

Original Research

Hemodynamic Instability in Trauma Patients Assessed by Shock Index: A Prospective Cohort Study on Injury Patterns and Early Outcomes in Tanzania

Samih Issa, MBChB, MMed, FCS¹^a, Gimbo Hyuha, MD, MMed², Allen Kisanga, MD, MMed³, Asha Abdullah, MD, MMed⁴

¹ Department of Orthopaedics, Traumatology and Neurosurgery, Muhimbili University of Health and Allied Sciences, ² Department of Emergency Medicine, Muhimbili University of Health and Allied Sciences, ³ Department of Orthopaedics and Traumatology, Muhimbili Orthopaedic Institute, ⁴ Department of Anaesthesia & Critical Care, Muhimbili Orthopaedic Institute

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Abstract

Background

Hemodynamic compromise remains a major contributor to trauma-related mortality, particularly in resource-limited settings. While validated in high-income countries, the prognostic utility of Shock Index (SI) as a marker of hemodynamic instability remains underexplored in the Eastern and Central African region. This study evaluated the proportion, injury patterns, and short-term outcomes of trauma patients presenting with elevated SI at a tertiary trauma center in Tanzania.

Methods

This prospective observational cohort study was conducted between June and September 2024. Adult trauma patients presenting with SI >0.7 were consecutively enrolled. Demographic characteristics, clinical parameters and trauma severity scores (New Injury Severity Score [NISS] and Revised Trauma Score [RTS]) were recorded on arrival. The primary outcomes were mortality within 7 days and prolonged hospital admission (>7 days). Multivariate logistic regression was used to identify independent predictors of the outcomes.

Results

Among 1235 trauma patients, 160 (13%) presented with SI >0.7, including 38% with SI ≥1. Markedly elevated SI (≥1) was associated with severe injury ($P < 0.0001$), anemia ($P < 0.0001$), and multisystem trauma ($P = 0.044$). Young males represented the majority of the population. Motor traffic crashes accounted for the majority of injuries (80.6%). The overall 7-day mortality rate of 5% was exclusive to patients with SI ≥1. Most patients (58.75%) experienced prolonged hospitalization. On multivariate analysis, SI ≥1, low RTS ($P = 0.037$), and low Glasgow Coma Scale (GCS) ($P = 0.022$) were significantly associated with mortality, while higher NISS ($P < 0.0001$) and head injury ($P = 0.0029$) were significantly associated with prolonged hospital stay.

Conclusions

Elevated SI was a useful early marker of hemodynamic instability and mortality risk among trauma patients in this setting. An SI ≥1, low RTS, and low GCS were associated with mortality. Higher NISS and head injury were associated with prolonged hospitalization. Incorporating these factors into triage may support improved risk stratification and resource use.



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Introduction

Trauma remains a leading global cause of morbidity and mortality, particularly among individuals 45 years and younger.¹⁻⁵ Hemorrhagic shock resulting from uncontrolled exsanguination accounts for nearly half of trauma-related deaths within the first 24 hours, with a substantial proportion occurring during the initial 2–3 hours following injury.^{6,7} Prompt recognition and resuscitation are critical to improving survival by preventing the progression of the lethal triad: hypothermia, acidosis, and coagulopathy.^{2,8-10}

Standard shock classification as described in Advanced Trauma Life Support guidelines remains central to trauma assessment. However, estimation of blood loss and reliance on individual physiological parameters may be influenced by compensatory mechanisms in early shock, and volume loss is often difficult to quantify instantaneously.^{11,12} While serum lactate level is a reliable biomarker for hypoperfusion, testing for it is often unavailable in trauma centers located in low- and middle-income countries (LMIC).¹³ Trauma severity scoring systems like the New Injury Severity Score (NISS) and Revised Trauma Score (RTS) have demonstrated utility for prognostication, but their dependence on comprehensive diagnostics limits their application in many LMICs.¹⁴

In this context, composite measures such as the Shock Index (SI), defined as the ratio of heart rate to systolic blood pressure, with a normal range of 0.5 to 0.7, may provide an additional simple, rapid, and noninvasive indicator of early hemodynamic compromise.^{2,8} The application of SI in trauma triage across the sub-Saharan region remains limited, and it is rarely integrated into routine clinical practice or national treatment protocols.¹⁵⁻¹⁸ LMICs, including Tanzania, experience challenges in trauma care from limited pre-hospital services, delayed imaging and laboratory diagnostics, and inadequate care infrastructure.^{19,20}

