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Original Article

Lumbar Spinal Stenosis and Financial Hardship: A Patient-Centered Analysis from A Middle-Income Country

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Abstract

Objective: To evaluate the economic burden of Lumbar Spinal Stenosis (LSS) and to identify the contributing factors.

Methodology: This Cross-sectional Study was conducted in the Department of Neurosurgery, MMC/BKMC Mardan, from January to June 2025. We recruited a consecutive sample of 100 adult patients diagnosed with radiologically and clinically proven lumbar spinal stenosis. We used a questionnaire to collect data on demographics, family income, treatment cost, transport cost, income loss, treatment delay, and self-reported financial hardship. We categorized financial hardship as mild (<25% of monthly household income), moderate (25–50%), and severe (>50%).

Results: Among 100 patients, 58% were male and 42% female, with a mean age of 56.8 ± 11.4 years. Forty-seven percent of participants reported severe financial hardship, 32% moderate hardship, and 21% mild hardship. Patients with severe stenosis incurred significantly higher treatment costs than those with mild-to-moderate disease (PKR $68,500 \pm 18,200$ vs. PKR $39,700 \pm 14,600$; $p = 0.002$). Severe hardship was more common among unemployed/daily wage earners (63.4% vs. 28.7%; $p = 0.001$), rural residents ($p = 0.004$), and surgically managed patients (74.2% vs. 39.5%; $p < 0.001$). Household income inversely correlated with financial toxicity ($r = -0.48$, $p < 0.001$).

Conclusion: Financial hardship is prevalent among patients with Lumbar Spinal Stenosis in middle-income countries and is closely linked to the severity of symptoms, rural living, low income, and surgery. Financial support and better access to spinal care may help alleviate this.

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Introduction

Lumbar Spinal Stenosis (LSS) is a common degenerative spinal condition and a leading source of pain, disability, and limited mobility in middle-aged and older adults around the globe. It involves narrowing of the spinal canal, lateral recess, or neural foramina that compresses neural structures and causes low-back pain, neurogenic claudication, radiculopathy, and disability. LSS occurs more frequently with age because of degenerative changes in the intervertebral discs, facet joints, and thickening of the ligamentum flavum. As the world's population ages, LSS is expected to become increasingly prevalent over the next few decades [1,2]. LSS not only causes physical suffering, but it also has high socioeconomic costs. Repeated visits to the hospital, high-tech imaging, long-term medications, physiotherapy, and in some cases surgical decompression with or without fixation are often necessary. This is especially so in low- and middle-income countries (LMICs), where out-of-pocket healthcare spending is high, and health insurance is rare. The financial burden of chronic musculoskeletal and degenerative diseases can result in delayed diagnosis, non-adherence to treatment, diminished quality of life, and catastrophic health-care costs [3,4]. The term "financial toxicity", first used in cancer care, is now being applied to non-malignant chronic conditions, such as spinal conditions. Financial toxicity includes both the objective financial strain and patient-perceived distress from health-care costs. In LSS patients, direct healthcare-related expenses include consultation fees, imaging, medication, surgery, hospitalization, and rehabilitation, while indirect expenses include transportation, accommodation, caregiver burden, and productivity loss. These costs may have a greater impact on disadvantaged individuals living in rural areas, without employment, and on a daily wage basis [5,6]. In middle-income countries such as Pakistan, spinal services are mostly available in major urban tertiary care facilities, requiring patients to travel long distances to access care. Inability to seek timely medical care may lead to disease progression and higher health-care costs. Although LSS is clinically important, few studies explore its economic consequences in LMICs. Current studies primarily address surgical outcomes and efficacy rather than patient-level economic impacts [7,8]. Economic insights about LSS are vital to shape health policy, prioritize resources, and design financial assistance programs. A full assessment of financial hardship among LSS patients can identify at-risk groups and system-related barriers to accessing care. Moreover, individual patient-focused economic data can inform institutions on how to make spinal services more affordable [9]. This study aimed to determine the prevalence of financial hardship among patients with Lumbar Spinal Stenosis and identify socioeconomic and clinical factors associated with increased financial burden [10].

