Comparison of Trauma Scoring Ability to Predict Survival Rate in Countries with Low to Middle-Income

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Abstract

The use of trauma scoring in the hospital is very important because it has a significant impact both clinically and economically. However, not all trauma scoring that we know today is suitable for use in low to middle-income countries or applied in hospitals with limited resources. The purpose of compiling a systematic review is to identify which trauma scoring is most appropriate for use in low to middle-income countries. This systematic review was built by identifying scientific articles published between 2010-2019. Search for articles was carried out with the keywords "Trauma Scoring" and "Low And Middle-Income Country". The search was carried out with the help of databases including ProQuest, science direct, and PubMed and SpringerLink. From this search, we found 3802 articles. Furthermore, the 3802 articles were screened with the help of PRISMA flow diagrams and criticized with the JBI tool. After that, 9 articles relevant to the research question were obtained to be analyzed into a systematic review. The results showed that 4 articles were stating that the Kampala Trauma Score (KTS) had a higher AUC ROC value when compared to another trauma scoring. Also, in these four articles, KTS had the lowest AIC score. Thus, it can be concluded that VCT is trauma scoring which is most suitable to be applied in low to middle-income countries or hospitals in rural areas with limited resources.

Keywords: *Trauma Scoring, Low and Middle-Income Country.*

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A. INTRODUCTION

Deaths due to trauma in the world are still high and even continue to increase. This is because death due to trauma in developing countries is still a neglected health problem (Gosselin, Spiegel, Coughlinc, & Zirkled, 2009; Joshi, Banstola, Bhatta, & Mytton, 2017; Sakran, Greer, Werlin, & McCunn, 2012; Simons, 2017). As a result, low-income countries are the countries that account for the most traumatic deaths in the world. The evidence is that the mortality rate from trauma in low-income countries is 103/100,000/year. Meanwhile, the mortality rate due to trauma in high-income countries was only 52/100,000/year (Joshipura, Mock, & Gosselin, 2019).

Reducing the mortality rate due to trauma must be done by improving the quality of service. For this reason, researchers from various health institutions in the world have tried to develop various scoring systems to assess the severity of patients to predict prognosis so that appropriate actions can be taken (Domingues, Coimbra, Poggetti, Nogueira, & Sousa, 2018). Many scoring systems for assessing severity and survival rates in trauma patients have been developed in recent decades (Weeks et

al., 2014). Some of these scoring systems include; The Abbreviated Injury Scale (AIS), Injury Severity Score (ISS), New Injury Severity Score (NISS), and Trauma and Injury Severity Score (TRISS), Revised Trauma Score (RTS), Kampala Trauma Score (KTS), MGAP and GAP. The use of these tools has a significant impact both clinically and economically because they can predict patient outcomes, thus impacting service quality (Weeks et al., 2016). However, not all trauma scoring that we know today is suitable for use in low to middle-income countries. This is due to the limited resources that most hospitals in low- to medium-income countries have. Therefore, the purpose of writing this mathematics review is to identify which scoring system is most suitable to be applied in low - middle-income countries.

B. METHOD

The preparation of this review went through several stages, namely determining research questions using the PICOS method. Furthermore, articles are collected for review by going through the following process stages: identification, screening, eligibility selection, and determination of inclusion criteria. In the final stage, a review is carried out by synthesizing the literature to obtain a systematic review.

1. Research Question

The research questions in this review are, "can all trauma scoring be used in small-medium-income countries" and "which trauma scoring is most suitable for small-medium-income countries?

2. Identify the Relevant Journal from the Title/Abstract

Journal identification is done by searching for journal articles that have been published in 2010-2019 in international journals available on several databases such as ScienceDirect, ProQuest, SpringerLink, and PubMed via google search. The search was performed using the keywords, "trauma scoring", "survival rate" and "low and middle-income country. The reference selected for the synthesis must meet the inclusion criteria for examining the application of trauma scoring in low-middle income countries.

3. Screening and Eligibility

In the search, there were 3802 article titles and then screened based on the titles obtained through abstracts, obtained 79 articles relevant to trauma scoring in small-middle-income countries. The selection was continued by selecting journals relevant to trauma scoring in small-medium-income countries, eligible, and having a similar study design. At this final stage, only 9 trauma scoring journals were obtained in small-middle-income countries.

