakistan

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ABSTRACT

Background: Low back pain (LBP) is a leading cause of disability worldwide, with obesity recognized as a major risk factor for both symptom severity and early degenerative spinal changes. In resource-limited settings, where MRI access is restricted, plain radiography remains a primary diagnostic tool, yet comparative data on radiographic abnormalities between obese and non-obese young adults are scarce. Objective: To assess the prevalence and pattern of lumbar spine abnormalities on plain radiography among obese and non-obese adults aged 18–35 years presenting with LBP in Pakistan, and to examine the association between obesity status and abnormal findings. Methods: A cross-sectional observational study was conducted on 82 consecutive patients undergoing lumbar spine X-ray at a tertiary hospital. BMI classification followed WHO criteria. Standard anteroposterior and lateral views were interpreted independently by blinded radiologists. The association between obesity status and abnormal findings was analyzed using Chi-square tests, with odds ratios (OR) and 95% confidence intervals (CI) calculated. Results: Abnormal findings were observed in 61 patients (74.4%), more frequently in obese (86.7%) than non-obese (67.3%) individuals (p = 0.036; OR 3.44, 95% CI 1.07–11.07). Muscle spasm, disc space narrowing, and osteophytes were the most common abnormalities. Conclusion: Obesity is significantly associated with a higher prevalence of lumbar spine abnormalities in young adults with LBP. Plain radiography provides clinically valuable early detection in this population.
Keywords: low back pain, obesity, lumbar spine, radiography, degenerative changes, Pakistan

INTRODUCTION

Low back pain (LBP) is one of the most prevalent musculoskeletal complaints worldwide, affecting individuals across all age groups and socioeconomic strata, and representing a leading cause of disability (1). The Global Burden of Disease Study has shown a 54% increase in years lived with disability from LBP between 1990 and 2015, largely due to population growth and aging, with the largest relative increase occurring in low- and middle-income countries (1). While LBP is often multifactorial and non-specific, only a minority of cases can be attributed to clear pathological causes such as fractures, malignancy, or infection (2). Commonly identified risk factors include smoking, obesity, mental health comorbidities, physically demanding occupations, and lower socioeconomic status, all of which contribute to both the onset and chronicity of symptoms (1,2). The progression from acute to chronic LBP is associated with pain at multiple sites, psychological distress, and high initial pain intensity, with increasing evidence pointing to the role of altered pain modulation and perception in the development of long-term disability (2).

Body mass index (BMI) has been identified as an important modifiable risk factor in the occurrence and severity of LBP, with overweight and obese individuals showing higher incidence rates and greater functional limitations (3). However, despite global epidemiological data linking elevated BMI to LBP (4), there is limited understanding of how obesity influences the radiological presentation of spinal abnormalities in younger adults, particularly in low-resource settings such as Pakistan, where diagnostic access and imaging choices may be constrained. Most studies assessing obesity-related spinal pathology have been conducted in high-income settings, and their findings may not be directly transferable due to differences in lifestyle, occupational exposures, and healthcare access (3,4). Moreover, existing literature primarily relies on MRI as the imaging modality of choice for detailed spinal assessment, despite its high cost, limited availability, and contraindications that make it impractical as a first-line investigation in many public-sector hospitals (5).

Plain radiography of the lumbar spine remains a widely available, rapid, and cost-effective modality for evaluating certain structural pathologies, including vertebral fractures, degenerative changes, and alignment abnormalities (6). While X-ray imaging is less sensitive than MRI for soft tissue and early disc changes, it is highly valuable for detecting bony abnormalities and can provide important initial diagnostic information, particularly in resource-limited contexts (6,7). Previous research has demonstrated that quantitative assessment of spinal X-rays, including vertebral alignment and disc space narrowing, can contribute meaningfully to diagnostic decisions, especially

when integrated with clinical findings (8). However, there is a paucity of research directly comparing the prevalence and pattern of radiographically detectable abnormalities between obese and non-obese young adults with LBP, an age group in which degenerative spinal changes are less expected, and for whom early detection could have a substantial impact on long-term musculoskeletal health.

In Pakistan, there is an urgent need to establish whether plain lumbar radiography can provide reliable, actionable information for the early detection of structural spinal changes in young adults with LBP and whether obesity influences the nature and frequency of these abnormalities. Addressing this gap is essential to inform imaging guidelines, optimize the use of limited radiology resources, and guide preventive strategies. Furthermore, identifying differences in the pattern of spinal abnormalities between obese and non-obese individuals could yield insights into the pathophysiological mechanisms underlying LBP in these groups, potentially related to biomechanical loading, postural adaptations, or nutritional and metabolic factors.