The prognostic utility of SI in obstetrics, cardiovascular emergencies and trauma has mostly been demonstrated by retrospective studies originating from high-income countries.²¹ There is also a marked paucity of prospective research on patterns of trauma with elevated SI within sub-Saharan Africa, where trauma systems face unique resource and infrastructure constraints.²²

This study aims to address existing regional gaps by examining the proportion and clinical characteristics of trauma patients presenting with hemodynamic compromise or instability (SI >0.7) at a national referral center in Tanzania. It further assesses how varying levels of elevated SI correlate with injury severity, trauma scores (NISS and RTS), and short-term outcomes. Additionally, the study identifies predictors of mortality and prolonged hospitalization among patients with elevated SI to support early risk stratification in resource-limited settings.

Methods

Study site, design and settings

This was a prospective, observational cohort study conducted between June and September 2024 at a high-volume, tertiary national trauma referral center in an urban area of Dar es Salaam, Tanzania. The center functions as one of the country's primary facilities for orthopedics, trauma, and neurosurgery, serving a catchment population exceeding 10 million. It operates a 24-hour emergency department (ED) staffed by specialist trauma personnel and manages approximately 4000 outpatient visits and 110 inpatient admissions weekly.

Study population and eligibility criteria

All adult trauma patients (aged ≥ 18 years) presenting at the ED during the study period with a SI >0.7 were eligible. The threshold of >0.7 was selected because it exceeds the upper limit of normal physiological range (0.5–0.7) and reflects early hemodynamic compromise, thereby allowing identification of patients at risk of clinical deterioration. Exclusion criteria included known cardiac disease, pacemaker use, ongoing inotropic or chronotropic medication, pregnancy, confirmed infection, death on arrival, or prior major surgical intervention or hospital care before referral. These exclusions were applied to minimize non-trauma related physiological modifiers confounding heart rate and blood pressure responses, thereby preserving the interpretive validity of SI as a marker of trauma-induced hemodynamic compromise. All included patients sustained blunt trauma, without penetrating injuries. Informed consent was obtained from all participants or their proxies.

Sampling and data collection

Patients were recruited using consecutive sampling. Trained research personnel used a structured data collection tool to prospectively gather data, including brief patient history (including age and mechanism of injury) alongside clinical records and assessments. Eligible patients were identified immediately upon arrival at ED triage area, irrespective of time of presentation. Research assistants worked in shifts to ensure continuous recruitment, and patients for whom consent could not be obtained were excluded ([Figure 1](#)).

During casualty department triage assessment, demographic variables and injury mechanisms and patterns were recorded and verified with attending clinicians. Baseline clinical data at patient arrival, before initiation of resuscitative interventions, were obtained from ED triage records. Data included heart rate, systolic blood pressure, respiratory rate, GCS, and hemoglobin level. Patients were followed for 7 days after admission to assess early outcomes.