The selection and selection of documents are carried out using the PRISMA flowchart, which can be seen in Figure 1.

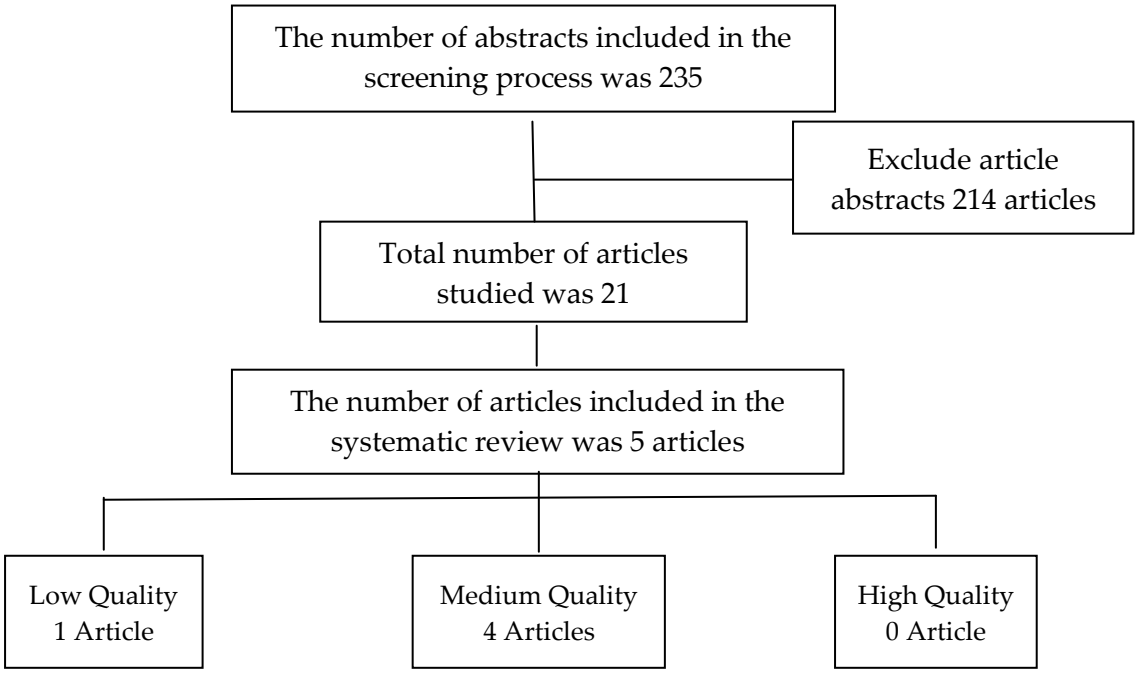

Figure 1 Selection and Selection of Documents Process

4. Appraisal (Assessment)

The eight articles obtained were analyzed using the Joanna Brigg Institution (JBI) journal critique instrument. Based on the appraisal carried out, a summary of the results of the research is listed in table 1 and synthesized into a systematic review.

