Vol. 7 (Iss. 2) 2026, pp. 1352-1361 African Journal of Empirical Research https://ajernet.net ISSN 2709-2607

Clinical characteristics and treatment outcomes among traumatic head injury patients at Embu Level Five Hospital in Kenya

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https://doi.org/10.51867/ajernet.7.2.118

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ABSTRACT

Traumatic head injury (THI) is a major cause of death and disability worldwide, especially in resource-limited areas where more sophisticated diagnostics are not available. Empirical data from local clinical settings on the effect of clinical features on THI treatment outcome in Kenyan regional hospitals is still limited. To analyse the association between clinical characteristics and treatment outcome of patients with traumatic head injury at Embu Level 5 Hospital, Kenya. This study was guided by the three-delay model. A descriptive cross-sectional hospital-based study was conducted using a simple random sampling technique of 240 THI patients out of a total population of 600 patients who were treated from July 2022 to June 2023. IBM SPSS Version 27 was used to analyse the data that was extracted from patient medical records. Chi-square test and Pearson's correlation coefficients were used to analyse the relationship between clinical parameters and treatment outcome. Results: 46.4% of the study cohort were mild, 33.9% were moderate and 19.7% were severe THI. There was a significant relationship between severity of injury and longer hospital stays ($p < .001$). The Glasgow Coma Scale (GCS) scores showed a strong positive correlation with clinical diagnosis ($r = .65$, $p < .001$), with 10.8% of the patients having severe neurological impairment (GCS < 8). The proportion of patients who were maintaining oxygen saturation > 90% was suboptimal at 50.2%, with 34.3% of vital sign data not available at all. In addition, a significant lack of documentation of computed tomography (CT) scans was found, with 51.9% of patients not having a documented CT scan. It can be concluded that low GCS scores and physiological instability at presentation are the most important factors associated with poor treatment outcomes. Major systemic challenges, such as delays in accessing neuroimaging and inconsistent recording of vital signs, greatly impact clinical decision-making and continuous patient monitoring. The study recommends that the hospital should improve its initial triage system to quickly recognise high-risk patients, ensure continuous uniform monitoring of vital parameters, and streamline referral pathways to tertiary neurosurgical centres to minimise delays and maximise survival.

Keywords: Clinical Characteristics, Emergency Triage, Glasgow Coma Scale, Neuroimaging Deficits, Resource Constrained Environment, Traumatic Head Injury, Treatment Outcomes

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I. INTRODUCTION

Deficit of optimal treatment outcomes, patients with severe medical emergencies have irreversible physical and cognitive deterioration, creating an unsustainable strain on health care systems around the world. Turnaround is the key to addressing these long-term deficits and to helping patients survive, and effective clinical management is the foundation for turnaround. In the global context, treatment outcomes in traumatic head injury (THI) are the measurable clinical outcomes of medical intervention such as mortality, days in hospital, and neurologic recovery (World Health Organisatio [WHO], 2019).

This variable is one of great significance as THI affects an estimated 69 million people globally every year and thus, treatment effectiveness must be evaluated to help minimize morbidity and mortality globally (Adegboyega *et al*., 2021). This heavy burden is reflected based on empirical evidence in various healthcare environments. Darnell (2021) did a wide review in both developed and developing countries and concluded that THI is a significant public health crisis and causes huge admissions to the ED. In addition, Messelu *et al*. (2023) and Abebe *et al*. (2024) have reviewed the trend of deaths and concluded that even though medical interventions have been made, THI is still a cause of more than half a million deaths each year, especially in developing countries.

These important treatment outcomes are in part dependent upon the clinical features of the patients at the time of presentation, which may be primary predictors of the trajectory of recovery. Clinical characteristics include physiological measurements like Glasgow Coma Scale (GCS) score, pupillary response, mechanism and type of injury, time to hospital presentation and the presence of co-injuries, which determine the severity of the initial brain injury and the medical response necessary.

These physiological and clinical characteristics associated with injury have been shown in specific studies to be clearly linked to the treatment results obtained. The World Health Organization (WHO, 2019) determined that the initial clinical severity (measured using GCS score) is a major factor in long term neurologic deficits and functional recovery. Moreover, Grände (2017) showed that the clinical mechanism of injury, specifically severe trauma sustained in road traffic crashes directly correlates with higher mortality rate and poorer neurological recovery outcomes than less severe mechanisms of injury. Furthermore, Gerritsen *et al*. (2018) reported that the clinical severity of the injury determines treatment outcomes; they stated that the recovery period for those who had injuries with acute hospital admissions was significantly longer and the number of complications was higher compared to those who had mild injuries treated in primary care.