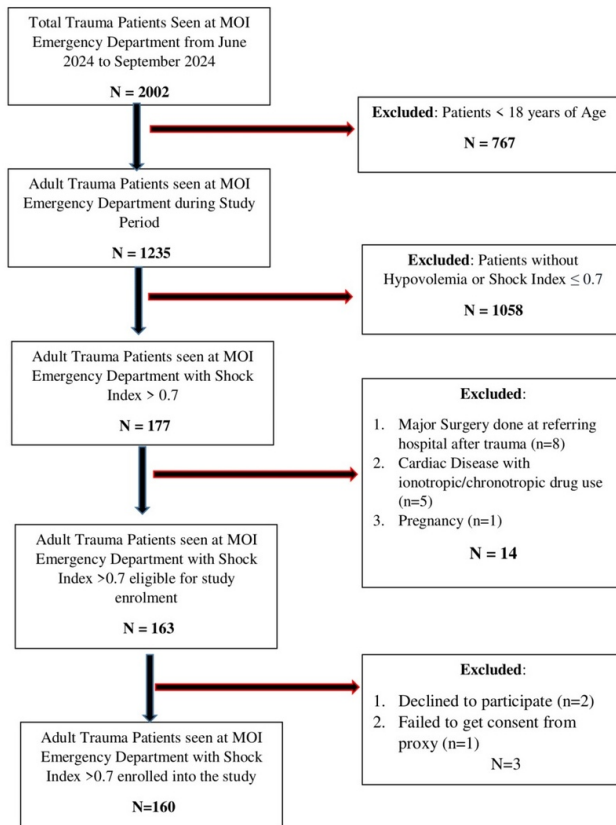


Figure 1. Study Participants Selection Flowchart

Study variables and measures

Primary variables included SI, NISS, and RTS. Secondary variables were age, sex, mechanism of injury, hemoglobin level, and the count and location of significantly injured anatomical regions.

A significant injury was defined as one of at least moderate severity, requiring medical intervention and corresponding to an Abbreviated Injury Scale (AIS) score of ≥ 2 . NISS, which quantifies anatomical injury, was computed by squaring and summing the three highest AIS scores.

Hemoglobin level was recorded from the first laboratory sample obtained at presentation to the casualty department, with laboratory services available continuously. Values were recorded as continuous variables and classified as anaemic or non-anaemic according to World Health Organization hemoglobin thresholds for adults (hemoglobin < 13.0 g/dL in males and < 12.0 g/dL in females).

Weighted RTS, a physiological scoring system, was calculated using GCS, systolic blood pressure, and respiratory rate. For analytical purposes, SI was categorized into low ($SI < 1$) and high ($SI \geq 1$) cohorts, consistent with established literature identifying $SI \geq 1$ as a threshold associated with increased risk of decompensation and mortality.

The primary outcomes were mortality and length of hospitalization (≤ 7 days vs > 7 days). A threshold of 7 days was selected to reflect the intensity of early inpatient care after trauma and to capture clinically meaningful short-term hos-

pital utilization. Longer-term data is often difficult to obtain in our setting because patients are often lost to follow-up after their initial stabilization and discharge.

Bias mitigation

Selection bias was minimized through consecutive, nonselective patient enrollment and predefined eligibility criteria. Patients with comorbidities or prior trauma surgical care were excluded to reduce confounders from treatment. Standardized data collection tools and validated trauma scores (SI, NISS, RTS) were used. Anatomical injury scoring was independently verified by surgical specialists and radiologists to reduce measurement bias. This study was conducted at an orthopedic and trauma national referral center where attending-level oversight is mandated for all admitted patients as part of routine institutional policy.

Data management and statistical analysis

Data were double-entered into Excel, Version 2019 (Microsoft Corporation, Redmond, WA, USA) and analyzed using SPSS Statistics for Windows, Version 25.0 (IBM Corp, Armonk, NY, USA) and RStudio Version 2024.03.0+492; R version 4.3.2 (RStudio, PBC; Boston, MA, USA). Continuous variables were summarized using means and standard deviations or medians and interquartile ranges, as appropriate. Categorical variables were presented as frequencies and percentages. Bivariate analysis was performed using chi-square and Fisher's exact tests for categorical variables and independent t tests, and the Mann-Whitney U (Wilcoxon) test for continuous variables. Relative risks (RR) with 95% confidence intervals (CI) were calculated. A two-tailed P value $\leq .05$ was considered statistically significant. SI was also dichotomized into low ($SI < 1$) and high ($SI \geq 1$) categories for subgroup analysis.

Multivariable logistic regression was performed to identify independent predictors of mortality within 7 days and prolonged hospitalization. Variables with $P \leq .20$ on univariate analysis, as well as those considered clinically relevant from prior literature, were entered into the model. A forward stepwise (likelihood ratio) approach was used for variable entry and retention. Adjusted odds ratios (AOR) with 95% CI were reported, and statistical significance was set at $P \leq .05$.