Title	Authors & Year	Purpose	Method (Design)	Sample	Data Analysis	Major Findings
Choice of injury scoring system in low- and middle-income countries: lessons from mumbai	2015 • Adam D. Laytin • Vineet Kumar • Catherine J. Juillard • Bhakti Sarang • Angela Lashoher • Nobhojit Roy • Rochelle A. Dicker,	1. To assess the feasibility of calculating five injury scoring systems – ISS (injury severity score), RTS (revised trauma score), KTS (Kampala trauma score), MGAP (mechanism, GCS (Glasgow coma score), age, pressure) and GAP (GCS, age, pressure) – with data from a trauma registry in a lower middle-income country 2. To determine which of these scoring systems most accurately predicts in-hospital mortality in this setting	This is a retrospective analysis of data from an institutional trauma registry in Mumbai, India. Values for each score were calculated when sufficient data were available.	A total of 1117 severely injured patients with life- or limbthreatening injuries were treated by the Lokmanya Tilak Municipal General Hospital Trauma Ward between October 16, 2010 and February 14, 2012	• Trauma registry data were entered into the EpiInfo 6 software (CDC Statistical package), transferred to Excel (Microsoft, Redmond, Washingto, 2007) for editing, and then imported to Stata 13 statistical software (StataCorp, College Station, TX: 2013) for analysis. • Data analysis using logistic regression	ISS was the weakest predictor of in-hospital mortality, while RTS, KTS, MGAP and GAP scores all correlated well with in-hospital mortality (area under ROC (receiver operating characteristic) curve 0.69 for ISS, 0.85 for RTS, 0.86 for KTS, 0.84 for MGAP, 0.85 for GAP)
Validation of international	2016 • Nobhojit Roy, MS MPH • Martin Gerdin,	To validate commonly used trauma severity scoring systems ranging from the purely anatomy-based Injury	This prospective multi-centre observational cohort study was	All adult patients presenting to the casualty department with	• Pearson's chi-squared test was used to compare	Over a 30-day period, the scores (AUC) was TRISS (0.82), RTS (0.81), KTS (0.74), NISS (0.65) and ISS (0.62). RTS was the most

trauma scoring systems in urban trauma centres in India	MD PhD • Eric Schneider, PhD • Deepa K. Kizhakke Veetil, MS • Monty Khajanchi, DNB • Vineet Kumar, DNB FNB • Makhal Lal Saha, MS • Satish Dharap, MS • Amit Gupta, MS • Göran Tomson, MD PhD • Johan von Schreeb, MD PhD	Severity Score and New Injury Severity Scale (NISS) score, to more physiology-focused scores, including the Kampala Trauma Score (KTS) and the Revised Trauma Score (RTS) score, as well as the combined score TRauma Injury Severity Score (TRISS), both within and across facilities treating substantial numbers of trauma patients in India.	conducted under the guidance of the collaborative research consortium "Towards improving trauma care outcomes" (TITCOIndia) from 1 September 2013 to 28 February 2015 in four Indian teaching and referral hospitals, each of which operate trauma units that receive citywide referral of trauma patients. The megacities (populations of more than 10 million) were geographically representative of urban India, namely Kolkata, Mumbai (2-centres) and Delhi	a history of injury and who were admitted to inpatient care were included. The primary outcome was inhospital mortality within 30-days of admission	mortality rates among patients who did and did not have sufficient data to calculate each score recorded. • Association between injury scoring systems and in-hospital mortality was evaluated using logistic regression. • The sensitivity and specificity associated with the ability of each score to predict inpatient mortality within 30 days was assessed by analyzing the	parsimonious model with the lowest AIC score. Considering overall mortality, both physiologic scores (RTS, KTS) had better discrimination and goodness-of-fit than ISS or NISS. The ability of all Injury scores to predict early mortality (24 h) was better than late mortality (30 day).

					areas under the receiver operating characteristic (ROC) curve (AUC)	
Exploring injury severity measures and in-hospital mortalit: A multi-hospital study in Kenya	2017 • Yuen W. Hunga • Huan He • Amber Mehmoo • Isaac Botcheya • Hassan Saidi • Adnan A. Hyder • Abdulgafoor M. Bachania	To identify the comparative performance of injury severity measures across different patient populations and levels of care. This would allow a better understanding of the performance and validity of various injury severity measures in low-resource settings	This study was performed using data from trauma registries implemented in four public hospitals in Kenya. Estimated ISS, MGAP, GAP, RTS, TRISS and KTS were computed according to algorithms described in the literature.	• All trauma patients who presented in these hospital for care between January 2014 to January 2016 • 16,548 patients were included in the study	• Performance in discriminating in-hospital death was first assessed with the seven severity measures using complete data. • Discriminating ability was estimated using area under the receiver operating characteristics (ROC) curve and model fit statistic (Akaike information criterion [AIC]) of the	1. To estimate the effect of missing data on our analyses, multiple imputations were performed as a sensitivity test to assess the robustness of our results (Table 2). TRISS remained having the highest AUC overall (0.895, 95% CI: 0.878–0.913), and remained similar with KTS (0.871, 95% CI: 0.852–0.889). KTS still showed statistically significantly better discrimination than GCS and RTS; however, it was no longer statistically significantly different from MGAP and GAP. Estimated ISS had higher AUCs with multiple 2. TRISS and KTS were found to have relatively consistent and high performance of across several hospitals in Kenya, providing good evidence for their applicability to risk adjustment and mortality prediction in these settings. The good discrimination character-istics of KTS is consistent with