While these physiological clinical profiles are known to be associated with recovery globally, there is a lack of data outlining the relationship between such profiles and recovery outcomes in resource-limited settings. Knowledge of these relationships is crucial for optimizing interventions for that patient population in a local setting. Hence, in this study the authors intend to investigate the correlation of clinical features and treatment outcome of patients with traumatic head injury in Embu Level 5 hospital in Kenya.

1.1 Statement of the Problem

The timely clinical evaluation of traumatic head injuries is essential to avoid death and disability. In environments where advanced imaging is not available, like Embu Level 5 Hospital, the doctors must make decisions on the first clinical signs of a brain injury, including Glasgow Coma Scale scores, pupillary response, and the nature of the injury. Thus, those with poor clinical signs are at increased risk for suboptimal clinical outcomes such as extended hospitalization, neurologic deficits and mortality. Given these implications, there is a great need for local empirical evidence on the direct links between clinical characteristics and treatment outcomes in Kenyan regional hospitals. Hence, this study was aimed at determining the correlation between clinical factors and treatment outcome of patients with traumatic head injuries at Embu level five hospital to inform on management.

1.2 Objective of the Study

To analyse the association between clinical features and treatment outcome of patients with traumatic head injury at Embu level 5 hospital, Kenya.

II. LITERATURE REVIEW

2.1 Theoretical review

2.1.1 Three Delays Model

This study used a modified version of the "Three Delays" model to explore the obstacles to emergency care of patients with traumatic head injury (THI) at Embu Level 5 Hospital. This model was formulated by Thaddeus and Maine (1994). The first delay is related to the pre-hospital decision-making process in which financial, cultural and awareness barriers hinder the prompt search for medical help (Keating *et al*., 2022). These initial delays directly exacerbate the clinical characteristics of the patient when they arrive: injury severity, neurological deterioration, as well as other factors, are all primary predictors of the final treatment outcomes (Zimmerman *et al*., 2020).

Further contributing to the poor clinical management of these patients is the second and third delay which is transportation to the facility and adequate care once they have arrived. There are delays in transport to definitive care because of inadequate rural infrastructure and the third delay is that at hospital. Lack of adequate specialized staffing, as well as limited diagnostic equipment including CT scan (Mehmood *et al*., 2021), also contribute to inadequate timely interventions that may result in early death and high morbidity at Embu Level 5 Hospital.

Finally, the model can be used as a tool to study the interaction of systemic delays, structural health restrictions, and patient-specific clinical factors in determining the outcome of THI treatment. The study can link these care delays with the clinical picture of the patients at the time of arrival, thus showing the adverse effect of infrastructural and operational delays on survival and neurological recovery. This emphasises the need to undergo extensive changes throughout all phases of emergency care, to ensure that the outcome of treatment of THI patients is optimised in this resource-constrained environment.

2.2 Empirical Review

Pre-existing medical conditions are also important aspects, which affect the treatment results of THI. For instance, intra-cerebral haemorrhage is more likely to occur in patients with hypertension due to poor blood supply to the brain (Stanton *et al*., 2021). Hanafy *et al*. (2021) evaluated the situation of the impact of comorbidities on the THI outcomes in the tertiary care sector of neurosurgery in India. The study was put in the framework of the physiological reserve theory, in which the pre-existing hypertension and diabetes were taken as independent variables and prognosis of patients as dependent variable. These were measured with clinical variables such as baseline HbA1c, blood pressure (BP) and Glasgow Outcome Scale (GOS). Study design used was prospective observational with the study population consisting of 39 head injury patients with comorbidities selected by consecutive sampling. Direct clinical assessment was used to collect the data, which were analysed using descriptive statistics and logistic regression. The study identified that there was a significant impact of co morbidities as only 3/39 patients had a good prognosis. Also, the study is limited by its small sample size which restricts statistical power and the ability to generalise its findings to a very vulnerable clinical group.

Forslund *et al*. (2019) also conducted a retrospective cohort study of 7,489 geriatric patients in the United States and found that pre-existing comorbidities and advanced age were significant factors and that 6.2% of patients died before hospital discharge. Thus, it is important to assess existing conditions and stratify risks for prevention. Although mild TBI (GCS 13-15) is the most common form of TBI, with greater than 90% of patients presenting to hospital in this category, approximately 50% of the adult population with mild TBI do not return to their pre-injury health status within 6 months (Maas *et al*., 2022). In other conditions, such as Parkinson's disease, post injury mortality may be 2.16 times higher (Ilmaniemi *et al*., 2023).

