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Association of Injury Severity Score to Mortality and Length of Hospital Stay in Polytrauma Patients

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Abstract

Background

Polytrauma is an important cause of morbidity and mortality internationally and is frequently caused by road traffic accidents, falls from height and industrial injuries. Accurate assessment of injury severity is important to help predict injury outcomes, best utilize resources, and help optimize trauma management strategies. The Injury Severity Score (ISS) is a commonly accepted scoring system that is used to measure the overall severity of injuries in polytrauma patients. Despite evidence of its use, there is still a need for the evaluation of the association of ISS with clinically relevant outcomes, especially mortality and length of hospitalization, in diverse patient populations.

Objective

The main aim of this study was to examine the correlation between the ISS and mortality in the polytrauma patient. The secondary objective was to determine the correlation of ISS and hospital stay and gain information about resource utilization and prognosis in trauma care.

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Methodology

A prospective observational study was performed in the Lady Reading Hospital, Peshawar between August 2024 and August 2025. Polytrauma patients aged 18 years and above, presenting with injuries of multiple anatomic regions to the emergency department, were considered. Patients who had isolated injuries, incomplete records or pre-existing terminal illnesses were excluded. Demographic data, clinical parameters, ISS, duration of hospital stay, and mortality outcome were registered. Statistical analysis was done to analyze the relation between ISS and mortality and hospital stay, correlation analysis and regression analysis.

Results

A total of patients that met the inclusion criteria were enrolled. The mean ISS was found to be proportional to mortality rates thus showing the significant positive correlation. Higher ISS was also found to be associated with a longer length of hospital stay reflecting resource utilization severity of injury. Subgroup analysis showed that patients with ISS above the cutoff of 25 had significantly higher mortality and longer hospitalization than those with low scores. These findings demonstrate its predictive validity in clinical decision-making and outcome assessment in polytrauma management.

Keywords

Injury Severity Score, Polytrauma, Mortality, Hospital stay, Trauma surgery

Introduction

Polytrauma, where injuries affect several parts of the body, is one of the leading causes of morbidity and mortality globally, especially among the young and productive population. Globally, trauma can be a leading cause of death, responsible for more than 5 million deaths worldwide annually, which is almost 9% of the world's mortality, with patients of polytrauma forming a major part of this mortality. The burden of trauma is disproportionately greater in low- and middle-income nations because of factors including rapid urbanization, high vehicular density, lack of pre-hospital care and inadequate trauma-related infrastructure.

In Pakistan, the number of polytrauma cases is steadily increasing, which is mainly the result of road traffic accidents, falls from height, industrial and occupational trauma and interpersonal violence. These injuries occur at high speeds and often involve several organ systems resulting in complex clinical presentations where immediate and multidisciplinary care is required. Effective management of polytrauma relies on quickly assessing and averting complications. One of the most important factors determining patient outcome is the severity of injuries incurred, including mortality, morbidity, hospital resource use, and long-term functional outcome. Accurate and timely determination of injury severity

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provides clinicians the chance to prioritize intervention, optimize allocation of intensive care resources, and reduce preventable deaths.

Various scoring systems have been developed for this purpose, among which the Injury Severity Score (ISS) has been practiced in the most accepted and validated form globally. Introduced in about 1970, the ISS is a specific method that rates the severity of trauma by examining injuries to six areas of the body including the head and neck, face, chest, abdomen, extremities and external structures. Each injury receives an Abbreviated Injury Scale (AIS) score ranging from 1 (minor) to 6 (unsurvivable), and the ISS is determined by squaring the three worst AIS scores from different body regions and adding them up. The scores spoken on the ISS range from 0 to 75, with the higher score indicating more severe trauma. An ISS of >15 is generally considered to indicate major trauma requiring advanced trauma care and multidisciplinary management.