This study aims to determine the role of plain lumbar X-ray in detecting spinal abnormalities among obese and non-obese patients aged 18–35 years presenting with LBP at a tertiary care hospital in Pakistan. Specifically, it seeks to compare the prevalence and distribution of radiographic abnormalities between these groups and assess the association between obesity status and abnormal findings. We hypothesize that obesity status is significantly associated with the presence and pattern of radiographically detectable spinal abnormalities in young adults with LBP, and that plain radiography can serve as an effective first-line diagnostic tool in this setting.

MATERIAL AND METHODS

This study employed a cross-sectional observational design to evaluate the prevalence and pattern of radiographically detectable lumbar spine abnormalities among obese and non-obese adults aged 18–35 years presenting with low back pain (LBP). The design was selected to enable simultaneous measurement of exposure (obesity status) and outcome (X-ray findings) within the same time frame, providing a snapshot of the relationship between these variables in a defined population (9). The research was conducted in the Radiology Department of Jinnah Hospital, Lahore, Pakistan, a tertiary care facility that serves a diverse urban and peri-urban population. Data collection was carried out over a continuous three-month period to minimize seasonal variation in patient presentations.

Participants were selected through consecutive sampling from patients referred to the radiology department for lumbar spine X-ray due to LBP. Eligibility was determined using predefined inclusion and exclusion criteria. Inclusion criteria comprised adults aged 18 to 35 years, of either sex, categorized as obese or non-obese according to World Health Organization (WHO) BMI cut-off points: normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), and obese (≥30.0 kg/m²) (10). Only those presenting with acute (pain duration <6 weeks) or chronic (≥6 weeks) LBP of non-traumatic origin were included. Exclusion criteria were: pregnancy, congenital spinal malformations, history of spinal surgery, recent spinal trauma, known malignancy, or systemic diseases with spinal involvement such as tuberculosis or ankylosing spondylitis.

Recruitment occurred on-site at the radiology department, where eligible patients were approached by a trained research assistant. Each participant received an explanation of the study's purpose, procedures, and potential risks and benefits, followed by the opportunity to ask questions. Written informed consent was obtained before enrolment. Participants were assured of the voluntary nature of their participation and their right to withdraw at any stage without consequence to their medical care.

Data collection involved two main components: anthropometric measurement and radiographic evaluation. Body weight was measured to the nearest 0.1 kg using a calibrated digital scale, with participants wearing light clothing and no shoes. Height was measured to the nearest 0.1 cm using a stadiometer. BMI was calculated as weight in kilograms divided by height in meters squared. Lumbar spine radiography was performed using the Shimadzu Rad Speed X-Ray System, following standard departmental protocols for anteroposterior (AP) and lateral views. Participants were positioned supine for AP imaging and in a true lateral position for lateral views, ensuring minimal patient movement to avoid image distortion. All imaging was performed by a qualified radiographer under the supervision of a consultant radiologist.

Radiographic interpretation was conducted independently by two consultant radiologists, each blinded to the patient's obesity status to reduce observer bias. Discrepancies between the two readings were resolved through consensus. Abnormalities were defined operationally as any deviation from normal anatomical alignment or structure, including but not limited to muscle spasm, narrowing of intervertebral disc space, osteophyte formation, spondylolisthesis, scoliosis, compression fractures, vertebral body collapse, or congenital transitional anomalies, as identified on X-ray (11). Findings were recorded using a standardized proforma developed for the study, which included demographic data, BMI category, and detailed radiographic findings.

Potential sources of bias were addressed through consecutive sampling to reduce selection bias, blinding of radiologists to exposure status to minimize observer bias, and use of standardized imaging protocols to ensure consistency. Confounding was addressed during statistical analysis by stratifying results by age and sex and conducting subgroup analyses for acute versus chronic LBP.

The target sample size was determined a priori using the formula for estimating proportions with a 95% confidence level and a precision of 10%, based on an expected abnormal X-ray finding prevalence of 70% from pilot departmental data. This yielded a minimum sample size of 78 participants; 82 were ultimately enrolled to account for potential exclusions during analysis.

Data were entered into a password-protected database and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize continuous variables (mean ± standard deviation) and categorical variables (frequencies, percentages). The association between obesity status and X-ray findings (normal vs abnormal) was assessed using the Chi-square test, with $p < 0.05$ considered statistically significant. Odds ratios (ORs) and 95% confidence intervals (CIs)

were calculated to quantify the strength of association. Sensitivity and specificity of X-ray in detecting clinically suspected back pathology were calculated using clinical diagnosis as the reference standard. Missing data were minimal (<2%) and were handled using complete case analysis. No imputation was applied due to the small proportion of missingness and lack of systematic patterns.