Results

Demographic and clinical characteristics

From June 1st to September 30th 2024, 1235 adult trauma patients presented to the ED, and 160 (13%) met eligibility criteria for elevated SI ($SI > 0.7$) indicating hemodynamic instability (Figure 1). Among them, 61 (38.1%) demonstrated markedly elevated SI ($SI \geq 1$). Median age did not differ significantly between the high- and low-SI cohorts (35.0 vs 34.2 years, $P = .676$), and age distribution was sim-

Table 1. Clinical characteristics stratified by Shock Index (SI)

		SI ≥ 1 N (%) 61 (38.1)	SI < 1 N (%) 99 (61.9)	P Value
Age group (years)	≤ 40	46 (38.7%)	73 (61.3%)	.961
	> 40	15 (36.6%)	26 (63.4%)	
Sex	Male	56 (41.8)	78 (58.2)	.0454
	Female	5 (19.2)	21 (80.8)	
NISS	> 15	59 (64.1)	33 (35.9)	<.001
	≤ 15	2 (2.9)	66 (97.1)	
RTS	< 6	13 (76.5)	4 (23.5)	.0015
	≥ 6	48 (33.6)	95 (66.4)	
GCS	≤ 8	12 (75.0)	4 (25.0)	.0022
	> 8	49 (34.0)	95 (66.0)	
Baseline hemoglobin	Anemia	54 (50.9)	52 (49.1)	<.001
	Normal	7 (13.0)	47 (87.0)	
Mean values (95 % CI)	Age (Years)	35.0 (32.1–37.9)	34.2 (31.8–36.6)	.6764
	NISS	30.5 (27.3–33.8)	14.8 (13.5–16.1)	<.001
	RTS	7.06 (6.79–7.33)	7.75 (7.67–7.82)	<.001
	Hemoglobin (g/dL)	10.4 (9.8–11.0)	12.4 (12.0–12.8)	<.001

NISS = New Injury Severity Score; RTS= Revised Trauma Score; GCS= Glasgow Coma Scale

ilar ($P = .961$). Males were significantly more likely to present with high SI than females (41.8% vs 19.2%, $P = .045$; RR = 2.17, 95% CI: 0.96–4.90).

High SI was associated with greater injury severity. Patients with SI ≥ 1 were more likely to have NISS > 15 (64.1% vs 35.9%, $P < .0001$; RR = 21.8), RTS < 6 (76.5% vs 23.5%, $P = .0015$; RR = 2.28), and GCS ≤ 8 (75.0% vs 25.0%, $P = .0022$; RR = 2.20). Anemia was also more prevalent among high SI patients (50.9% vs 13.0%, $P < .0001$; RR = 3.93) (Table 1).

Injury mechanisms, distribution, and early outcomes

Motor traffic crashes were the most common injury mechanism in both groups, with no significant difference between high- and low-SI patients ($P > .05$). In contrast, injury pattern and distribution differed significantly (Table 2).

Head injuries were more frequent among high SI patients (58.2% vs 41.8%, $P < .0001$; RR = 3.14, 95% CI: 1.92–5.15), as were chest injuries (73.9% vs 26.1%, $P = .0003$; RR = 2.30) and abdominal injuries (90.9% vs 9.1%, $P = .0006$; RR = 2.66). Multisystem trauma was more common in the high-SI cohort; patients who sustained > 3 injuries were 2.5 times more likely to present with high SI ($P = .0021$; RR = 2.53). The median injury count was also higher (3 vs 1, $P = .0001$).

Early outcomes were worse in the high SI cohort. All deaths within 7 days occurred among patients with SI ≥ 1 ($P = .00033$; RR = 27.42). Prolonged hospitalization (> 7 days) was also significantly more likely (78.7% vs 21.3%, $P = .00012$; RR = 1.69) in this cohort.

Multivariate predictors of high SI and clinical outcomes

On multivariate analysis, three variables were associated with high SI (SI ≥ 1): higher NISS (AOR = 1.32, 95% CI: 1.17–1.50, $P < .001$), lower hemoglobin levels (AOR = 0.68, 95% CI: 0.53–0.86, $P = .002$), and presence of more than three injured anatomical regions (AOR = 33.97, 95% CI: 1.09–696.04, $P = .044$). Individual injury locations, RTS, and GCS were not independently associated with high SI. The model showed strong fit (pseudo $R^2 = 0.498$, $P < .001$).

Penalized logistic regression showed that high SI (AOR = 13.30, 95% CI: 1.15–3361, $P = .035$), low RTS (AOR = 25.89, $P = .037$), and low GCS (AOR = 0.39, $P = .022$) were significantly associated with 7-day mortality (Table 3). NISS, anemia, and injury locations lost significance after adjustment. NISS > 15 (AOR = 33.48, 95% CI: 5.98–187.51, $P < .0001$) and head injury (AOR = 1.43, 95% CI: 1.03–5.75, $P = .0029$) remained associated with prolonged hospital stays (Table 4). SI and other injury characteristics were not independent predictors of prolonged hospitalization (> 7 days).