Previous research has shown a significant correlation between ISS and important clinical outcomes such as in-hospital mortality, requirement for surgical intervention, intensive care unit (ICU) admission, and hospital length of stay. International research, for example, Flum and Koepsell (2002), has proven that patients with higher ISS not only have a higher mortality rate, but also need longer hospitalization, complex interventions, and an increased amount of healthcare resources. Likewise, Atema et al. (2025) stressed that ISS is a reliable tool for risk stratification, clinical decision-making, and trauma system evaluation.

Despite the wealth of evidence from developed countries, there is a paucity of comprehensive data on the applicability of ISS in the trauma populations of Pakistan where demographic profiles, mechanisms of injury, and healthcare infrastructure are very different from those of Western countries. The mechanism of injury is also an important factor in the severity of trauma. High-energy mechanisms such as road traffic accidents and falls from a significant height tend to cause multiple critical injuries, increased ISS, as well as poor outcomes. In contrast to this, low-energy mechanisms may result in a less severe polytrauma with lower ISS and better prognosis. Additionally, patient-related factors such as age, comorbidities, and physiological reserve also have an effect, hinting at the need for region-specific validation of the ISS in predicting mortality and hospital stay.

While the definitive value of using ISS in estimating the severity of trauma is established, combining its use with elements of clinical judgment, as well as complementary scoring systems such as the Revised Trauma Score (RTS) or the Trauma and Injury Severity Score (TRISS), could provide increased predictive and individual patient management value. This study was carried out to address the gap of region-specific data regarding the association of ISS on clinically important outcomes, i.e., mortality and length of hospital stay for polytrauma patients at Lady Reading Hospital, Peshawar. By providing evidence from a tertiary care center in Pakistan, the aim of this research is to support clinicians in early risk stratification and inform protocols for trauma management, as well as aid hospital administrators in planning resource allocation. Furthermore, understanding the relationship between ISS and patient

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outcomes may aid in the development of standardized trauma care pathways, reduce patient preventable deaths, and improve the overall quality of care. Ultimately, this study adds to the growing number of studies highlighting the usefulness of the ISS as an important tool in assessing trauma, focusing on its role in guiding clinical decision-making and in optimizing patient outcomes across various healthcare settings.

Methodology

Study Design and Setting

This study was carried out as a prospective observational study at Lady Reading Hospital (LRH), Peshawar, a major tertiary care center in Khyber Pakhtunkhwa province. LRH is a high-volume trauma referral center and deals with patients from both urban and rural settings presenting with road traffic accidents, occupational injuries, falls, and assault-related trauma. The hospital offers comprehensive trauma care facilities such as emergency management, surgical intervention, intensive care units (ICUs), and rehabilitation that make it an ideal place for evaluating the outcomes of polytrauma.

The study was conducted during the period of twelve months from August 2024 to August 2025 for a sufficient number of patients to be enrolled and followed. The prospective nature of the study ensured that clinical data was collected in real time, that injury severity was assessed uniformly, and outcomes were recorded accurately so recall bias and data inconsistency would be minimized.

Study Population

The study included adult polytrauma patients (aged 18 years and above) presenting to the emergency room. Polytrauma was considered to be injuries involving two or more anatomical regions conforming to internationally accepted definitions.

Methodological Framework and Parameters

Parameter	Description
Study Setting	Lady Reading Hospital (LRH), Peshawar
Study Period	August 2024 - August 2025 (12 Months)
Study Population	Adult polytrauma patients (Age >= 18)
Total Sample Size	312 Patients
Scoring Tool	Injury Severity Score (ISS) via AIS categorization

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Anatomic Regions	1. Head/Neck, 2. Face, 3. Chest, 4. Abdomen/Pelvis, 5. Extremities, 6. External

Inclusion and Exclusion Criteria

- Inclusion: Adult patients aged 18 years or older presenting with polytrauma involving multiple body regions.
- Inclusion: Presentation within 24 hours of the time of injury to ensure accurate acute ISS assessment.
- Inclusion: Informed consent obtained from the patient or a legally authorized representative.
- Exclusion: Patients who have isolated single-region injuries.
- Exclusion: Patients with pre-existing terminal illnesses (e.g., advanced malignancy) which could confound clinical outcomes.
- Exclusion: Patients who died before getting into the hospital (pre-hospital deaths).
- Exclusion: Incomplete medical records or missing data which precluded calculation of a definitive ISS.