The most important clinical parameter associated with THI outcomes is post-resuscitation GCS. Ogolo and Ibe (2021) reviewed the hospital based emergency and neurosurgical sector of traumatic head injury in Nigeria with a focus on context of predictors of outcome. The acute physiological and chronic health evaluation framework was used in the study, and post-resuscitation GCS, age, and injury mechanism were used as independent variables, while treatment outcome was used as dependent variables. Conceptualization of variables was based on the standard GCS scoring system, patient age (in years), and categorized injury mechanisms. The type of study was cross sectional with study population of 150 trauma patients using systematic random sampling. Clinical data was acquired from the clinical records and analysed using multivariate logistic regression. Results of this study demonstrated that post-resuscitation GCS was the most significant factor that affected the outcome of traumatic head injury. The benefit of this study is that the most important clinical predictor was found, but the cross-sectional study yielded data at only one time, and it does not show how these variables varied throughout the process of recovery. In addition, there may be a small but significant risk of bad outcomes post head trauma for people who are on anticoagulants (Fuller *et al*., 2026).

For the survival of neurons, sufficient oxygen delivery is crucial in the patients with THI. It is influenced by blood pressure, haemoglobin levels, systemic oxygenation and microcirculation (Godoy *et al*., 2023). Main goal of THI management is to keep the CPP within normal range and prevent hypotension and hypoxia and prevent secondary harm. This is done by controlling ICP and mean arterial pressure. Also, existing atherosclerosis can exacerbate neurologic deficits following injury by reducing cerebral blood flow due to the presence of plaques in the arteries. High blood pressure (hypertension) is also a risk factor for cerebral haemorrhage and can worsen cognitive symptoms such as memory loss and executive dysfunction following a THI (Billups *et al*., 2018).

THI is often accompanied by emotional disorders, especially anxiety and depression. 33%–62% of TBI survivors have been found to suffer from post-traumatic stress disorder (PTSD), generalized anxiety, and social anxiety disorders (Koome *et al*., 2022; Kumara & Dhugasa, 2020). Systemic comorbidities including hypertension, diabetes, and cardiac diseases will impact on the physiological response to the post-injury changes and poorer prognosis (Ayton *et al*., 2024). The critical care therapy for moderate to severe TBI focuses on lowering ICP, avoiding hypoxia, managing mechanical ventilation, blood transfusion, nutrition, and seizure prophylaxis (Robinson, 2021). Although new techniques such as brain tissue oxygen (PbtO2) monitoring have been developed to optimize cerebral blood flow, direct ICP monitoring is still necessary for the management of severe THI, in addition to clinical examination and imaging (Udy *et al*., 2025).

The variability of blood pressure is highly associated with outcomes of the patient. Murase et al. (2024) examined the US neurosurgical system landscape of blood pressure variability and hematoma expansion. The study was based on the hemodynamic stress theory, and the independent variable was the systolic blood pressure coefficient of variation (SBPCV) and the dependent variable was hematoma expansion. Operationalization of these was by means of continuous arterial line blood pressure measurements and sequential CT scan volumetrics. The study design was retrospective cohort with study population of 350 neurosurgical patients who were obtained by consecutive sampling. Electronic health records were used to gather data, and Cox proportional hazards models were used for analysis. Results showed that a higher SBPCV was a significant variable associated with a ≥30% chance of hematoma expansion. Although intensive hemodynamic monitoring is one criticism of this study, the single-centre design might not be applicable to hospitals lacking continuous arterial monitoring. The use of percentile targets based on age is recommended over standard targets as admission SBP < 75th percentile is associated with increased hospital mortality in paediatric severe TBI (Suttipongkaset *et al*., 2018).

In addition, high blood pressure variability is associated with decreased odds of hospital discharge in patients with traumatic intraparenchymal haemorrhagic contusions (Maas et al., 2022). In an analytical observational study in Indonesia with 280 patients, Muballe *et al*. (2022) determined that age, initial Glasgow coma scale (GCS), severity of traumatic brain injury (TBI), pupillary response, and major extracranial injuries were important variables that were highly correlated with actual 14-day mortality outcomes. Lastly, Murase *et al*. (2024) showed that quantitative pupillary findings and low GCS were important variables that could be used as good indicators of prognosis in diffuse axonal injury in a prospective diagnostic study of 120 TBI patients in Japan. While literature on clinical parameters exists in abundance, there is a need for literature on the relationship of clinical parameters and patient outcomes in local settings, like Embu Level 5 Hospital.

