**Time to Selective Computed Tomography is not Clearly Associated with Mortality in Adult Trauma Patients in an Urban Indian Setting**

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**ABSTRACT**

**Introduction***:* Nearly five million deaths occur annually as a result of trauma, and of these, approximately 90 percent occur in low- and middle-income countries (LMICs). There is a strong push to perform computed tomography (CT) as early as possible during a diagnostic workup to detect potentially lethal or disabling injuries. However, there has been limited research regarding how the timing of CT is associated with the outcome of trauma patients in LMICs.

**Aim:**To assess whether time to selective CT is associated with mortality in adult trauma patients in an urban Indian setting.

**Material and Methods:**Data came from the anonymised Towards Improved Trauma Care Outcomes (TITCO) database of 16,000 trauma patients enrolled from four public hospitals in urban India in 2013-2015. Direct admissions and patients aged 15 years or older were included. Time from injury to selective CT was measured within 24 hours of arrival and modelled using restricted cubic splines. The outcome was mortality within 30 days of arrival to the participating centre or until discharge, whichever occurred first.

**Results:** Data from 2,089 patients were analysed. An association between time to selective CT and 30-day mortality was not reliably identified, as indicated by the confidence intervals for both time to CT spline terms in adjusted analyses (0.741-1.038 and 0.944-1.779).

**Conclusion:**Our results do not suggest a clear association between time from injury to selective CT and mortality when selective CT is performed within 24 hours of arrival to a hospital in directly admitted patients. These findings do not support a clinical policy to push for performing selective CT as early as possible in the management of adult trauma patients in this setting.

**Keywords:** Trauma, India, computed tomography, time, urban lower-middle-income setting

**WHAT THIS PAPER ADDS**

**What is already known on this subject:**

- There is a strong push to perform computed tomography (CT) as early as possible during a diagnostic workup to detect potentially lethal or disabling injuries.

- However, there has been limited research regarding how the timing of CT is associated with the outcome of trauma patients in LMICs.

**What this study adds:**

- Our study does not suggest a clear association between time from injury to selective CT and mortality when selective CT is performed within 24 hours of arrival to a hospital in directly admitted patients in an urban Indian setting. These findings do not support a clinical policy to push for performing selective CT as early as possible in the management of adult trauma patients in this setting.

- By knowing that the first valuable minutes of emergency trauma care can be calmly devoted to resuscitating and stabilizing the patient, instead of rushing to selective CT, these findings will aid understaffed and resource-constrained hospitals in similar settings on how to best distribute their resources when handling a disproportionate burden of trauma. This study is among the first to investigate the time aspect of selective CT imaging, especially in a low- to middle- income setting.

**INTRODUCTION**

Trauma is a major threat to public health worldwide, each year is responsible for more deaths than malaria, tuberculosis, HIV/AIDS and maternal conditions combined (1). Almost five millions deaths occur annually as a result of injuries, and of these, approximately 90 percent occur in low- and middle-income countries (LMICs) (2). An increase in road traffic deaths has been seen in many LMICs where motorization and urbanization has not been accompanied by sufficiently improved road safety strategies (2). In fact, in the age group 15-29 years, road traffic injuries are the leading cause of death worldwide (2). With these changing patterns in global health, trauma is now a condition needing greater priority to reduce avoidable mortality in young and middle-aged adults (1).

Early detection of potentially lethal or disabling injuries is crucial to reduce trauma mortality and morbidity. Imaging is at the core of such detection, and Computer Tomography (CT) is the gold standard in trauma systems all over the world (3). Studies comparing whole-body CT (WBCT) to selective CT imaging (organ-selective CT imaging according to the Advanced Trauma Life Support (ATLS) guidelines), suggest that WBCT is associated with better outcomes and lower mortality (3). In a well-structured environment, WBCT during trauma resuscitation has been associated with significantly decreased mortality in haemodynamically stable and haemodynamically unstable major trauma patients (4).

There is a strong push to perform CT as early as possible as part of the diagnostic workup (5). A novel trauma workflow, comprising immediate CT diagnosis and rapid bleeding control without patient transfer, as realized in a hybrid ER, has been associated with improved mortality in severe trauma (6). A close distance of the CT scanner to the trauma room (7), as well as immediate WBCT after initial examination compared to selective CT imaging, have also been associated with an improved probability of survival of severely injured patients in high-income countries (HICs) (8).

However, WBCT may not be accessible in all trauma facilities regionally and globally. In these settings, selective CT imaging may be of importance instead. No similar studies have been conducted in LMICs, and there are concerns about such investigations delaying time-critical interventions (9). In low-resource settings, the CT scanner may be situated far from the trauma room, with no secure way to transport unstable patients between them (10). Therefore, whether time to CT is associated with mortality remains unknown in LMICs settings, which are disproportionally affected by trauma. The aim of this study was to assess whether time to selective CT is associated with mortality in adult trauma patients in an urban Indian setting.

