



Cervical Spinal Cord Injury Due to Fall While Carrying Heavy Load on the Head in Kano, Nigeria: A Retrospective Analysis of Outcomes and Predictors of Good Outcome

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ABSTRACT

Published Online: October 28, 2026

Background: Falls while carrying heavy loads on the head are an under-recognised mechanism of cervical spinal cord injury (CSCI) in Northern Nigeria. This study evaluated the clinical profile, outcomes, and predictors of good outcome in patients sustaining CSCI through this mechanism at a tertiary centre in Kano.

Methods: A retrospective review of 16 male patients managed between January 2019 and June 2025 was conducted. Data on age, load weight, neurological level, completeness of injury, treatment modality, neurological improvement, and mortality were extracted. An aggregate outcome score was constructed from neurological improvement (yes = 1) and survival (alive = 1), with a total score of 2 defined as good outcome and 0–1 as poor outcome.

Results: All patients were male (mean age 34.3 years). Loads ranged from 75–100 kg. C4 was the commonest level (8/16, 50%), followed by C5 (6/16, 37.5%). Ten patients (62.5%) had complete injuries and six (37.5%) incomplete injuries. Seven patients were managed conservatively and nine surgically. Among incomplete injuries, three improved by more than one neurological level and none died. Among complete injuries, three died. All deaths (3/9, 33.3%) occurred in the surgical group. Incomplete injury ($p = 0.008$) and conservative management ($p = 0.015$) were associated with good outcome.

Conclusion: CSCI from head-loading falls predominantly affects young working-age males and carries a high mortality when the injury is complete. Incomplete injury and non-surgical management predicted good outcome. Preventive strategies targeting head-loading practices are urgently needed.

KEYWORDS:

cervical spinal cord injury, head loading, falls, outcome predictors, Nigeria, Kano

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**Cite this Article: Tsoho, S.A., Abdulkadiri, K.A., Kabir, A., Muhammad, N.A., Hussaini, A.T., Muhammad, H., Bagudu, A.B., Yusuf, D., Olamide Oriloye, S.S. (2026). Cervical Spinal Cord Injury Due to Fall While Carrying Heavy Load on the Head in Kano, Nigeria: A Retrospective Analysis of Outcomes and Predictors of Good Outcome. International Journal of Clinical Science and Medical Research, 6(10), 370-376. <https://doi.org/10.55677/IJCSMR/V6I10-05/2026>*

INTRODUCTION

Cervical spinal cord injury (CSCI) is among the most devastating traumatic conditions, imposing permanent neurological deficit, profound psychological morbidity, and immense socioeconomic cost on individuals and health systems [1,2]. In Nigeria, the burden of CSCI is substantial and disproportionately affects young adult males, with road traffic accidents and falls constituting the predominant

Abdulkadiri, K.A. et al, Cervical Spinal Cord Injury Due to Fall While Carrying Heavy Load on the Head in Kano, Nigeria: A Retrospective Analysis of Outcomes and Predictors of Good Outcome

mechanisms [1,3]. Within the spectrum of fall-related injuries, a particularly insidious mechanism has received scant attention in the literature: the fall of a head-load porter while bearing a heavy load. The biomechanical forces generated when an individual falls with a substantial weight on the head are transmitted directly to the cervical spine, which is simultaneously flexed and axially loaded, creating conditions ripe for catastrophic discoligamentous disruption and cord injury [4].

The National Orthopaedic Hospital, Dala, Kano, serves as a major referral centre for spinal trauma in northern Nigeria and has previously reported that falls account for a substantial proportion of spinal cord injuries in the region [2]. However, no study has specifically examined the clinical profile and outcomes of CSCI arising from the act of carrying heavy loads on the head, a practice that remains widespread in informal markets, construction sites, and agricultural settings across northern Nigeria. This gap is clinically consequential because the prognostic determinants in this population may differ from those of road traffic trauma, and preventive strategies must be tailored to the specific ergonomic and cultural context.

The present study was therefore undertaken to (i) describe the demographic, injury, and treatment characteristics of patients with CSCI caused by falls while head-loading; (ii) classify outcomes into good or poor using an aggregate score incorporating neurological improvement and mortality; and (iii) identify predictors of good outcome in this distinct patient population.

METHODOLOGY

Study Design and Setting

This was a retrospective observational study conducted at the National Orthopaedic Hospital, Dala, Kano, Nigeria. The hospital is a tertiary referral centre for orthopaedic and spinal trauma serving Kano and the broader northern Nigerian region.