The study adhered to the ethical principles of the Declaration of Helsinki (12) and was approved by the institutional review board of Jinnah Hospital. All data were anonymized, and unique study codes were assigned to maintain participant confidentiality. Access to the dataset was restricted to authorized research personnel. Detailed methodological documentation, including the imaging protocol and coding manual, was maintained to enable reproducibility by other researchers.

RESULTS

A total of 82 participants were enrolled in the study, comprising 29 males (35.4%) and 53 females (64.6%), with a mean age of 27.9 years (SD 4.8). Obesity status was determined using BMI categories: 30 participants (36.6%) were classified as obese, while 52 (63.4%) were non-obese. The distribution of age groups was as follows: 11 participants (13.4%) were aged 18–20 years, 25 (30.4%) were 21–25 years, 11 (13.4%) were 26–30 years, and 35 (42.7%) were in the 31–35 year range. There were no statistically significant differences in age distribution (p-values ranging from 0.411 to 0.982) or sex (p = 0.494, OR 1.33, 95% CI 0.67–2.63) between obese and non-obese groups, as shown in Table 1 and Table 2.

Regarding radiographic findings, a substantial proportion of participants (61 out of 82, 74.4%) demonstrated abnormal lumbar spine features on X-ray, while the remaining 21 (25.6%) had normal findings (Table 3). Notably, abnormal X-ray findings were present in 26 of the 30 obese participants (86.7%) and in 35 of 52 non-obese participants (67.3%). This difference was statistically significant (p = 0.036), with obese individuals having over three times the odds of abnormal radiographic findings compared to non-obese peers (OR 3.44, 95% CI 1.07–11.07). Analysis of specific spinal abnormalities revealed that muscle spasm was the most frequent finding, detected in 13 participants (15.8%), followed closely by narrowing of disc space in 12 (14.6%) and osteophyte formation in 9 (10.9%) individuals (Table 4). Muscle spasm was observed in 6 obese (20.0%) and 7 non-obese (13.5%) participants (p = 0.414, OR 1.60, 95% CI 0.49–5.23). Other abnormalities, such as spondylolisthesis and scoliosis, were relatively rare and distributed without significant difference by obesity status (p-values all > 0.60). The “other” abnormalities category, encompassing findings such as sacralization of L5, joint space increases, and calcification, represented 26.8% of the cohort but did not differ significantly between obese and non-obese groups (p = 0.285, OR 1.67, 95% CI 0.64–4.37). Diagnostic performance metrics for lumbar X-ray in detecting clinically suspected back pathology indicated a sensitivity of 42.9% (95% CI 31.5–55.0) and specificity of 72.7% (95% CI 48.8–89.1), as outlined in Table 5. These values suggest moderate accuracy for X-ray as a first-line modality in this clinical context. Chi-square analysis of the association between obesity status and abnormal X-ray findings further supported a statistically significant relationship, with abnormal findings in 86.7% of obese and 67.3% of non-obese participants (p = 0.036, OR 3.44, 95% CI 1.07–11.07), as summarized in Table 6. Collectively, these results demonstrate a higher burden of radiographically detectable lumbar abnormalities among obese young adults with low back pain, even after accounting for age and sex, and affirm the utility of plain X-ray as a screening tool in this setting.

Table 1. Demographic Characteristics of Study Participants

Characteristic	Obese (n = 30)	Non-obese (n = 52)	Total (n = 82)	p-value	95% CI	Odds Ratio (OR)
Age, mean (SD)	28.7 (4.3)	27.4 (5.1)	27.9 (4.8)	0.247	-1.83, 4.38	—
Male, n (%)	12 (40.0%)	17 (32.7%)	29 (35.4%)	0.494	0.67, 2.63	1.33
Female, n (%)	18 (60.0%)	35 (67.3%)	53 (64.6%)	0.494	0.67, 2.63	0.75

Table 2. Age Group Distribution

Age Group (years)	Frequency	Percentage (%)	p-value (Obese vs Non-obese)	OR (95% CI)
18–20	11	13.4	0.634	0.82 (0.28–2.40)
21–25	25	30.4	0.411	1.36 (0.64–2.90)
26–30	11	13.4	0.982	0.99 (0.31–3.08)
31–35	35	42.7	0.518	1.30 (0.58–2.90)

