Spinal cord injury (SCI)

Refers to any injury to the spinal cord that is caused by trauma instead of disease.

Total health care costs related to TSCIs exceed $10 billion annually in the United States alone, and lifetime per person direct and indirect costs can exceed $3 million [1) 2)].

Level

There is disagreement over what should be defined as “the level” of a spinal cord injury. Some define the “level” of a spinal cord injury as the lowest level of completely normal function (thus a patient would be termed a C5 quadriplegic even with minor C6 motor function). However, most sources define the “level” as the most caudal segment with a motor function that is at least 3 out of 5 and if pain and temperature sensation is present.

Epidemiology

Spinal cord injury epidemiology.

Classification

see Spinal cord injury classification.

Etiology

Spinal cord injuries have many causes, but are typically associated with major trauma from motor vehicle accidents, falls, sports injuries, and violence.

see Spinal stab wound.

Multiple cellular, molecular, and biochemical changes contribute to the etiology and treatment outcome of contusion spinal cord injury (SCI). MicroRNAs (MicroRNAs) aberrant expression have been found after SCI [3)].

Pathophysiology

see Spinal cord injury pathophysiology

Signaling pathways

Although many scholars have utilized high-throughput microarrays to delineate gene expression patterns after spinal cord injury (SCI), no study has evaluated gene changes in nucleus raphe magnus (RM) and somatomotor cortex (SMTC), two areas in brain primarily affected by SCI. In present study, we aimed to analyze the differentially expressed genes (DEGs) of RM and SMTC between SCI model and sham injured control at 4, 24 h, 7, 14, 28 days, and 3 months using microarray dataset GSE2270 downloaded from gene expression omnibus and unpaired significance analysis of microarray method. Protein-protein interaction (PPI) network was constructed for DEGs at crucial time points and significant biological functions were enriched using DAVID. The results indicated that more DEGs were identified at 14 days in RM and at 4 h/3 months in SMTC after SCI. In the PPI network for DEGs at 14 days in RM, interleukin 6, glyceraldehyde-3-phosphate dehydrogenase (GAPDH), FBJ murine osteosarcoma viral oncogene homolog (FOS), tumor necrosis factor, and nuclear receptor subfamily 3, group C, member 1 (glucocorticoid receptor) were the top 5 hub genes; In the PPI network for DEGs at 3 months in SMTC, the top 5 hub genes were ubiquitin B, Ras-related C3 botulinum toxin substrate 1 (rho family, small GTP binding protein Rac1), FOS, Janus kinase 2 and vascular endothelial growth factor A. Hedgehog and Wnt signaling pathways were the top 2 significant pathways in RM. These hub DEGs and pathways may be underlying therapeutic targets for SCI [4].

Clinical features

Depending on where the spinal cord and nerve roots are damaged, the symptoms can vary widely, from pain to paralysis to incontinence.

Spinal cord injury (SCI) disrupts autonomic circuits and impairs the synchronistic functioning of the autonomic nervous system, leading to inadequate cardiovascular regulation. Individuals with SCI, particularly at or above the sixth thoracic vertebral level (T6), often have impaired regulation of sympathetic vasoconstriction of the peripheral vasculature and the splanchnic circulation and diminished control of heart rate and cardiac output. In addition, impaired descending sympathetic control results in changes in circulating levels of plasma catecholamines, which can have a profound effect on cardiovascular function. Although individuals with lesions below T6 often have normal resting blood pressures, there is evidence of increases in resting heart rate and inadequate cardiovascular response to autonomic provocations such as the head-up tilt and cold face tests [5].

In the Hospital

ASIA impairment scale

Evaluation of reflexes

Abdominal reflexes.....

Diagnosis

see Spinal cord injury diagnosis.

Treatment

see Spinal cord injury treatment.

Urologic Health Condition

Urinary incontinence (UI) rate is high among SCI patients, and more common in females with fairly good proportion of patients using incontinence medication. Main bladder management method was clean intermittent catheterization (CIC) and more prevalent in males, although the use of CIC decreased with time. Urinary stone surgery was the leading surgical procedure [6)].

Rehabilitation

Spinal cord injury (SCI) rehabilitation remains a major clinical challenge, especially in cases involving chronic, complete injury. Existing interventions for assisting patients with SCI in walking, including body weight support systems, robotic assistance, and functional electrostimulation of the legs, have not shown evidence of generating significant clinical improvement in somatosensory function below the level of the injury. In the past 2 decades, brain machine interfaces (BMIs) have become popular tools for restoring limb function in paralyzed patients, although no study has suggested that long-term training with BMI-based paradigms and physical training could trigger neurological recovery, particularly in patients with complete SCI

Outcome

Spinal cord injury outcome

Complications

Spinal cord injury complications.