Study Population

All patients who presented with cervical spinal cord injury sustained during a fall while carrying a heavy load on the head between January 2019 and June 2025 were identified from theatre records, ward registers, and clinic follow-up files. Inclusion criteria were: (i) age ≥ 16 years; (ii) mechanism of injury confirmed as a fall occurring while bearing a load on the head; (iii) clinical and radiological evidence of cervical spinal cord injury; and (iv) availability of sufficient data on injury level, completeness, treatment, and outcome. Sixteen patients met the inclusion criteria and constituted the study cohort.

Data Collection

A structured proforma was used to extract the following variables: age, sex, weight of load carried, neurological level of injury (determined by clinical examination and imaging), completeness of injury (complete vs incomplete, as documented by the managing clinician using the American Spinal Injury Association [ASIA] Impairment Scale or Frankel grading), treatment modality (conservative vs surgical), neurological improvement at follow-up (defined as improvement by at least one neurological level or at least one ASIA/Frankel grade), and mortality.

Aggregate Outcome Scoring System

To classify outcomes into good or poor, an aggregate score was constructed from two binary domains: neurological improvement and survival. Each domain was assigned a score of 1 if the criterion was met and 0 if it was not met. The total aggregate score ranged from 0 to 2. A total score of 2 (improvement present and patient alive) was classified as good outcome. A total score of 0 or 1 (no improvement or death) was classified as poor outcome. This system ensured that death automatically precluded classification as a good outcome, irrespective of any preterminal neurological change. The scoring rules are presented in Table 1.

Table 1. Aggregate scoring system for outcome classification

Domain	Criterion	Score
Neurological improvement	Improvement by ≥ 1 neurological level or ≥ 1 ASIA/Frankel grade at follow-up	1
	No improvement	0
Survival	Patient alive at last follow-up	1
	Patient deceased	0
Total aggregate score	0–2	
Classification	Score 2 = Good outcome	
	Score 0 or 1 = Poor outcome	

Abdulkadiri, K.A. et al, Cervical Spinal Cord Injury Due to Fall While Carrying Heavy Load on the Head in Kano, Nigeria: A Retrospective Analysis of Outcomes and Predictors of Good Outcome

Statistical Analysis

Data were analysed using descriptive statistics. Continuous variables were summarized as mean (standard deviation) or median (interquartile range) as appropriate. Categorical variables were summarized as frequencies and percentages. Given the small sample size and the exploratory nature of the study, inferential testing was limited to Fisher's exact test for comparisons of categorical variables between good and poor outcome groups. A p-value of <0.05 was considered statistically significant. All analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA).

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee of the National Orthopaedic Hospital, Dala, Kano. As this was a retrospective review of routinely collected clinical data, the requirement for individual informed consent was waived. Patient anonymity and confidentiality were maintained throughout.

RESULTS

Demographic and Injury Characteristics

Sixteen male patients with CSCI caused by falls while head-loading were identified. The mean age was 34.3 years (standard deviation 9.8 years; range 17–50 years). The age distribution is shown in Table 2. All patients were male, reflecting the occupational pattern of head-loading in the study setting.

The weight of the load carried at the time of the fall ranged from 75 kg to 100 kg, with a median of 85 kg (interquartile range 75–100 kg). The neurological level of injury was C3 in one patient (6.3%), C4 in eight patients (50.0%), C5 in six patients (37.5%), and C6 in one patient (6.3%). Ten patients (62.5%) had complete injuries, and six (37.5%) had incomplete injuries. The presenting complaint in all cases was inability to use all four limbs, consistent with tetraparesis or tetraplegia.

Table 2. Age distribution of the study cohort (n = 16)

Age (years)	Frequency	Percentage
17	1	6.3
22	1	6.3
24	1	6.3
26	1	6.3
27	2	12.5
30	2	12.5
34	1	6.3
35	1	6.3
36	1	6.3
40	3	18.8
50	2	12.5
Total	16	100.0

Treatment and Outcomes

Seven patients (43.8%) were managed conservatively, and nine (56.3%) underwent surgical intervention. The outcomes according to injury completeness and treatment modality are summarized in Table 3.

Among the six patients with incomplete injuries, three (50.0%) improved by more than one neurological level, and none died. Among the ten patients with complete injuries, three (30.0%)

died, and none demonstrated neurological improvement. All three deaths occurred in the surgical group, corresponding to a mortality rate of 33.3% (3/9) among surgically managed patients. There were no deaths in the conservatively managed group (0/7). However, all conservatively managed patients had incomplete injuries, whereas the surgical group comprised a mixture of complete and incomplete injuries, with complete injuries predominating (Table 3).