					logistic regression with in-hospital deaths with all four hospitals and by each hospital. • Bias-corrected 95% confidence intervals were estimated using bootstrap statistics with 1000 resamples • Calibration curves for each measure were constructed using complete data on all seven measures. • Sensitivity analysis was conducted by applying multivariate	findings from other settings

					normal imputation • Skewness of the data were handled by applying analysis on the log-transformed components • Twenty imputations were performed following Graham et al. 's recommendation • All statistical analyses were performed using Stata 14	
The Utility of the Kampala Trauma Score as a Triage Tool in a Sub-Saharan	• BryceHaac • Carlos Varela • Andrew Geyer • Bruce Cairns • Anthony Charles	To evaluate the ability of the Kampala trauma score (KTS) to assess injury severity and its potential as an outcome predictive tool in Malawi	This is a prospective cohort study of trauma patients presenting to Kamuzu Central Hospital in 2012. We recorded admission KTS and Revised trauma score (RTS), emergency	All trauma patient presenting to Kamuzu Central Hospital in 2012	Logistic regression and ROC curve analyses were used to compare the KTS to the widely accepted RTS.	For KTS and RTS, the odds of admission with each increment increase in score was 0.44 and 0.3, respectively. Similarly, odds of mortality is 0.48 and 0.36. Neither KTS ($p = 0.96$, ROC area 0.5) nor RTS ($p = 0.25$, ROC area 0.5) correlated significantly with hospital LOS. KTS and

African Trauma Cohort			department disposition, and hospital length of stay (LOS) and survival.			RTS performed equally well as predictors of mortality, but KTS was a better predictor of need for admission (KTS ROC area 0.62, RTS ROC area 0.55, p\0.001).
Is the Kampala Trauma Score an Effective Predictor of Mortality in Low-Resource Settings? A Comparison of Multiple Trauma Severity Scores	• Sharon R. Weeks • Catherine J. Juillard • Martin E. Monono • Georges A. Etoundi • Marquise K. Ngamby • Adnan A. Hyder • Kent A. Stevens	.	This study analyzed prospective data collected in the Emergency Department (ED) of the Central Hospital of Yaounde kameron a 500-bed teaching and referral hospital that handles the largest trauma volume in the capital city of Cameroon	2,855 trauma patients were enrolled in the study	predictors of mortality using logistic regression models and analysis of areas under the receiver operating characteristic (ROC) curve (AUC). Scores were also assessed with Akaike information criteria as well as Pearson's v2 goodness-of-fit test.	1. Logistic regression models were used to construct ROC curves for sensitivity and specificity. The greatest AUC was calculated for the ROC curve of KTS, with an AUC of 0.7748 (95 % CI 0.6285–0.9212) (Fig. 1). When compared to the RTS, ISS, TRISS, and GCS in a pairwise fashion (Fig. 2), KTS not only had a greater AUC but had greater sensitivity for a given specificity at all points except one point in the comparison with TRISS. No pair-wise difference between the area under the ROC curve of KTS compared to the other scores was statistically significant (p[0.05 for all) 2. ROC analysis was also performed on the subset of 244 patients with severe injuries, defined as having an ISS C16. As with the more inclusive analysis above, when compared to RTS, ISS, TRISS, and GCS in a pairwise fashion, KTS not only

						had a greater AUC but had greater sensitivity for a given specificity at all points (Fig. 3). The greatest AUC was calculated for the ROC curve of KTS, with an AUC of 0.9820 (95 % CI 0.9585–1.000). Again, no pairwise differences between ROC areas of KTS and other scores were statistically significant

C. RESULT AND DISCUSSION

Based on the analysis of the article, it is known that there are still many differences of opinion between one study and another regarding which trauma scoring is most suitable to be applied in Low and Middle-income Countries.