A total of 312 patients met the inclusion criteria and were successfully enrolled, with complete follow-up data registered until the time of hospital discharge or death.

Data Collection Procedures

Upon arrival, each patient was initially assessed by the trauma team based on the Advanced Trauma Life Support (ATLS) guidelines (airway, breathing, circulation, disability, and exposure [ABCDE] evaluation). Demographic data (age, sex), mechanism of injury (road traffic accident, fall from height, industrial/occupational injuries, assault), and a suite of comorbidities (hypertension, diabetes, cardiovascular disease) were recorded.

Clinical parameters monitored included vital signs (blood pressure, heart rate, respiratory rate, oxygen saturation), Glasgow Coma Scale (GCS) score, laboratory tests (complete blood count, electrolytes, renal and liver function tests), and imaging as indicated (X-rays, CT scans, ultrasound).

Injury Severity Assessment

The Injury Severity Score (ISS) was calculated for each patient to quantify trauma severity. Injuries were categorized using the Abbreviated Injury Scale (AIS) across six anatomic regions: 1) Head and neck, 2) Face, 3) Chest, 4) Abdomen and pelvic contents, 5) Extremities and pelvic girdle, and 6) External structures. The top three highest AIS scores from different body regions were squared and added to give the ISS, ranging from 0 to 75. Threshold levels were defined as follows: Severe trauma (ISS >= 25), Moderate trauma (ISS 16-24), and Mild trauma (ISS < 16). Independent verification of the calculations was done by two senior trauma surgeons to guarantee absolute accuracy and reliability.

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Outcome Measures

- Primary Outcome: Mortality (In-hospital death or death occurring within 30 days of discharge in case of readmission).
- Secondary Outcomes: Length of hospital stay (determined from the date of admission to the date of discharge or death), ICU admission, requirement for mechanical ventilation, number and types of surgical interventions, and post-operative complications (such as infections, organ failure, thromboembolism, etc.).

Ethical Considerations

The study protocol was approved by the Institutional Ethical Review Committee at Lady Reading Hospital. Written informed consent was obtained from all participants or their legally authorized representatives. All data were strictly de-identified, and patient confidentiality was preserved throughout. Management and standard of care were dictated purely by patient clinical needs and hospital protocols.

Statistical Analysis

Data were entered and processed using Version 25 of the Statistical Package for Social Sciences (SPSS). Continuous variables, such as age, ISS, and length of hospital stay, were presented as mean +- SD or medians (interquartile range) depending on distribution. Categorical variables were summarized by frequencies and percentages. Correlation analysis between the ISS and length of hospital stay was performed using Spearman's correlation coefficient. The association of ISS with mortality was analyzed using Chi-square tests for categorical groups, and multivariate logistic regression analysis was executed to control for compounding/confounding factors including age, comorbidities, and mechanism of injury. A p-value of <0.05 was considered statistically significant.

Quality Assurance

To guarantee data integrity: Double entry verification was performed to eliminate data entry errors; independent review of ISS calculations was conducted by two separate trauma surgeons; regular standardization meetings were held with the research team regarding data collection protocols.

Results

Demographic Profile

A total of 312 polytrauma patients were included over the one-year study period. The demographic profile showed a significantly higher percentage of males: 210 patients were male (67.3%) and 102 were female (32.7%). The mean age of the study subjects was 35.8 +- 14.6 years, with a range of 18–78 years. The majority of patients (42%) were between 21 to 40 years of age, confirming that polytrauma primarily affects the young, economically productive segment of the population.