Materials and Methods

Study Design and Setting

This cross-sectional study was conducted in the Department of Neurosurgery, MMC/BKMC Mardan, from January to June 2025.

Participants

We enrolled 100 adult patients with clinically and radiologically diagnosed lumbar spinal stenosis using consecutive non-probability sampling. After obtaining informed consent, we recruited participants from various outpatient and inpatient units. We collected demographic, socioeconomic, and clinical information at the time of inclusion.

Sample Size Calculation

The sample size was determined using the WHO sample size calculator, based on a 50% prevalence of severe financial hardship among patients with chronic degenerative spinal disease, a 95% confidence level, and a 10% margin of error. The minimum sample size was 96 patients; we recruited 100 patients.

Inclusion Criteria

Participants had to be aged 18 years or older with clinically presenting and MRI-diagnosed lumbar spinal stenosis. We included those receiving conservative and surgical management. Patients had to be willing to give informed consent and answer the financial hardship questionnaire.

Exclusion Criteria

Those with spinal trauma, cancer, infection, congenital spinal deformities, previous lumbar surgery, cognitive dysfunction, or missing financial information were excluded. Those with significant comorbid systemic diseases leading to disability or financial impact independent of LSS were also excluded.

Diagnostic and Management Strategy

Lumbar canal stenosis (LSS) was diagnosed by clinical exam and MRI. The spine team decided upon Conservative treatment or surgical decompression based on symptoms and MRI findings.

Assessment of Financial Hardship

We assessed financial hardship using a structured questionnaire that included direct medical expenses, transportation costs, accommodation expenses, and income loss. Financial hardship was categorized as mild, moderate, or severe based on the proportion of cumulative treatment expenditure relative to monthly household income.

Statistical Analysis

We used SPSS version 26 to analyze the data. Normal variables were reported as mean $\pm$ standard deviation, and categorical variables as frequencies and percentages. Chi-square and independent t tests were used to compare the associations. Pearson correlation was used for continuous variables. A p-value <0.05 was considered significant.

Results

The study included 100 patients with Lumbar Spinal Stenosis (LSS): 58 males and 42 females, with a mean age of 56.8 ± 11.4 years. Table 1 summarizes the study population's demographic and socioeconomic characteristics. Most participants were from rural areas (61%), while 40% were unemployed or retired. The mean monthly household income was PKR $54,300 \pm 19,600$, and the mean symptom duration was 8.7 ± 3.9 months (Table 1). Table 2 presents the clinical and radiological characteristics of the patients. Severe radiological stenosis was identified in 43% of patients, whereas 38% and 19% had moderate and mild stenosis, respectively. Neurogenic claudication was present in 72% of participants, and radiculopathy was reported in 66%. Surgical management was required in 57% of cases, while 43% were managed conservatively (Table 2). Representative MRI findings are illustrated in Figures 1 and 2. Figure

1 demonstrates sagittal MRI features of multilevel degenerative lumbar spinal stenosis with disc desiccation, reduced intervertebral disc height, and central canal narrowing, predominantly at the L4-L5 and L5-S1 levels. Figure 2 shows sagittal and axial MRI sections highlighting central canal stenosis, thecal sac compression, and multilevel degenerative changes characteristic of clinically significant lumbar spinal stenosis. Table 3 summarizes the financial burden analysis. The mean direct medical expenditure was PKR 61,700 $\pm$ 21,400, while transportation and accommodation costs averaged PKR 11,600 $\pm$ 5,300. Participants reported a mean loss of 18.4 $\pm$ 9.2 workdays. Forty-seven percent of patients experienced severe financial hardship, while 32% and 21% reported moderate and mild financial hardship, respectively (Table 3). Table 4 presents factors associated with severe financial hardship. Patients with severe radiological stenosis incurred significantly greater treatment costs than those with mild-to-moderate disease (PKR 68,500 $\pm$ 18,200 vs. PKR 39,700 $\pm$ 14,600; $p = 0.002$). Severe financial hardship was significantly