Discussion

This prospective observational cohort study highlights the substantial occurrence of hemodynamic compromise among trauma patients at a national referral center in Tanzania, with 13% of adult trauma admissions presenting with SI values above the normal physiological range. Retrospective studies from high-income settings have shown com-

Table 2. Injury sites, etiology and outcomes stratified by Shock Index (SI)

		SI ≥1 N (%) 61 (38.1)	SI <1 N (%) 99 (61.9)	P Value
Mechanism of injury	Assault	1 (33.3)	2 (66.7)	.998
	Fall from a height	2 (11.1)	16 (88.9)	.25
	Heavy machinery	1 (33.3)	2 (66.7)	.998
	Heavy object trauma	4 (57.1)	3 (42.9)	.51
	Motor traffic crash	53 (41.1)	76 (58.9)	.172
Anatomical region of injury	Head	46 (58.2)	33 (41.8)	<.001
	Chest	17 (73.9)	6 (26.1)	<.001
	Abdomen	10 (90.9)	1 (9.1)	<.001
	Pelvis	9 (56.2)	7 (43.8)	.193
	Spine	5 (50.0)	5 (50.0)	.644
	Limbs	58 (38.9)	91 (61.1)	.655
Number of injuries	>3	8 (88.9)	1 (11.1)	.0021
	≤3	53 (35.1)	98 (64.9)	
Median number of injuries per patient		3	1	<.001
Patient Outcomes				
Mortality	Within 24 hours	2 (1.3)	0 (0.0)	.144
	Within 72 hours	3 (1.9)	0 (0.0)	.054
	Within 7 days	8 (5.0)	0 (0.0)	<.001
Hospital stay	>7 days	48 (51.1)	46 (48.9)	<.001
	≤7 days	13 (19.7)	53 (80.3)	

Table 3. Predictors of 7-day mortality (bivariate and multivariate analysis)

Variable	Survived	Died	BV P value	Adjusted OR* (95% CI)	MV P value
SI ≥ 1, n (%)	53 (34.9)	8 (100)	<.001	11.8 (1.4–98.7)	.035
NISS (mean)	18	42	<.001	1.1 (1.0–1.3)	.0845
RTS (mean)	7.6	6.0	<.001	25.9 (1.6–97.8)	.037
GCS (median)	15	7	<.001	0.4 (0.1–0.9)	.022
Injury count (median)	2	3	.011	1.1 (0.3–4.0)	.669

* Multivariate estimates generated using penalized logistic regression due to sparse events (n = 8 deaths).

BV, bivariate; GCS, Glasgow coma scale; MV, multivariate; NISS, new injury severity scale score; OR, odds ratio; RTS, revised trauma score; SI, Shock Index

Table 4. Predictors of prolonged hospitalization (bivariate and multivariate analysis)

Variable	Admission (%)		Relative Risk (95% CI)	BV P value	Adjusted OR (95% CI)	MV P value
	>7 days	≤7 days				
NISS >15	73 (79.3)	19 (20.7)	2.6 (1.8–3.7)	<.001	33.5 (6.0–187.5)	<.001
Anemia	69 (65.1)	37 (34.9)	1.4 (1.0–1.9)	.028	1.3 (0.6–2.8)	.58
SI ≥1	48 (78.7)	13 (21.3)	1.7 (1.3–2.2)	<.001	1.1 (0.4–3.0)	.88
Head injury	53 (67.1)	26 (32.9)	1.3 (1.0–1.7)	.038	1.4 (1.0–5.8)	.003
Chest injury	18 (78.3)	5 (21.7)	1.4 (1.1–1.8)	.043	1.0 (0.3–4.3)	.96

BV, bivariate; MV, multivariate; NISS, new injury severity score; OR, odds ratio; RR, relative risk; SI, Shock Index

paratively lower proportions of unstable patients.⁷ The differences are likely due to variations in pre-hospital care, trauma system maturity, and referral pathways that influence physiological status at hospital arrival.