The research that conducted by Laytin et al., 2015 at General Hospital of Lukmaya Tilak Mumbai India, Among 1117 severe trauma patients, the following results were obtained; ISS is the weakest mortality predictor, while the strongest mortality predictor is KTS, then it is followed by RTS, MGAP, and GAP. ISS is said to be the weakest mortality predictor because AIS is one of the compositions that make up ISS. As a result, the evaluation process is often incomplete and subsequently results in a weak assessment of patients with severe head injuries (Gerdin et al., 2014). In this study, it also appears that KTS is the strongest predictor of mortality. This is indicated by the AUC ROC values as follows: 0.69 for ISS, 0.85 for RTS, 0.86 for KTS, 0.84 for MGAP, 0.85 for GAP.

Almost the same thing also happens in the following studies which show that VCT is the best scoring trauma in predicting the survival rate of head trauma patients in low and middle-income countries or hospitals with limited resources. These studies include; the research conducted byHaac et al., 2015to all trauma patients who visited Kamuzu Central Hospital. In Malawi-Africa. In this study, it was found that KTS and RTS had the same ability to predict mortality of trauma patients, however, KTS had a better performance in predicting admission of head trauma patients. This can be seen from the AUC KTS value which is higher than the AUC RTS value, namely 0.62 for KTS 0.55 for RTS; In research conducted by Weeks et al., 2014of 2855 trauma patients at Younde Kameron Central Hospital. In this study, it appears that KTS has the largest AUC value and also has higher specificity and sensitivity values when compared to RTS, ISS, TRISS, and GCS.

In the three studies above, it appears that KTS is the strongest predictor of mortality. This is because KTS has many advantages, among others; Valid and Reliable for use on children and adults(Demyttenaere *et al.*, 2009), easy, simple, and usable for quick assessment (Romanelli & Farrell, 2019).

Different things appear in the research conducted byRoy et al., 2016in 4 teaching hospitals in India between 1 September 2013 to 28 February 2015. In this study, it was found that TRISS was the best trauma scoring used to predict survival rates in trauma patients. This is indicated by the results of the research as follows: TRISS has the highest AUC value, which is 0.82, followed by RTS 0.81, KTS 0.74, NISS 0.65, and the lowest is ISS with an AUC value of 0.62.

In line with the research conducted by Roy, et., Al 2016, research conducted byHung et al., 2017also shows that TRISS is in line with research conducted by Roy, et., al 2016, research conducted by Hung et al., 2017also shows that TRISS. Apart from TRISS, in this study, the results also show that KTS also has a higher and more consistent performance when compared to other trauma scoring systems.

TRISS has the highest Auc score because TRISS is the most sensitive and specific scoring tool in predicting the survival level of a trauma patient in intra

hospital (Bouzat et al., 2016). TRISS is also known as the most complete and complex trauma scoring because it combines the trauma mechanism, age, injury severity score (ISS) and the Revised Trauma Score (RTS) (Lam, Lingsma, Beeck, & Leenen, 2015) and is also a combination of the calculation system with anatomic elements and physiological elements (Barwell, Bishop, & Midwinter, 2018).However, TRISS has several drawbacks, among others, TRISS cannot be used to predict mortality in patients with chest trauma. Also, TRISS cannot be calculated quickly so it is difficult to use it in making decisions in emergencies (Moon et al., 2017).

D. CONCLUSION

There are still many differences of opinion between one study and another regarding which trauma scoring is most suitable to be applied in Low and Middle-income Countries. However, based on the results of the above research, it can be concluded that KTS and TRISS are trauma scoring which is the best trauma scoring if used in countries with small-medium income or hospitals with limited resources. Even so, KTS has many advantages, among others; Valid and Reliable for use on children and adults, easy, simple and can be used for rapid assessment. While TRISS has several drawbacks, among others, TRISS cannot be used to predict mortality in patients with chest trauma. Also, TRISS cannot be calculated quickly so it is difficult to use it in making decisions in emergencies.

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