

AMERICAN UNIVERSITY OF BEIRUT

THE USE OF INJURY SEVERITY SCORE (ISS) TO ASSESS THE
ECONOMIC BURDEN OF TRAUMA AT A TERTIARY CARE
CENTER IN BEIRUT, LEBANON

by
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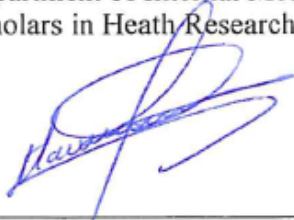
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AN ABSTRACT OF THE THESIS OF

Mohamad Khaled Nasser for Master of Science
Major: Health Research (SHARP)

Title: The Use of Injury Severity Score (ISS) to Assess The Economic Burden of Trauma at a Tertiary Care Center in Beirut, Lebanon

Background: According to the Global Burden of Disease Study (GBD) in 2017, injuries are one of the leading causes of death and have accounted for 4.48 million deaths worldwide. It is also a disease of the youth. All injuries, regardless of the mechanism or category, were higher in the age group of 15-49 years. Injuries account for 10.1 % of all-age all-cause Disability-Adjusted Life Year (DALY) at 252 million DALYs. In addition to the significant mortality and morbidity, injuries have significant economic burden in both developed and developing countries. The costs of injuries that result in a fatality were in the order of €1–6 billion euros in Europe in 2007, and when non-fatal injuries are included, this could rise to €290 billion. Even though organized trauma care systems were established within the health care systems of many developed countries and were effective in reducing the number of preventable trauma deaths and injury incidence, two thirds of the total injury deaths are still occurring today in developing countries. Few studies have performed an economic assessment in low and middle income countries (LMIC). To address the extent and burden of trauma, various models of injury scores were developed. The Injury Severity Score (ISS) is an established medical score to assess trauma severity that has been validated across different types of trauma, and has proven to be reproducible across various studies. The ISS based on Abbreviated Injury Scale (AIS) has been the gold-standard to assess trauma severity. A major trauma (or polytrauma) is defined as the Injury Severity Score being greater than 15. To our best knowledge, our study is the first to investigate the role of ISS in predicting the economic burden of trauma in Lebanon. Specifically, it will address the cost of care in the emergency department and in-hospital stay, in addition to the length of stay, at the American University of Beirut Medical Center (AUBMC), a tertiary care center in Beirut, Lebanon. The study aims to reflect on this association taking into consideration important clinical variables.

Hypotheses: Our hypotheses are: (1) the increase in the severity of trauma, reflected by an increase in ISS score, will be significantly associated with the increase in the acute cost of care of patients admitted to the hospital through the emergency department (ED); (2) the increase in the severity of trauma will be significantly associated with the increase in the length of stay of patients admitted to the hospital through ED.

Objectives:

Our primary objectives are to:

- (1) validate the association of ISS as a predictor of economic burden defined as the acute cost of care to trauma patients admitted to the hospital through ED.
- (2) assess possible confounders and effect modifiers that might affect ISS scores and acute cost of care respectively.

Our secondary objectives are to:

- (3) establish a subgroup analysis of ISS scores (minor, moderate, and major trauma) and acute cost of care.
- (4) check the validity of ISS as a predictor of ED and hospital length of stay (LOS).
- (5) describe characteristics of trauma patients such as demographics, geographical location, injury patterns, clinical characteristics, management interventions, and outcomes

Methods: Data were obtained from a database created specifically to answer the above questions. The database involves 430 patients who presented to AUBMC ED from 2008 through 2013, with data obtained retrospectively from AUBMC EHR. Inclusion criteria are based on definitions used in building Trauma registries in the US. More specifically, codes from the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) were adopted. ICD-9 CM codes 800-999 stand for injury and poisoning. Patients with missing charts were excluded from the study. With 95% confidence interval and significance level (α) 0.05, the Pearson correlation of two continuous variables (here cost and ISS) yields a sample size of $n=219$. To account for a one third missing data and other data access and storage problems the sample size will be increased to our convenient sample number which we collected at 430. Two researchers trained on Collaborative Institutional Training Initiative (CITI) have completed data collection. ISS was calculated from AIS, and cost was retrieved from the billing services. We did a descriptive analyses by calculating the mean and standard deviation for continuous, and number and percentage for categorical ones. We did inferential statistics, mainly bivariate analyses using the Chi-square test for categorical variables and independent Student's t-test for continuous ones to assess any possible effect modifiers or confounders. For the primary objective, we studied the correlation between the continuous ISS score (range of 0-75) and the acute cost of care in USD via Pearson r correlation statistic assuming normal distribution (hence parametric distribution).