A key finding of this study is the strong correlation between SI and established trauma severity indices, reaffirming SI as a meaningful physiological marker in the Tanzanian trauma care context. Patients with elevated SI demonstrated significantly higher NISS, indicating greater anatomical injury burden, alongside significantly lower RTS, reflecting compromised physiological reserve. This concurrent association with anatomical injury burden and physiological derangement supports the utility of SI as an early indicator of trauma-related circulatory instability.

Elevated SI was also significantly associated with lower hemoglobin levels at presentation, an effect that persisted after multivariate adjustment. This relationship may reflect reduced oxygen-carrying capacity contributing to hemodynamic compromise. In the Tanzanian context, where chronic anemia is relatively prevalent, pre-existing low hemoglobin may partially account for this finding, although differentiation from acute hemorrhage was not possible within the study design.

The use of SI >0.7 as an inclusion threshold and SI ≥ 1.0 for subgroup analysis aligns with established trauma literature from high-income settings. Previous studies have consistently demonstrated that SI >0.7 reflects early hemodynamic instability, while SI ≥ 1.0 is associated with markedly increased risks of hemorrhagic shock, transfusion requirements, physiological decompensation, and mortality.^{2,8,16,23,24} This two-tiered approach enabled sensitive identification of unstable patients while maintaining clinically meaningful stratification consistent with global SI research.

In this cohort, SI ≥ 1.0 was strongly associated with early mortality and accounted for all deaths occurring within 7 days. Multivariate analysis showed that SI ≥ 1.0 , along with low RTS and low GCS scores, were associated with short-term mortality. These findings underscore the prognostic sensitivity of SI in identifying patients at risk of rapid physiological deterioration, even when conventional vital signs may still appear acceptable. The concentration of early mortality within the high SI group may reflect delayed recognition and stabilization of critically unstable trauma patients, a challenge commonly encountered in LMIC settings.

The strong association between SI ≥ 1 and early mortality in this study underscores its practical value as a frontline triage tool. In resource-limited trauma settings where delays in diagnostic imaging, laboratory testing, and specialist review are common, SI provides an immediate physiologic signal identifying patients at high risk of deterioration. The exclusive occurrence of mortality among patients with SI ≥ 1 suggests that this threshold could serve as a trigger for early activation of resuscitation protocols, expedited surgical evaluation for potential sources of bleeding, and prioritization for closer hemodynamic monitoring. Moreover, SI can be recalculated rapidly and repeatedly at the bedside, allowing clinicians to detect trends indicating worsening instability. Integrating SI ≥ 1 into triage algorithms may therefore help reduce preventable delays, ensure timely escalation

of care, and optimize the allocation of limited resources such as resuscitation bays, blood products, and critical care beds.

The anatomical distribution of injuries further supports SI's ability to identify life-threatening trauma. Patients with elevated SI were significantly more likely to have sustained injuries involving the head, chest, and abdomen, regions often affected by high-energy mechanisms and associated with occult internal bleeding. The high SI group also demonstrated significantly longer hospitalization. This finding is consistent with international studies that have reported SI thresholds ≥ 1 to be associated with mortality and prolonged admission.^{2,17,25} However, the multivariate analysis for this study showed that elevated SI was not independently associated with prolonged hospital admission. Importantly, this finding contributes evidence specific to Tanzania, emphasizing SI's value in settings where advanced diagnostics may be delayed or unavailable.⁴

Demographic patterns in this study also mirror global trauma trends. Males constituted the majority of trauma victims, a pattern widely documented in trauma epidemiology.^{2,6-8,26} This disparity most likely reflects greater occupational exposure, engagement in high-risk activities, and disproportionate involvement in road traffic incidents. The mean age of 34.5 years highlights the heavy burden of injury among young adults, a population crucial to national productivity. Similar age distributions have been observed across LMICs, where young men commonly work in informal sectors, transport, and construction, settings associated with high trauma risk.^{2,3,26,27} These patterns underscore the urgent need for targeted injury prevention programs and occupational safety policies, particularly among working-age males.