III. METHODOLOGY

3.1 Study Area

The study was conducted in Embu level 5 hospital (EL5H) Embu County. There is only one level 5 referral hospital in Embu County – EL5H. It receives all referral cases from all other level of care in the county both private and public. It's also getting referrals from neighbouring counties such as Tharaka Nithi, Kirinyaga, Meru and Machakos. Embu Level 5 Hospital has a bed capacity of 618, a total of 317 staffs and 49 support staffs. EL5H has an annual Catchment Population of 73020.

3.2 Study Design

Descriptive cross-sectional type of study was used. This design helps to effectively sample and analyse past THI cases from existing hospital data. It accurately describes THI patients data. It sought to review patients' charts. Records of the patients who had head injuries were retrieved from the files of the patient.

3.3 Study Population

The study population comprised of 600 patients with traumatic head injuries who were treated at Embu County Referral Hospital from July 2022 to June 2023. This was taken from the hospital register.

3.4 Sample size determination

The patients in the study population were obtained from traumatic head injury records. Taro Yamane (1967) formula was used to calculate the required sample size from this finite population, n=N/(1+N(e)2).

3.5 Sampling Technique

Simple random sampling was employed, and 240 patient files were selected from the total population of 600 patient files.

3.6 Data Collection Instruments

Data extraction instrument was a well-structured data collection tool used to collect and structure clinical research data from patients with traumatic head injury in his study.

3.7 Validity and Reliability

Content validity was carried out by having the data collection tool checked by professionals from the field of accident and emergency department. A pilot study was carried out with 24 medical records (10% of the proposed sample size) from June 2020 to June 2021. This pre-testing process was essential to discover any possible inconsistencies, ambiguities or flaws in the design of the tool.

3.8 Data Analysis

Data analysis was done in a systematic manner in addressing the research purposes and answers to the research questions. All the data retrieved from the patient's records within Embu level 5 Hospital were analysed in IBM SPSS Statistics for Windows, version 27.0. Pearson's correlation coefficient (r) was used to examine the relationship with treatment between the continuous clinical variables (i.e. Glasgow Coma Scale (GCS) scores and blood pressure). This was selected to measure the magnitude and direction of linear relationships between interval level variables (Cohen *et al*., 2013). The results were given in tabular form, graphs and pie charts for proper and clear communication of results.

3.9 Ethical Considerations

This study was done following the ethical rules. This study got ethical clearance from the Mount Kenya University Ethics Committee with reference number MKU/ISERC/4309. The study was conducted with a license from National Commission for Science, Technology and Innovations (NACOSTI) No. NACOSTI/P/24/39737. Access to information from the hospital was granted by the medical superintendent of Embu Level 5 hospital based on the letter number EL5H/ADM/VOL.IV(157). All data obtained from the patient records was anonymised to conceal patients, thus ensuring confidentiality.

IV. RESULTS AND DISCUSSION

4.1 Results

4.1.1 Clinical Diagnosis on Admission

The clinical severity of the injuries at the time of admission are described in percentages as shown in Figure 1.