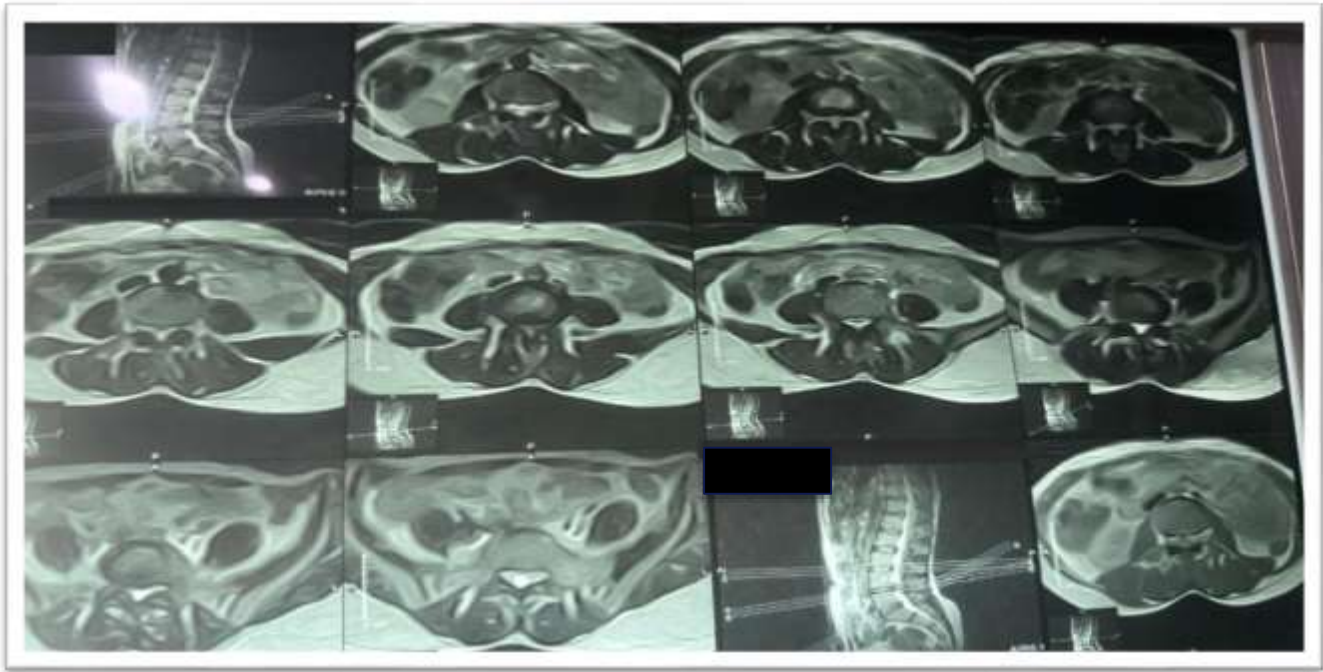
more common among patients undergoing surgical management (74.2%; $p < 0.001$), unemployed or daily wage earners (63.4%; $p = 0.001$), and rural residents (59.0%; $p = 0.004$). Delayed presentation beyond six months was also associated with increased financial burden (56.3%; $p = 0.011$). Furthermore, household income demonstrated a significant inverse correlation with perceived financial toxicity ($r = -0.48$, $p < 0.001$), indicating that lower-income households experienced greater economic hardship (Table 4).

Figure 1. Sagittal Magnetic Resonance Imaging of Multilevel Degenerative Lumbar Spinal Stenosis



Figure 1. (A) and (B) Representative sagittal T2-weighted magnetic resonance images of the lumbar spine demonstrating multilevel degenerative lumbar spinal stenosis. The images show disc desiccation, reduced intervertebral disc height, and central canal narrowing, most prominent at L4-L5 and L5-S1. These radiological findings are consistent with degenerative lumbar spinal stenosis and were used to confirm the diagnosis in the study population.