Motor traffic crashes accounted for over 80% of injuries in this study, a proportion higher than that reported in many regional studies.^{2,15,26,28,29} This likely reflects the unique urban transport dynamics of Dar es Salaam, Tanzania, where a large proportion of young men are employed as commercial motorcycle riders ("boda boda"). The rapid urbanization, inadequate protective infrastructure, and limited enforcement of traffic regulations have contributed to the rising incidence of road traffic trauma in East Africa.^{30,31} These findings reinforce the need for national road safety reforms and protective legislation for high-risk transport workers.

The distribution of injuries revealed a predominance of extremity and head trauma, with more than half of patients sustaining multisystem injuries. This pattern aligns with reports from other LMIC trauma centers.^{1,2,14,15,20} However, injuries involving the chest, abdomen, and pelvic viscera appeared underrepresented in our cohort. This may reflect multiple factors, including referral patterns as well as pre-hospital mortality. Severe thoracic and abdominal injuries are known to carry a high risk of death before hospital arrival, even in well-resourced trauma systems. In settings with limited pre-hospital care infrastructure, this effect may

be further amplified and could contribute to the injury distribution shown in this study.

Although SI is commonly used as an early marker of hemorrhagic shock, it is not specific to hypovolemia. Elevated SI may reflect other forms of hemodynamic instability, including hypovolemic, septic, obstructive, or mixed shock states. In contrast, neurogenic shock, characterized by hypotension with relative bradycardia due to loss of sympathetic tone, may result in a normal or reduced SI despite significant circulatory compromise.

Pain, anxiety, and sympathetic activation can also transiently elevate heart rate and reduce systolic blood pressure, resulting in increased SI values without significant blood loss. In this study, not all patients with elevated SI were anemic, and biochemical markers of hypo-perfusion such as lactate and base deficit were unavailable. Consequently, while high SI strongly correlated with anatomical injury severity and short-term adverse outcomes, it should be interpreted as reflecting circulatory compromise rather than as definitive confirmation of hemorrhage-driven hypovolemia.

Study strengths and limitations

A major strength of this study lies in its prospective design and use of validated trauma scoring systems: SI, NISS, and RTS, measured at the point of care. Real-time data collection in the ED and anatomical scoring confirmed by attending surgeons enhance the internal validity of our findings. To our knowledge, this is among the few prospective studies in sub-Saharan Africa assessing hypovolemic trauma using SI,⁴ thereby contributing important regional data that may inform trauma triage protocols and resource allocation in LMICs.

However, several limitations must be acknowledged. First, as this was a single-center study conducted at a national referral hospital, findings may not be generalizable to district-level or rural facilities where patient profiles and resource availability differ. Secondly, advanced laboratory parameters such as serum lactate and base deficit, which are valuable in shock assessment and risk stratification, were unavailable due to resource constraints.

The time interval between injury and hospital presentation was not systematically recorded, limiting assessment of pre-hospital delay and its potential influence on SI at presentation. Additionally, the very small proportion of elderly adults among the study participants limits the interpretation of SI performance in older populations, for whom predictive accuracy is known to be reduced.

Further, the relatively few outcome events, particularly mortality, may have limited the statistical stability of multi-

variable estimates and contributed to a wide CI. Lastly, the study's follow-up period was limited to 7 days, so complications, disability, or mortality beyond the acute phase were unrecorded.

Conclusion

Elevated SI was common among trauma patients in this setting and served as a useful early marker of haemodynamic compromise. Higher SI values were strongly associated with greater injury severity, anemia, multisystem trauma, and early mortality. SI ≥ 1 , together with low RTS and low GCS, independently predicted death within 7 days, underscoring the prognostic value of simple bedside evaluations in resource-limited trauma environments.

In contrast, prolonged hospitalization was determined by higher NISS and the presence of head injury, highlighting the importance of anatomical injury burden in driving recovery and resource needs. Incorporating SI into triage protocols may improve early risk stratification, while combining SI with anatomical scoring could enhance prediction of longer-term outcomes in sub-Saharan trauma care.

Ethical Approval

Ethical clearance was granted by the Muhimbili University of Health and Allied Sciences Institutional Review Board and Muhimbili Orthopaedic Institute Research Committee.

Informed Consent

Written, informed consent was obtained from all participants or their proxies. Refusal to participate did not affect patient management. The study adhered to the ethical guidelines of the Declaration of Helsinki.

Data Availability

The dataset is available from the authors upon request.

Conflict of Interest

The authors declare no conflicts of interest.

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