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Mechanism of Injury

The mechanisms of injury varied, aligning closely with regional trauma epidemiology. High-energy mechanisms, particularly road traffic accidents, were consistently linked to higher ISS scores and increased clinical severity.

Mechanism of Injury	Frequency (n)	Percentage (%)
Road Traffic Accident (RTA)	171	55%
Falls from Height	87	28%
Industrial/Occupational	31	10%
Assaults	22	7%

Distribution of Injury Severity Score (ISS)

The mean ISS of the study cohort was 21.4 +- 9.2. When categorized by severity level, the distribution was as follows:

- Mild trauma (ISS < 16): 108 patients (34.6%)
- Moderate trauma (ISS 16-24): 122 patients (39.1%)
- Severe trauma (ISS >= 25): 82 patients (26.3%)

Analysis revealed that higher ISS values were significantly associated with male gender and road traffic accidents, whereas falls and occupational injuries were generally associated with lower relative baseline scores. Among older patients (>60 years), even moderate values of ISS were associated with high clinical risks, suggesting an age compounding effect.

Mortality Outcomes

Overall, 38 patients (12.2%) died while in the hospital. The breakdown of mortality rates categorized by injury severity highlights an incremental risk gradient:

ISS Category	Severity Level	Mortality Rate (%)	Number of Deaths
ISS < 16	Mild	1.9%	2

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ISS 16 - 24	Moderate	9.8%	12
ISS >= 25	Severe	29.3%	24

The results of the Chi-square test indicated a highly significant statistical link between the ISS score and patient mortality ($p < 0.001$). Furthermore, logistic regression analysis (adjusted for age, gender, comorbidities, and mechanism of injury) showed that patients with an ISS of 25 or more had 6.8 times higher odds of dying compared to those with an ISS less than 16 (95% CI: 3.2-14.5, $p < 0.001$). Subgroup analysis also revealed that elderly patients (>60 years) with a high ISS experienced a disproportionately high mortality rate of 36%, compared to 28% observed in younger cohorts with similar scores.

Length of Hospital Stay and Resource Utilization

The overall mean length of hospital stay for the entire cohort was 12.6 +- 7.4 days. Hospital stay length expanded profoundly alongside structural injury severity:

- Mild trauma (ISS < 16): 7.8 +- 3.2 days
- Moderate trauma (ISS 16-24): 11.9 +- 5.1 days
- Severe trauma (ISS >= 25): 18.4 +- 8.3 days

Correlation analysis demonstrated a strong positive correlation between ISS values and total hospitalization duration (Spearman's rho = 0.68, $p < 0.001$). Patients suffering from severe trauma required significantly higher levels of healthcare resource utilization, characterized by: ICU admission required in 76% of severe cases, mechanical ventilation needed in 34% of cases, and multiple complex surgical procedures or revisions occurring in 69% of severe cases.

Surgical Interventions and Postoperative Complications

Among the total 312 patients, 212 (68%) required major surgical procedures. Common categories of surgeries included:

- Orthopedic fixation (extremity/pelvic fractures): 102 patients
- Laparotomy (abdominal/visceral injuries): 78 patients
- Thoracic interventions (chest tube placement, thoracotomy): 32 patients

Postoperative complications were documented in 64 patients (20.5%), displaying a direct proportional increase corresponding to higher baseline ISS scores:

- Surgical site infections: 28 patients
- Organ failure: 15 patients
- Respiratory complications requiring prolonged ventilation: 13 patients
- Thromboembolic events: 8 patients

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Mechanism-Specific Outcomes

Cross-tabulation of outcomes according to the underlying trauma mechanism indicated clear severity trends:

Mechanism of Injury	Mean ISS (+- SD)	Mortality Rate (%)
Road Traffic Accident (RTA)	24.1 +- 9.6	16%
Falls from Height	20.3 +- 7.8	11%
Industrial / Assault	17.5 +- 6.2	6% - 7%

Discussion

Polytrauma remains a major problem for healthcare systems throughout the world, especially in developing countries such as Pakistan which experience increased urbanization, higher vehicular traffic density, and limited trauma infrastructure. This prospective study established a clear, statistically strong association between Injury Severity Score (ISS) and key clinical endpoints—mortality and hospital stay length—among polytrauma patients admitted to Lady Reading Hospital, Peshawar. Our findings confirm that ISS acts as an invaluable independent risk-stratification tool within developing tertiary healthcare environments.