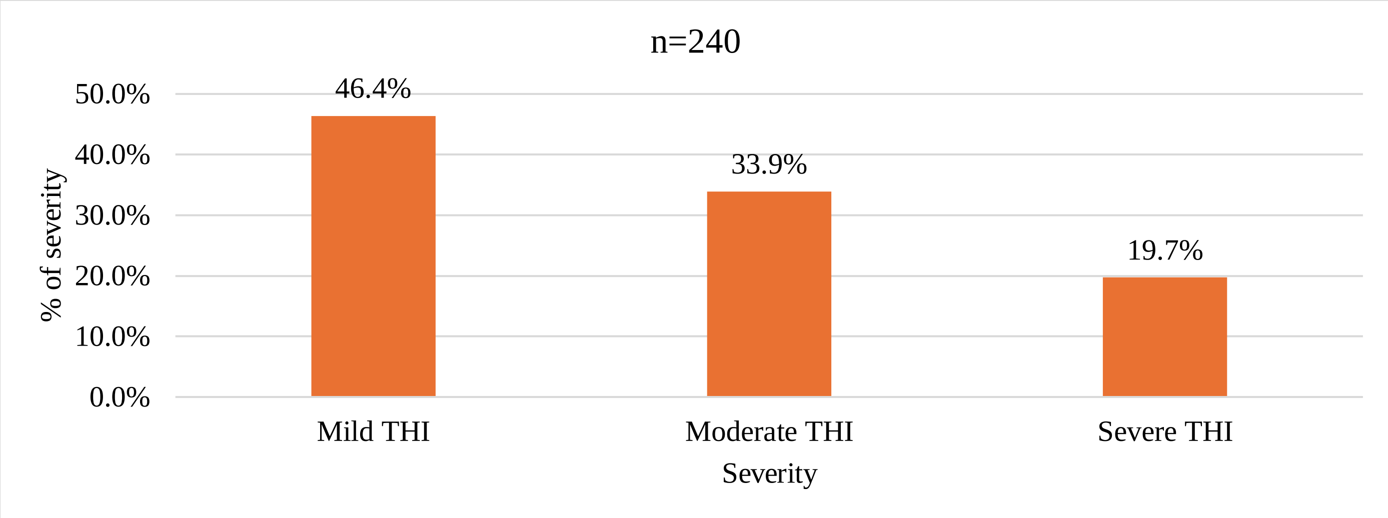

Figure 1
Clinical Diagnosis at Admission

At admission, 46.4% (n = 111) of the patients were diagnosed with mild THI, 33.9% (n = 81) with moderate THI, and 19.7% (n = 47) with severe THI. There was a very highly significant association between clinical diagnosis severity and LOS, chi square (6) = 177.30, $p < .001$.

4.1.2 Glasgow Coma Scale (GCS) Scores

The distribution of GCS score on admission is shown in Figure 2.

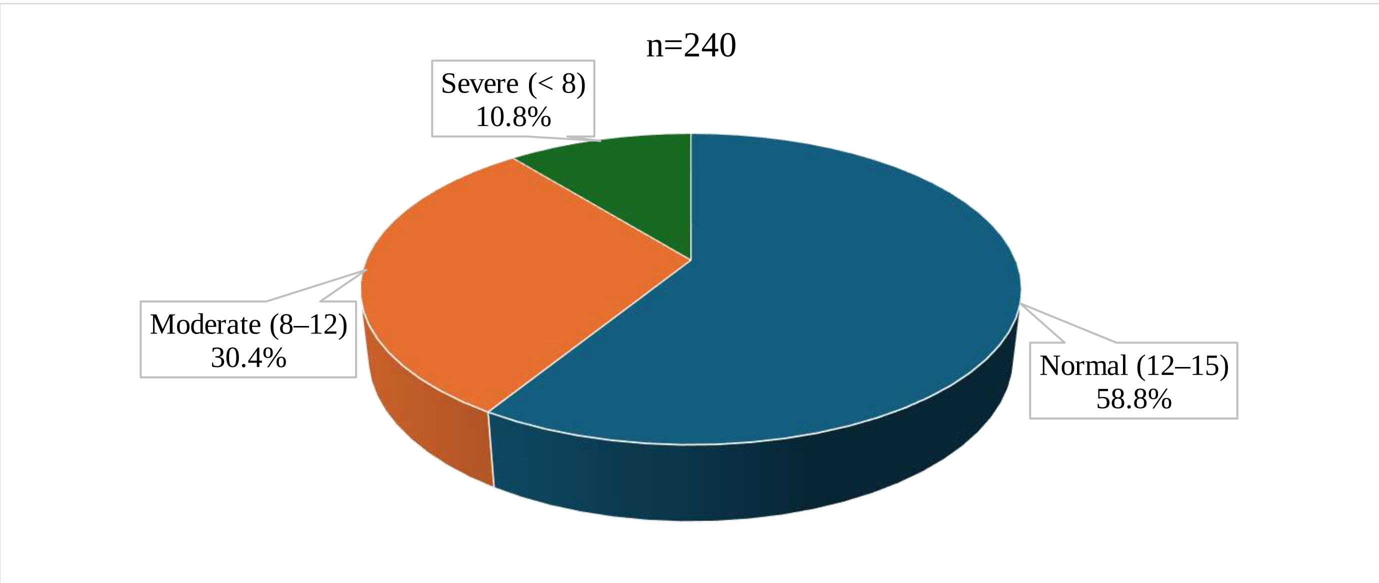

Figure 2
Glasgow Coma Scale Scores at Admission

Most patients had normal neurological functions (GCS 12-15, 58.8% (n = 141)). Moderate neurological impairment (GCS 8-12) was seen in 30.4% (n = 73) and severe neurological impairment (GCS < 8) in 10.8% (n = 26).

Pearson correlation was used to determine the relationship between GCS scores and clinical diagnosis. There was a highly significant positive correlation between GCS score and clinical diagnosis of injury severity ($r = .65$, $p < .001$).