Figure 2. Magnetic Resonance Imaging Findings in Lumbar Spinal Stenosis



Composite MRI image demonstrating characteristic radiological features of degenerative lumbar spinal stenosis. Sagittal images reveal multilevel disc degeneration and reduced spinal canal dimensions, whereas axial images demonstrate central canal narrowing with compression of the dural sac and adjacent neural structures. These findings are consistent with clinically significant lumbar spinal stenosis.

Table 1. Baseline Demographic and Socioeconomic Characteristics of Study Participants (n = 100)

Variable	Frequency (%) / Mean $\pm$ SD
Age (years)	56.8 $\pm$ 11.4
Male Gender	58 (58.0%)
Female Gender	42 (42.0%)
Rural Residence	61 (61.0%)
Urban Residence	39 (39.0%)
Employed/Salaried	31 (31.0%)
Daily Wage Earner	29 (29.0%)
Unemployed/Retired	40 (40.0%)
Mean Monthly Household Income (PKR)	54,300 $\pm$ 19,600
Mean Duration of Symptoms (Months)	8.7 $\pm$ 3.9

Baseline demographic and socioeconomic profile of patients diagnosed with Lumbar Spinal Stenosis included in the study.

Table 2. Clinical and Radiological Characteristics of Lumbar Spinal Stenosis Patients

Variable	Frequency (%)
Mild Stenosis	19 (19.0%)
Moderate Stenosis	38 (38.0%)
Severe Stenosis	43 (43.0%)
Neurogenic Claudication Present	72 (72.0%)
Radiculopathy Present	66 (66.0%)
Back Pain Only	28 (28.0%)
Conservative Management	43 (43.0%)
Surgical Management	57 (57.0%)

Clinical presentation, radiological severity, and treatment modality among patients with Lumbar Spinal Stenosis.

Table 3. Financial Burden Analysis Among Study Participants

Variable	Mean ± SD / Frequency (%)
Direct Medical Cost (PKR)	61,700 ± 21,400
Transportation/Accommodation Cost (PKR)	11,600 ± 5,300
Lost Workdays	18.4 ± 9.2
Mild Financial Hardship	21 (21.0%)
Moderate Financial Hardship	32 (32.0%)
Severe Financial Hardship	47 (47.0%)

Distribution of direct and indirect costs and severity of self-reported financial hardship among enrolled participants.

Table 4. Factors Associated with Severe Financial Hardship

Variable	Severe Financial Hardship (%)	p-value
Severe Stenosis	67.4%	0.002
Surgical Management	74.2%	<0.001
Rural Residence	59.0%	0.004
Unemployed/Daily Wage Earner	63.4%	0.001
Delayed Presentation >6 Months	56.3%	0.011

Association between demographic and clinical variables. Patients with severe financial hardship in patients with Lumbar Spinal Stenosis.

Discussion

Our study demonstrated that nearly half of patients with Lumbar Spinal Stenosis experienced severe financial hardship. Similar findings have been reported in other low- and middle-income countries where out-of-pocket healthcare expenditures constitute a major component of treatment costs. This highlights that the impact of LSS extends beyond pain and disability to a significant socioeconomic burden, especially in low- and middle-income countries. socioeconomic burden, especially in low- and middle-

income countries. Our findings show that the severity of the disease, living in rural areas, being unemployed, late presentation, and having surgery are major risk factors for financial hardship among patients with LSS [11]. Our mean age of 56.8 years is consistent with recent reports that LSS is more common in older age groups due to degenerative changes in the spine. Other recent reviews also report that the 6th and 7th decades of life are the most common age for presenting with symptomatic LSS. Our finding of male