In our study, in-hospital mortality expanded sequentially across mild (1.9%), moderate (9.8%), and severe (29.3%) trauma groups. The adjusted logistic regression model proved that high ISS represents an independent predictor of fatal outcomes, irrespective of baseline demographic variations or pre-existing comorbidities. These insights strongly align with international benchmarks set by Atema et al. (2025) and Flum & Koepsell (2002), which underscored the robust predictive validity of structural scoring. Structurally, higher scores indicate simultaneous multi-system compromise, forcing catastrophic physiological collapse and hemodynamical exhaustion, which naturally results in heightened mortality rates.

Additionally, our data highlights an alarming vulnerability within elderly cohorts (>60 years) and individuals carrying multiple comorbidities, reflecting patterns previously documented by Hajibandeh et al. (2022). Older patients possess diminished physiological reserve, rendering them far more susceptible to secondary systemic complications even at moderate ISS tiers.

Regarding hospitalization metrics, our analysis revealed a strong positive correlation (Spearman's rho = 0.68), with severe cases averaging an extensive 18.4 days in inpatient care. This extended timeline is

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directly tied to complex operational requirements, high ICU admission rates (76%), and mechanical ventilation support. These utilization rates mirror findings by Bhangu et al. (2015) and Chong et al. (2010), reinforcing how a high injury burden delays physiological recovery and expands health-associated institutional costs.

Clinical and Administrative Implications

Integrating baseline ISS into clinical care protocols yields several core benefits: first, it offers an objective framework to stratify and prioritize high-risk multi-trauma presentations within highly congested emergency rooms; second, it assists surgical decision-making regarding early definitive interventions versus conservative critical stabilization; third, it enables realistic prognostic discussions with patient families, establishing practical expectations around length of stay and potential recovery trajectories. For hospital administrators, routine ISS tracking facilitates optimized bed-turnover algorithms, efficient ICU resource mapping, and proactive rehabilitation service planning.

Strengths and Limitations

A major strength of this study is its prospective execution, allowing for real-time tracking, standardized scoring verification by senior surgeons, and minimal recall error. Conversely, primary limitations include its single-center setting, which restricts broader regional extrapolation, and the exclusion of pre-hospital fatalities, which potentially underestimates the total regional mortality burden. Furthermore, while ISS evaluates anatomic injury brilliantly, it lacks real-time physiological status integration, suggesting that future clinical models should combine it with dynamic scoring indicators like the Revised Trauma Score (RTS).

Conclusion

This study demonstrates a precise, significant, and clinically valuable association between the Injury Severity Score (ISS) and both mortality and length of hospital stay in polytrauma patients at Lady Reading Hospital, Peshawar. Patients presenting with an ISS >= 25 carry a significantly higher risk of in-hospital death and experience extended hospitalization periods. These results confirm the value of the ISS as an objective, reliable tool for risk stratification and outcome prediction in acute trauma management.

Furthermore, patient-specific variables such as advanced age, underlying comorbidities, and high-energy impact mechanisms (particularly road traffic accidents) drastically worsen clinical outcomes, manifesting as elevated mortality and increased healthcare resource utilization. Clinically, the routine calculation of ISS upon admission is highly recommended for all multi-trauma patients to improve early risk detection, optimize critical care resource allocation, and enhance data-driven decision-making across healthcare networks in Pakistan.

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