4.1.4 Oxygen Saturation

Descriptive analysis shows that 50.2% (n = 119) of the patients assessed while maintaining oxygen saturation levels > 90% as shown in Figure 3. In the remaining the data on hypoxia or missing inconsistently was recorded.

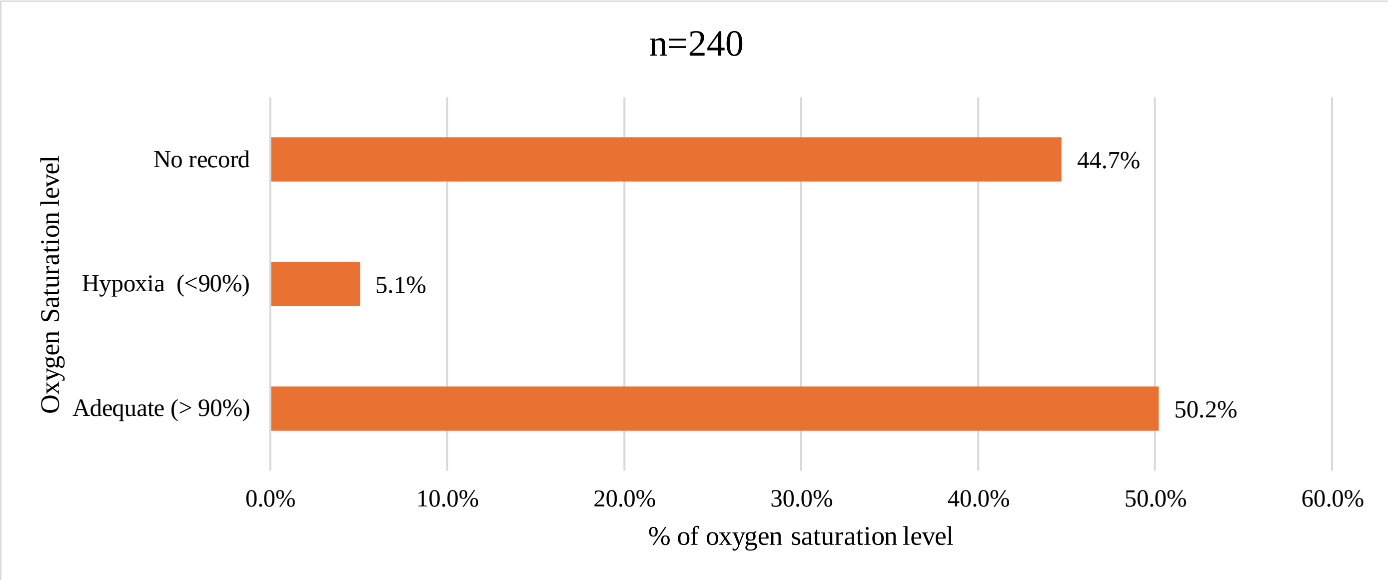

Figure 3
Oxygen Saturation Levels in THI Patients

4.1.5 Neuroimaging (CT/MRI) Reports

Diagnostic ability was very limited: 51.9% (n = 122) of patients did not have a CT scan performed or recorded. Among those who had imaging, 23.4% (n = 55) had normal imaging, 16.2% (n = 38) had incidental imaging findings unrelated to the presentation and 8.5% (n = 20) had imaging findings of intracranial haemorrhage. In Figure IV, the use and results of neuroimages are emphasized.

There was a significant lack of diagnostic capability, with 51.9% (n = 122) of patients not having a CT scan performed or recorded. Of those who had imaging, 23.4% (n = 55) had normal imaging, 16.2% (n = 38) had incidental imaging findings unrelated to the presentation, and 8.5% (n = 20) had imaging findings of intracranial haemorrhage. The utilization and findings of neuroimaging are highlighted in Figure IV.