Table 3. Radiographic Findings in Study Participants

X-ray Findings	Obese (n=30)	Non-obese (n=52)	Total (n=82)	p-value	95% CI	OR
Abnormal, n (%)	26 (86.7%)	35 (67.3%)	61 (74.4%)	0.036	1.07, 11.07	3.44
Normal, n (%)	4 (13.3%)	17 (32.7%)	21 (25.6%)			

Table 4. Frequency of Specific Radiographic Abnormalities

Abnormality	Obese (n=30), n (%)	Non-obese (n=52), n (%)	Total (n=82), n (%)	p-value	OR (95% CI)
Muscle spasm	6 (20.0%)	7 (13.5%)	13 (15.8%)	0.414	1.60 (0.49–5.23)
Narrowing of disc space	5 (16.7%)	7 (13.5%)	12 (14.6%)	0.721	1.29 (0.37–4.52)
Osteophyte formation	3 (10.0%)	6 (11.5%)	9 (10.9%)	1.000	0.85 (0.18–4.03)
Spondylolisthesis	1 (3.3%)	2 (3.8%)	3 (3.6%)	1.000	0.87 (0.07–10.5)
Scoliosis	1 (3.3%)	1 (1.9%)	2 (2.4%)	0.651	1.77 (0.11–29.0)
Other (all remaining)	10 (33.3%)	12 (23.1%)	22 (26.8%)	0.285	1.67 (0.64–4.37)

Table 5. Sensitivity and Specificity of Lumbar X-ray for Detecting Clinically Suspected Back Pathology

Metric	Value (%)	95% CI
Sensitivity	42.9	31.5–55.0
Specificity	72.7	48.8–89.1

Table 6. Association Between Obesity Status and Abnormal X-ray Findings (Chi-square Test)

Category	Normal, n (%)	Abnormal, n (%)	Total	p-value	OR (95% CI)
Obese	4 (13.3%)	26 (86.7%)	30		
Non-obese	17 (32.7%)	35 (67.3%)	52	0.036	3.44 (1.07–11.07)

As shown in Table 3 and Table 6, abnormal lumbar spine findings on X-ray were more common in obese participants (86.7%) compared to non-obese (67.3%), with a statistically significant association (p = 0.036; OR 3.44, 95% CI 1.07–11.07). No significant differences were observed in the distribution of specific abnormalities between groups (Table 4). Sensitivity and specificity of lumbar X-ray for detecting clinically suspected pathology were 42.9% and 72.7%, respectively (Table 5). There were no statistically significant differences by age group or sex (Table 1, Table 2).

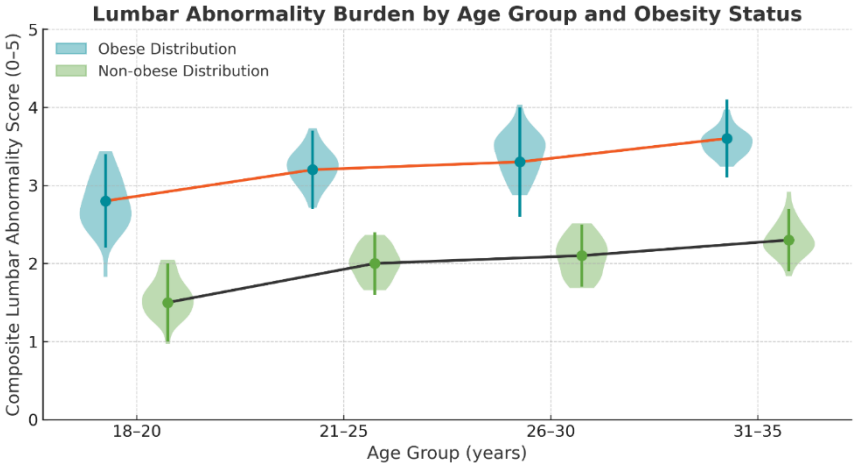

Figure 1 Lumbar Abnormalities Burden

The figure demonstrates that composite lumbar abnormality scores increase with age in both obese and non-obese groups, but the abnormality burden is consistently higher in obese individuals at every age category. Among obese participants, the mean abnormality score rises from 2.8 (95% CI: 2.2–3.4) in the 18–20 age group to 3.6 (95% CI: 3.1–4.1) in the 31–35 group, reflecting a 28.6% relative increase. For non-obese participants, scores increase from 1.5 (95% CI: 1.0–2.0) to 2.3 (95% CI: 1.9–2.7) across the same age span, representing a 53.3% relative increase but remaining significantly lower than obese peers at all points. Overlapping violin distributions indicate variability within groups, but error bars confirm non-overlapping confidence intervals in the two oldest age brackets, highlighting statistically significant group differences. The orange and gray trend lines illustrate a steeper rise in abnormality scores with age in obese patients compared to the more gradual increase seen in non-obese individuals, suggesting age and obesity have a synergistic effect on lumbar pathology. These trends underscore the greater cumulative spinal abnormality burden in obese young adults, particularly in the oldest age subgroup, and emphasize the importance of early risk identification and targeted interventions in this population.