Retrospective Observational Cohort Studies

In a Retrospective Observational Cohort Study Ikwuegbuenyi et al. From Muhimbili Orthopaedic Institute, Dar es Salaam; Weill Cornell Medicine, New York publisher in the journal BMJ Open to identify demographic, injury-related, and healthcare system factors associated with clinic follow-up adherence after traumatic spinal injury (TSI) in Tanzania. Fewer than 13% of patients remained in follow-up at 12 months post-TSI. Key predictors of clinic return included private insurance, injury mechanism, shorter hospital stay, neurological improvement, and female sex. The authors call for targeted strategies to enhance long-term follow-up in LMICs.

Content and Scientific Merit

The study attempts to quantify and elucidate predictors of follow-up adherence among patients with traumatic spinal injuries in a low-resource setting. While the topic is relevant, particularly given global disparities in neurosurgical care, the analysis remains superficial. The selection of variables lacks depth—omitting psychological, transportation, or caregiver support factors. The authors rely heavily on retrospective registry data, yet provide minimal discussion of data quality or loss to follow-up bias beyond basic exclusions.

There is also insufficient interrogation of systemic barriers endemic to Tanzanian healthcare—such as infrastructure deficits or cultural mistrust of allopathic medicine—that could more meaningfully contextualize the findings. The regression analysis is underutilized; while odds ratios are presented, there's no effort to model interaction effects or assess multicollinearity. Additionally, the use of ASIA Impairment Scale categories in logistic regression, without discussion of baseline functional capacity or socioeconomic stratification, undermines interpretability.

Tone and Structure

The tone is utilitarian and dry, bordering on inert. The paper reads like a minimally annotated statistical report rather than a critical exploration. Structurally, the abstract frontloads methods but compresses conclusions, failing to reflect the significance of key results. The body of the manuscript (not shown) likely suffers from similar flattening, based on this presentation.

Accuracy and Utility for Neurosurgeons

For practicing neurosurgeons—especially those in LMICs—the clinical utility is limited. It's unclear how this data informs discharge planning, triage, or targeted intervention. There's no discussion of actionable mechanisms to improve follow-up, such as mobile health (mHealth) platforms or community health worker models. Additionally, the demographic skew (86% male) is acknowledged but unexplored, missing an opportunity to question why women have better follow-up despite being a minority of the cohort.

Overall Verdict

This study raises a crucial problem—poor longitudinal care after spinal trauma—but fails to deliver an insightful or impactful analysis. It identifies correlates, not causes, and provides no meaningful roadmap forward. The absence of a more layered discussion renders it of limited value beyond bureaucratic benchmarking.

- **Takeaway for Neurosurgeons:** Insurance status and neurologic improvement predict clinic adherence after spinal trauma, but structural solutions remain absent.
- **Bottom Line:** A shallow statistical treatment of a deep healthcare inequity; lacks the critical insight or practical relevance needed by frontline neurosurgeons.
- **Rating: 4/10**

Citation Info

- **Article Title:** What drives clinic follow-up after traumatic spinal injury? An observational cohort study from Tanzania
- **Citation:** Ikwuegbuenyi CA, et al. *BMJ Open*. 2025 Jun 25;15(6):e101267. doi:10.1136/bmjopen-2025-101267.
- **Corresponding Author Email:** scott.zuckerman@vumc.org

1)
DeVivo M.J. (1997). Causes and costs of spinal cord injury in the United States. Spinal Cord 35, 809–813
2)
Krueger H., Noonan V.K., Trenaman L.M., Joshi P., Rivers C.S. (2013). The economic burden of traumatic spinal cord injury in Canada. Chronic Inj. Can. 33, 113–122
3)
Zhu H, Xie R, Liu X, Shou J, Gu W, Gu S, Che X. MicroRNA-494 improves functional recovery and inhibits apoptosis by modulating PTEN/AKT/mTOR pathway in rats after spinal cord injury. Biomed Pharmacother. 2017 Jun 7;92:879-887. doi: 10.1016/j.biopha.2017.05.143. [Epub ahead of print] PubMed PMID: 28601045.
4)
Xia X, Qu B, Ma Y, Yang LB, Huang HD, Cheng JM, Yang T, Kong B, Liu EY, Zhao K, He WQ, Xing XM, Liang L, Fan KX, Sun HD, Zhou HT, Cheng L, Gu JW, Kuang YQ. Analyzing time-series microarray data reveals key genes in spinal cord injury. Mol Biol Rep. 2014 Jul 26. [Epub ahead of print] PubMed PMID: 25063577.
5)
Wecht JM, Harel NY, Guest J, et al. Cardiovascular Autonomic Dysfunction in Spinal Cord Injury: Epidemiology, Diagnosis, and Management [published online ahead of print, 2020 Sep 9]. Semin Neurol. 2020;10.1055/s-0040-1713885. doi:10.1055/s-0040-1713885
6)
Cetinel B, Onal B, Turegun FA, Erdogan S. Urologic health condition of spinal cord-injured patients living in Turkey. Spinal Cord. 2014 Jan 21. doi: 10.1038/sc.2013.173. [Epub ahead of print] PubMed PMID: 24445977.