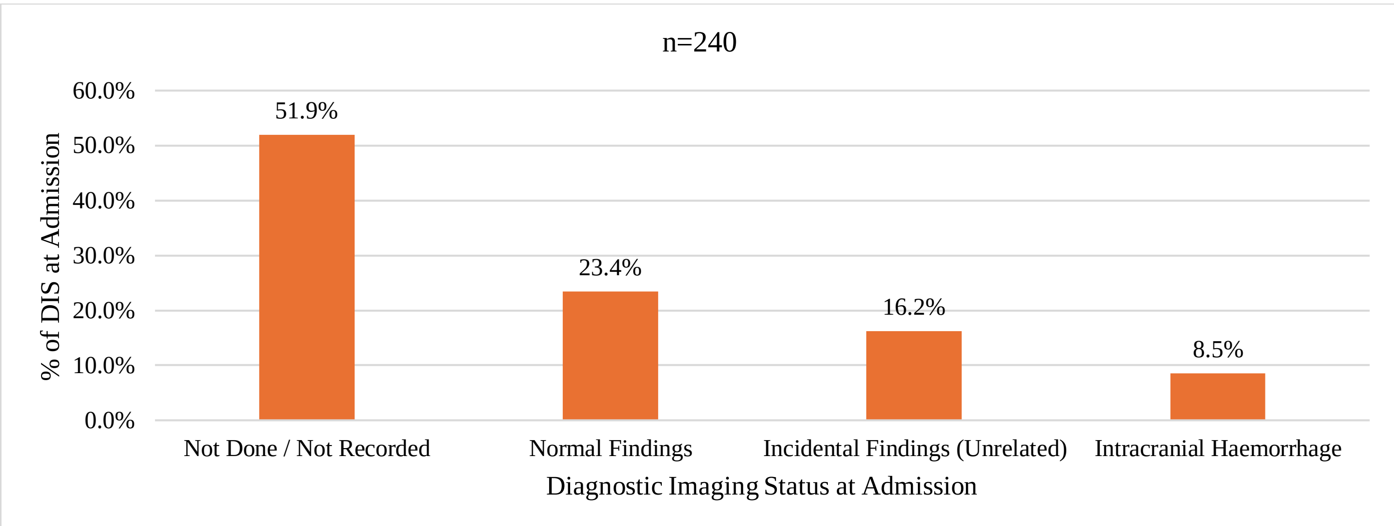

Figure 4
Neuroimaging reports of THI patients

4.1.5 Physiological stability and clinical management cross tabulation

The crosstabulation of respiratory rate, blood pressure, pulse rate which is very important in determining the physiological stability of the traumatic head injury patients at Embu Level 5 Hospital for identification of critical cases that need urgent intervention is shown in Table 1.

Table 1
Respiratory rate and blood pressure and pulse rate are cross tabulated

Pulse Rate (bpm)	Blood Pressure: Normal	Blood Pressure: Low	Blood Pressure: High	Not Recorded	Total
< 60	0	0	1	0	1
60–100	71	4	7	10	92
> 100	12	5	1	2	20
Not Recorded	51	5	0	70	126
Total	**134**	**14**	**9**	**82**	**239**

Vital signs distribution revealed that most of the patients documented had normal vital signs (e.g., normal blood pressure and pulse 60-100 bpm) while 8.4% (n=20) had tachycardia and 9.6% (5.9% low, 3.8% high) had abnormal blood pressure. This was in line with the 58.8% of mild THI cases (GCS 12-15).

4.2 Discussion

The study group had a diverse range of THI severity at admission, with 46.4% mild, 33.9% moderate, and 19.7% severe THI. Clinical injury severity was strongly correlated with length of stay (LOS) highlighting the importance of injury severity as the first tenet of resource use and recovery course. This distribution indicates that although the facility is very effective in managing the large number of mild patients, the heavy resource utilization of severe patients could be a challenge for the facility for inpatient management. The clear severity gradient of the clinical spectrum emphasises the importance of quick and accurate triage at presentation at the emergency department for best use of available ward and intensive care unit (ICU) beds. Results are in line with the existing literature on trauma care in Kenyan county facilities. The distribution of severity was also comparable to that found by Ojakapeli *et al*. (2025) in the referral hospitals of western Kenya, where the severe injuries disproportionately lead to the use of intensive care. Moreover, Koome *et al*. (2022) found that clinical severity on presentation is the most important predictor of prolonged LOS and death at all Kenyan public hospitals. The high proportion of severe THI in this study indicates a substantial clinical burden, with cases often requiring advanced care and neurosurgical interventions including those not readily available at the county level, which often entails complex inter-facility transfers as observed by Mukindu *et al*. (2025) at Meru Teaching and Referral hospital.

On admission, 58.8% of patients had normal neurological function (GCS 12–15), 30.4% had moderate and 10.8% had severe neurological impairment. The high correlation (statistically significant) between Glasgow Coma Scale (GCS) score and the clinical diagnosis of injury severity reflects the GCS as being a good reliable stratification tool in this context. This is in line with Saleeby *et al*. (2019) who found the GCS to be the most accurate initial severity assessment tool in the major trauma hospitals in Nairobi and Koome *et al*. (2022) who found that low initial GCS is an independent predictor of mortality and prolonged hospitalization. Of particular significance is the high prevalence of severe impairment (GCS < 8) at 10.8%, as this is an extremely vulnerable group at high risk of airway compromise; raised ICP and rapid neurological deterioration. This means patients need continual specialist monitoring which cannot be provided on a general ward (as stated by Chelogoi (2019)). It is imperative to have a standard of care for early airway management and early neurological stabilization at the county hospital level to avoid secondary brain injury.