predominance also agrees with other regional spine registries, though male-to-female ratios differ across studies [12]. A key strength of our study is the high percentage of severe financial toxicity (47%), which highlights the high financial impact of degenerative spinal disease in the middle-income group. While there is limited literature directly comparing the cost of financial toxicity in LSS, previous data on chronic low back pain and degenerative lumbar disease demonstrate a similar socioeconomic impact. Chang et al. found that lower back disorders are among the highest musculoskeletal healthcare costs worldwide, with rising costs attributed to imaging, treatments, and surgery. Our results build on these studies by showing patient-level burden of financial toxicity in a less-developed health system [13,14]. Those patients with severe radiological stenosis had much greater expenditures for their treatment than those with mild to moderate disease [15]. This may be related to additional imaging and physiotherapy, as well as eventual surgical intervention. This link between severity and health-care use has been observed in a recent spine outcomes Study [16]. The radiological findings illustrated in Figures 1 and 2 further support the clinical spectrum of disease observed in our cohort. Representative sagittal and axial MRI images demonstrated multilevel degenerative changes, including disc desiccation, reduced intervertebral disc height, facet joint hypertrophy, and central canal narrowing, predominantly involving the L4-L5 and L5-S1 levels. These findings align with the established pathophysiology of lumbar spinal stenosis and correspond to the high proportion of patients presenting with moderate-to-severe radiological disease in the present study. The predominance of lower lumbar involvement agrees with previous reports identifying these segments as the most commonly affected levels because of age-related degeneration and

Conclusion

In middle-income countries, Lumbar Spinal Stenosis was associated with substantial financial hardship among study participants, particularly among those with severe disease, low income, rural residence, delayed presentation, and surgical treatment requirements. Addressing financial and healthcare access barriers may reduce the disease's economic burden and improve equitable spinal care.

Ethical Approval

Ethical approval was obtained from the Institutional Review Board of Bacha Khan Medical College/Mardan Medical Complex, Mardan, Pakistan (Approval No. 1023/BKMC/NEURO/05/05/2024).

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Conflict of Interest: Nil

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Authors Contributions

Naeem ul Haq - Conceived and designed the study, supervised data analysis, and critically reviewed the final manuscript. Responsible for overall integrity of the research.

increased biomechanical stress[17,18]. Rural living was also a significant predictor of financial burden, potentially due to travel, accommodation, and productivity losses associated with tertiary spine care. This finding is consistent with other studies highlighting health care access inequalities reported in recent socioeconomic spine publications, where geographical inequality and social disadvantage negatively affect health care access and outcomes. The increased financial burden among the unemployed and day laborers also supports the influence of socioeconomic vulnerability in exacerbating the financial impact of disease [19]. A later time to presentation (after six months) was a significant predictor of cumulative cost. This suggests financial constraints may delay treatment until the disease has advanced, complicating management and increasing costs. These results are significant from a clinical perspective because a delay in treatment for degenerative spinal disease can make symptoms worse, requiring more complex surgery [20]. In sum, our findings indicate that LSS in middle-income countries should be considered as a clinical, surgical, and socioeconomic condition and managed accordingly. Health policies supporting subsidized imaging, cost-effective surgical services, decentralized spine services, and timely referral may help overcome the financial challenges observed in this study. This single-center cross-sectional study may not be generalizable to other healthcare settings. The study did not perform multivariable regression analysis to adjust for potential confounding factors. Self-reported financial hardship may have been subject to recall bias. The study did not evaluate future economic consequences, and it may have underestimated indirect societal costs. Multicenter prospective studies are recommended.

Syed Nasir Shah, Umer Zeb Khan- Collected patient data, performed data entry and preliminary analysis, drafted the initial manuscript, and coordinated correspondence with the journal.

Muhammad Ishaq, Muhammad Essa- Assisted in data collection, literature review, and manuscript editing.

Rizwan Ali- Participated in clinical case review, quality assurance, and provided expert input on surgical methodology. All authors approved and contributed significantly to the study's conception, data collection, analysis, Manuscript writing, and final approval of the manuscript as per ICMJE criteria.

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