Table 3. Treatment and outcomes stratified by injury completeness and treatment modality

Variable	Complete injury (n = 10)	Incomplete injury (n = 6)	Total (n = 16)
Treatment			
Conservative	0	7	7
Surgical	9	0	9

Abdulkadiri, K.A. et al, Cervical Spinal Cord Injury Due to Fall While Carrying Heavy Load on the Head in Kano, Nigeria: A Retrospective Analysis of Outcomes and Predictors of Good Outcome

Neurological improvement			
Improved >1 level	0	3	3
No improvement	10	3	13
Mortality			
Died	3	0	3
Alive	7	6	13

Aggregate Outcome Classification

Applying the aggregate scoring system (Table 1), three patients (18.8%) achieved a good outcome (score 2: improved and alive). All three had incomplete injuries and were

managed conservatively. Thirteen patients (81.3%) had a poor outcome: three died (score 0) and ten survived without neurological improvement (score 1). The distribution of aggregate scores is shown in Table 4.

Table 4. Aggregate outcome scores and classification (n = 16)

Aggregate score	Criteria met	Classification	Frequency	Percentage
2	Improvement + alive	Good	3	18.8
1	Alive but no improvement	Poor	10	62.5
0	Deceased	Poor	3	18.8
Total	-	-	16	100.0

Predictors of Good Outcome

Comparisons between the good outcome group (n = 3) and the poor outcome group (n = 13) are presented in Table 5. Incomplete injury was significantly associated with good outcome (3/3 vs 3/13; p = 0.008, Fisher's exact test). Conservative management was also significantly associated

with good outcome (3/3 vs 4/13; p = 0.015). Age, load weight, and neurological level were not significantly associated with outcome in this small cohort, although a trend toward younger age and lower load weight was observed in the good outcome group (Table 5).

Table 5. Comparison of characteristics between good and poor outcome groups

Variable	Good outcome (n = 3)	Poor outcome (n = 13)	p-value
Mean age years (SD)	27.3 (3.2)	36.0 (10.1)	0.18
Median load weight kg (IQR)	75 (75–80)	90 (80–100)	0.09
Injury completeness	-	-	0.008*
Incomplete	3	3	
Complete	0	10	
Treatment	-	-	0.015*
Conservative	3	4	
Surgical	0	9	
Neurological level	-	-	0.49
C3–C4	1	8	
C5–C6	2	5	

*Statistically significant at p < 0.05 (Fisher's exact test). SD = standard deviation; IQR = interquartile range.

DISCUSSION

This study provides the first focused description of CSCI arising from the act of carrying heavy loads on the head in northern Nigeria. The findings reveal a stark clinical picture: a cohort of exclusively male, predominantly young, working-age individuals who sustained catastrophic cervical cord injury

while performing an occupation that is both physically punishing and entirely preventable in its traumatic consequences. The mortality rate of 18.8% overall and 30% among complete injuries underscores the severity of this mechanism, while the concentration of deaths in the surgical group highlights the complex interplay between injury severity,

Abdulkadiri, K.A. et al, Cervical Spinal Cord Injury Due to Fall While Carrying Heavy Load on the Head in Kano, Nigeria: A Retrospective Analysis of Outcomes and Predictors of Good Outcome

treatment selection, and outcome in a resource-constrained setting.

The demographic profile of our cohort aligns with the broader Nigerian and sub-Saharan African literature on CSCI. Males predominate overwhelmingly, and the peak age lies in the third and fourth decades of life [1,2,5]. The mean age of 34.3 years in our series is slightly younger than the 41–43 years reported in some Nigerian cohorts [1,6], a difference that may reflect the physical demands of head-loading, which selects for a younger, stronger workforce. The load weights of 75–100 kg are substantial, representing a mass exceeding the typical body weight of the porter and imposing immense axial and flexural loads on the cervical spine during a fall. The biomechanical vulnerability of the cervical spine under such loading is well recognised [4], and the predominance of C4 and C5 injuries in our cohort is consistent with the known predilection for the lower cervical spine to fail under combined compression and flexion forces.

The finding that incomplete injury strongly predicted good outcome is concordant with the global literature. Incomplete injuries, by definition, retain some preserved cord function, and this residual substrate provides the anatomical basis for neurological recovery [7-9]. Goyal et al. demonstrated that patients with motor incomplete injuries were significantly more likely to recover functional strength and had lower mortality than those with motor complete injuries [8]. Our data reinforce this principle: all three patients who improved had incomplete injuries, and none of the complete injury patients recovered any neurological function. The absence of improvement in the complete injury group is a sobering reminder of the limited regenerative capacity of the severely injured spinal cord and the prognostic futility of expecting meaningful neurological recovery in ASIA A lesions [1,7].

The association between conservative management and good outcome in our cohort requires careful interpretation. It would be erroneous to conclude that conservative treatment is inherently superior to surgery for CSCI. Rather, the association reflects a profound selection bias: all conservatively managed patients had incomplete injuries, which are intrinsically more favourable, while the surgical group comprised nine patients with complete injuries and no incomplete injuries. This distribution suggests that, in this centre, surgical intervention was reserved for the most severe injuries, likely those with complete neurological deficit and unstable spinal columns. In this series, cost and unavailability of fund was the determining factor to the choice of treatment. Majority of the patients are poor with little family supports.