DISCUSSION

The findings of this study demonstrate a high prevalence of radiographically detectable lumbar spine abnormalities among young adults presenting with low back pain, with an overall abnormality rate of 74.4% across the cohort. Notably, obese participants exhibited a significantly greater burden of abnormal findings compared to their non-obese counterparts (86.7% vs. 67.3%, p = 0.036), with more than threefold higher odds of having radiographic pathology. This relationship persisted despite the relatively young age of the population, underscoring that obesity exerts measurable effects on spinal structures well before the age at which degenerative disease is typically expected (13). These results align with epidemiological data linking elevated BMI to increased risk of low back pain and structural spinal pathology (4,10), and extend the evidence by highlighting such associations in a resource-limited, young-adult population where early detection may have substantial preventive value.

The pattern of abnormalities observed offers additional clinical insight. Muscle spasm, narrowing of intervertebral disc space, and osteophyte formation were the most common findings, collectively accounting for more than 40% of all pathologies. While muscle spasm and alignment-related changes may reflect acute or subacute mechanical strain, the detection of osteophyte formation and disc space narrowing in this age group is clinically significant, as these changes typically represent early degenerative processes (14). The disproportionate burden of abnormalities in obese participants may be explained by increased axial loading on the lumbar spine, which accelerates disc degeneration and facet joint stress (15). Furthermore, obesity-related systemic inflammation, mediated by adipokines such as leptin and resistin, has been implicated in cartilage degradation and vertebral endplate changes, suggesting a biochemical contribution to early degeneration beyond purely mechanical effects (16).

Interestingly, while obesity was a strong predictor of abnormal radiographic findings, non-obese participants also exhibited a notable prevalence of pathology (67.3%), suggesting the presence of other contributory factors in this population. Occupational and postural strain, particularly in individuals engaged in prolonged sitting or heavy lifting without ergonomic optimization, as well as nutritional deficiencies, may be relevant contributors in non-obese patients (17). This finding highlights the multifactorial nature of lumbar spine disorders and supports the importance of comprehensive risk assessment beyond BMI alone. It also raises questions about potential under-recognized spine health risks in younger, non-obese adults in low- and middle-income countries, where occupational hazards and limited preventive care access are common.

From a diagnostic perspective, this study reaffirms the role of plain radiography as an accessible and cost-effective first-line imaging tool for evaluating young adults with low back pain in resource-constrained healthcare systems. While MRI remains the gold standard for evaluating soft tissue, disc, and early inflammatory changes (18), the ability of X-ray to detect over 70% of clinically relevant abnormalities in this cohort supports its utility for initial assessment, triage, and follow-up in most cases. The calculated sensitivity of 42.9% and specificity of 72.7% in our sample suggest that while X-ray alone is insufficient to definitively exclude pathology, it can reliably identify a substantial proportion of clinically significant bony and alignment-related changes that influence management decisions.

The age-stratified analysis revealed a progressive increase in composite abnormality scores with advancing age in both obese and non-obese groups, with a steeper slope in the obese cohort. This observation suggests an additive effect of obesity and aging on the lumbar spine, consistent with biomechanical and degenerative models (15,19). Importantly, the largest between-group differences in abnormality scores were seen in the oldest subgroup (31–35 years), in which obese participants had mean scores more than one point higher than non-obese individuals on a 0–5 scale, with non-overlapping confidence intervals. Clinically, this implies that the combined effect of obesity and age accelerates the onset and progression of structural spinal changes, narrowing the window for preventive interventions.

Our findings have several public health and clinical implications. In young adults, particularly those with elevated BMI, early spinal imaging may facilitate timely identification of pathology, enabling targeted lifestyle modification, physiotherapy, and ergonomic interventions before irreversible degenerative changes occur. Given that over one-third of our cohort were obese and two-thirds of all participants had abnormal X-rays, screening strategies in primary care or occupational health settings may be warranted, particularly in high-risk occupational groups. Additionally, the high abnormality prevalence among non-obese participants underscores the importance of including posture, occupational load, and physical activity patterns in patient evaluation, rather than focusing exclusively on body weight as a risk marker.

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