We implemented a multivariate analysis to identify predictors while controlling for potentially confounding variables, more specifically, multivariate linear regression analyses was used. We also performed a subgroup analysis to assess the relation of acute cost of care with the three categories of ISS (0-4: minor, 5-15: moderate, and ≥ 16 major trauma). P-values <0.05 will indicate statistical significance and will not be corrected for secondary objectives.

Results: The total Sample of the database from 2008 to 2013 included 431 patients with a mean age of 32.77 years. More than 50% of the population were younger than 26 years. Male to female ratio was 1.6 times. More than one third of trauma patients were self-payers (35%), while half of them were covered by private insurance (50%), and the rest were either covered by national social security fund (NSSF) or other means (15%). Only 11.1 % of injuries occurred on motorways. The majority of injuries occurred via blunt mechanism (65.4%). The ISS mean score of the sample was 6.399 (± 7.794). There was a positive association between ISS and cost ($R=0.279$, $R^2=0.078$, $P<0.001$). ISS could explain 7.8 percent of the cost. Similarly, when ISS was grouped into three levels of severity, there was a positive association with cost for all subgroups. Minor injuries costed on average \$230, moderate injuries \$982, and severe injuries \$1,6431 per admission. The use of EMS, class of admission, presence of specific comorbidities (diabetes, CAD, CHF, COPD, and cancer),

performing ED labs, procedures in ED and procedures in hospital significantly affects the cost. It is important to note that the location of injury was not associated with the cost of care. There was a positive association between ISS and Length of Stay in ED ($R=0.313$, $R^2=0.098$, $P<0.001$). ISS can explain 9.8 percent of length of stay in ED.

Conclusion: Our study has shown that trauma severity, assessed via ISS, is associated with a substantial economic burden on the Lebanese population. The multifactorial effect of comorbidities and lack of appropriate EMS increase the burden, highlighting the need to design an approach that also targets other non-communicable diseases and improves trauma provision.

Further research is needed to form a national database to provide population-based data to inform local policymakers to implement preventive policies. An efficient and effective trauma and EMS system has been found to be a key component.

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ABBREVIATIONS

AAAM	Association for the Advancement of Automotive Medicine
AIDS	Acquired immunodeficiency syndrome
AIS	Abbreviated Injury Scale
ATLS	Advanced Trauma Life Support
AUBMC	American University of Beirut Medical Center
CAD	Coronary artery disease
CHF	Congestive heart failure
CITI	Collaborative Institutional Training Initiative
CMNNs	Communicable, maternal, neonatal, and nutritional diseases
COPD	Chronic obstructive pulmonary disease
CT	Computed Tomography
DALY	Disability-Adjusted Life Year
ED	Emergency department
EHR	Electronic health records
EMS	Emergency medical services
ESI	Emergency Severity Index
EU-OSHA	European Agency for Safety and Health at Work
EuroTARN	European Trauma and Audit Research Network
FFP	Fresh frozen plasma
GBD	Global Burden of Disease
GCS	Glasgow Coma Scale
GDP	Gross domestic product
HIP	Health Insurance Plan
HIV	Human Immunodeficiency Virus
HTN	Hypertension
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
ICD-11	International Classification of Diseases
ICU	Intensive Care Unit
ILO	International Labour Organization

IQR	Interquartile range
ISS	Injury Severity Score
LMIC	Low- and middle-income countries
LMWH	Low molecular weight heparin
LOS	Length of stay
MCC	Motor cycle collision
MMWR	Morbidity and Mortality Weekly Reports
MTOS	Major Trauma Outcome Study
MVC	Motor vehicle collision
NCDs	Non-communicable diseases
NHTSA	National Highway Traffic Safety Administration
NICE	National Institute for Health and Care Excellence
NISS	New injury severity score
NSSF	National Social Security Fund
OR	Operation Room
PTS	Pediatric Trauma Score
RCR	Retrospective chart review
RR	Respiratory rate
RTS	Revised Trauma Score
SBP	systolic blood pressure
SD	Standard deviation
SDI	Socio-demographic index
SPSS	Statistical Package for Social Sciences
STDs	Sexually transmitted diseases
TARN	Trauma Audit and Research Network
TBI	Traumatic brain injuries
UK	United Kingdom
US	United States
WISQAR	Web-based Injury Statistics Query and Reporting System
WHO	World Health Organization
YLLs	Years of life lost