For primary physiological stabilization, only 50.2% were recorded with oxygen saturation (SpO2) greater than 90% on initial assessment, suggesting there was a high prevalence of hypoxia or poor documentation of this. Hypoxia is a powerful secondary insult which can cause ICP to rise exponentially and worsen neurologic deterioration after primary brain injury. The suboptimal SpO2 levels reported correlate with trends reported across the region; Koome *et al*. (2022) found admission hypoxemia to be one of the most important independent risk factors of death in Kenyan trauma centres and Saleeby *et al*. (2019) reported early deaths in the ED to be associated with poor initial resuscitation. Additionally, the significant amount of missing or inconsistent SpO2 data suggests a widespread issue with consistent SpO2 monitoring. Inconsistent recording of basic physiological parameters was also cited by Mukindu *et al*. (2025) as a significant process barrier which hides signs of secondary brain injury. The results in this study underscore the importance of systematic and regular physiologic monitoring in resource-limited environments to prevent secondary brain injury.

The diagnostic records review showed that there was a significant lack of imaging capacity, especially computed tomography (CT) scans (51.9% of patients did not have one documented). Only 8.5% of those that were imaged had intracranial haemorrhage. Without timely CT imaging, the physician has to rely on clinical examination, and this greatly restricts the ability to detect expanding intracranial haemorrhage and delays life-saving neurosurgical procedures. The lack of an onsite CT scanner is well documented in Kenyan county hospitals, for example, Mukindu *et al*. (2025) noted that a CT scanner was missing at Meru Teaching and Referral Hospital leading to delays in diagnosis and hence increased mortality. Likewise, Ojakapeli *et al*. (2025) and Shisoka *et al*. (2019) found that lack of local neuroimaging leads to high-risk referral, and longer hospital stay because of diagnostic uncertainty which may lead to premature discharge of deteriorating patients. A key limitation in the study cohort was the availability of CT data in only 48.1% of cases, reflecting an important systemic limitation that requires the establishment of specific facilities for neuroimaging to assure adequate triage and timely neurosurgical care.

Finally, although most patients were euvolemic, a significant proportion had tachycardia (8.4%) or abnormal blood pressure (9.6%) consistent with systemic stress and/or shock. Worse, 34.3% of vital signs data were completely missing in medical records. Hemodynamic instability, especially hypotension, is a critical reduction in cerebral perfusion pressure which results in the ischemic secondary brain injury, and tachycardia can be a clue to compensatory mechanisms in hypovolemia. Admission hemodynamic instability is a strong independent predictor of death and aggressive fluid resuscitation is necessary, as shown by Koome *et al*. (2022). The high proportion of missing data is consistent with regional estimates by Chelogoi (2019) and Mukindu *et al*. (2025) that poor routine documentation in Kenyan critical care units is a systemic issue that hinders timely interventions. The fact that there were documented derangements in the hemodynamic and the lack of information for a lot of the other parameters highlights that there is a huge lack in routine clinical monitoring. To prevent secondary ischemic injury and to maximise overall survival at Embu Level 5 Hospital, it is imperative to have established standardised early monitoring and resuscitation protocols for haemodynamic.

V. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study concludes that clinical severity of the injury at the time of initial presentation is the most important and consistent predictor of outcome of treatment for patients. Low Glasgow Coma Scale (GCS) score on admission and some intracranial diagnosis and physiologic instability is highly associated with poor outcomes like prolonged hospital stay, long-term complications and death. Importantly, there is an acknowledged barrier regarding the access to advanced diagnostic imaging (CT/MRI) for best clinical decision making. There is a lack of timely neuroimaging, leading to delayed interventions and unnecessary referrals and preventable clinical deterioration, of moderate to severe cases. Further, it is difficult to continuously monitor the physiology required for optimal care of the neurotrauma patient because of the lack of uniformity in recording vital signs.

5.2 Recommendation

The hospital should enhance its first point of contact triage system to rapidly recognise those with a low GCS (coma score) and/or those that are physiologically unstable. Formalized and expedient referral systems with tertiary neurosurgical centres are important to facilitate prompt referral of such severe cases and decrease the "third delay" and increase chances of survival.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding Declaration

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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