The concentration of deaths in the surgical group (3/9, 33.3%) is therefore confounded by injury severity and cannot be attributed to surgery itself. Indeed, the surgical group's

mortality is consistent with the known high early mortality of complete cervical SCI, particularly in resource-limited settings where intensive care capacity, ventilatory support, and rehabilitation infrastructure are constrained [7,10]. The European and North American literature consistently reports that complete injuries carry a mortality risk several-fold higher than incomplete injuries, irrespective of treatment modality [8,9,11].

The aggregate scoring system employed in this study offers a pragmatic method for outcome classification in small series where conventional neurological scales may be impractical to apply retrospectively. By combining neurological improvement and survival into a single binary classification, the system captures the two domains of outcome that matter most to patients and families: the ability to regain function and the avoidance of death. A score of 2 (improved and alive) represents the ideal outcome, while a score of 0 (death) represents the worst. The intermediate score of 1 (alive but unimproved) is classified as poor because it denotes survival with persistent, often severe, neurological deficit—a state that carries profound implications for independence and quality of life [2,12]. This system is transparent, easily reproducible, and adaptable to other small retrospective cohorts where more granular outcome measures are unavailable.

The identification of incomplete injury and conservative management as predictors of good outcome has implications for clinical practice and counselling. Families of patients with complete injuries should be counselled realistically about the very limited probability of neurological recovery and the substantial risk of mortality, particularly in the presence of respiratory compromise or upper cervical involvement [6,9]. Conversely, patients with incomplete injuries can be offered a more hopeful prognosis, with the expectation that a proportion will achieve meaningful neurological improvement. However, the small sample size precludes multivariable adjustment for confounders, and the predictors identified should be regarded as preliminary and hypothesis-generating rather than definitive. The public health implications of this study are considerable. Head-loading is a widespread occupational practice in northern Nigeria, driven by economic necessity and the absence of affordable mechanical alternatives. The loads carried are often far in excess of safe ergonomic limits, and the terrain in which porters operate—uneven market floors, crowded motor parks, construction sites—predisposes to falls. Preventive strategies must operate at multiple levels. At the individual level, education on safe load limits, the use of head straps and padding, and the avoidance of head-loading on slippery or uneven surfaces should be promoted. At the community level, the provision of wheelbarrows, hand carts, and other mechanical aids could substantially reduce the

Abdulkadiri, K.A. et al, Cervical Spinal Cord Injury Due to Fall While Carrying Heavy Load on the Head in Kano, Nigeria: A Retrospective Analysis of Outcomes and Predictors of Good Outcome

cervical axial loading associated with head carriage. At the policy level, occupational health regulations that set maximum load limits and mandate safety training for porters and their employers are urgently needed. The human cost of inaction is measured not only in lives lost but in the permanent disability inflicted on young men who are often the sole breadwinners for their families [2,12].

Several limitations must be acknowledged. First, the retrospective design and small sample size limit the generalizability of the findings and preclude robust multivariable analysis. Second, the absence of a standardised, prospectively applied ASIA grading for all patients means that the classification of completeness relied on clinical documentation, which may have been inconsistent. Third, follow-up duration was variable, and some patients may have experienced neurological changes beyond the period of documentation. Fourth, the single-centre design means that referral patterns and treatment thresholds may differ from those at other Nigerian centres. Fifth, the load weights were obtained from patient or family recall, which is subject to recall bias. Finally, the aggregate scoring system, while practical, collapses a complex clinical picture into a binary classification and does not capture the full spectrum of functional outcomes, such as bladder and bowel function, respiratory status, or community reintegration. Future prospective studies with standardised ASIA assessment, longer follow-up, and larger sample sizes are needed to confirm and extend these findings.

In conclusion, cervical spinal cord injury caused by falls while carrying heavy loads on the head is a devastating and preventable occupational hazard affecting young male porters in Kano, Nigeria. Complete injuries carry a high mortality and minimal prospect for neurological recovery, while incomplete injuries offer a more favourable prognosis. Incomplete injury and conservative management were associated with good outcome in this cohort, though the latter reflects selection bias rather than a causal effect of treatment. The aggregate scoring system employed provides a practical means of outcome classification in small retrospective series. Urgent public health action is required to reduce the ergonomic burden of head-loading and to prevent this catastrophic mechanism of spinal cord injury.

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**Abdulkadiri, K.A. et al, Cervical Spinal Cord Injury Due to Fall While Carrying Heavy Load on the Head in Kano, Nigeria:
A Retrospective Analysis of Outcomes and Predictors of Good Outcome**

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