**METHODS**

**Study Design**

This is a retrospective analysis of the cohort study Towards Improved Trauma Care Outcomes in India (TITCO) (11–14). Data was collected under a waiver of informed consent by the ethics review board at each participating centre (Jai Prakash Narayan Apex Trauma Center, EC/NP-279/2013 RP-O1/2013; King Edward Memorial Hospital, IEC(I)/OUT/222/14; Lokmanya Tilak Municipal General Hospital, IEC/11/13; Seth Sukhlal Karnani Memorial Hospital, IEC/279). The study was registered at ClinicalTrials.gov (NCT03453593) before this analysis was undertaken.

**Setting**

The anonymised TITCO cohort includes approximately 16,000 patients enrolled from four public university hospitals in urban India between July 2013 and December 2015 (11). The hospitals are located in the megacities Mumbai (two centres), Delhi and Kolkata. Jai Prakash Narayan Apex Trauma center in New Delhi is a standalone trauma center with almost 180 beds. The other hospitals are trauma units providing trauma services as a part of a general hospital. Lokmanya Tilak Municipal General Hospital in Mumbai has a trauma ward with 14 beds, while Seth Sukhlal Karnani Memorial Hospital in Kolkata has no dedicated trauma ward. Patients are transported to hospital by police or civilians. The ambulance service is limited and does not provide pre-hospital care. There is generally no pre-notification to receiving hospitals and only in one of the four participating hospitals is there a trauma team available. Urban public tertiary care hospitals in India are often resource-constrained and understaffed with a disproportionate burden of trauma. This is an environment where the use of CT scanners may be restricted to patients with low GCS. It takes about 10-15 min for transportation to the CT scanner and the expertise to keep the patient stable to and from the CT may be limited. The participating centres currently follow recommendations of the ATLS guidelines that CT scans should only be conducted in haemodynamically stable patients. The decision to go to CT was made based on clinical judgment.

One project officer at each site collected the data. Data was gathered prospectively on admission on a standardized intake form for eight hours per day by directly observing the staff delivering trauma care. They rotated daily through each eight-hour shift (morning, evening, night), including public holidays. For patients admitted outside the eight-hour observed shift, the data was retrospectively retrieved from patient records within the initial few days. Due to the shift pattern, approximately two-thirds of the data was retrospectively collected. They did not perform their own recordings, but relied on the measurements performed by the residents and nurses on duty. To reduce measurement bias, on-site quality control sessions were performed on two occasions. During each check, a random selection of 1-5% of entries were cross-checked with official patient records and no major discrepancies were observed. In the anonymised TITCO cohort, time to first selective CT was recorded within the first 24 hours of arrival to a participating centre. Selective CTs done later than during the first 24 hours were not captured.

**Participants**

Eligibility criteria

Patients included in the database were all patients at the trauma centres admitted to the hospital for treatment for an injury caused by a road traffic accident, railway accident, fall, assault or burn. Patients who were dead on arrival or had isolated limb injuries were excluded. The added inclusion criteria to form the study sample were (1) direct admission to the participating centre (not referrals), (2) that the patient was 15 years or older and (3) that CT imaging (any selective CT or WBCT) was conducted as part of the trauma workup.

Source and method of participant selection

The on-site project officer included patients from participating hospitals, either by prospective observation or by retrospective data retrieval from patient records.

**Variables and data sources**

Outcome

The outcome was mortality within 30 days of arrival to a participating centre or until discharge, whichever occurred first. Patients were followed up until death in hospital or discharge from hospital, but no longer than 30 days. There was no follow up of mortality after discharge, therefore patients discharged alive before day 30 were assumed to be alive at day 30. Mortality data were extracted from patient records.

Exposure

Time from injury to selective CT imaging in hours was extracted from patient records.

Covariates

Age in years, sex, and mechanism of injury (recorded as road traffic injury, railway injury, fall, assault or other) were all extracted from patient records or reported by participants. Burns were included in other because of very low numbers. Vital signs on arrival to the participating centre included systolic blood pressure (SBP), heart rate (HR), and Glasgow coma scale (GCS) score. Vital sign data were extracted from patient records. Anatomical injury severity was quantified using the injury severity score (ISS), calculated by a single accredited coder based on text injury descriptions. We also included a unique centre identifier.

**Bias**

All project officers observing and collecting the data had a health science master degree. They were not employed by participating centres but by the project administration centrally. In addition, they were continuously trained and supervised throughout the study period.

**Quantitative variables**

Quantitative variables were handled as continuous. Variables for which a non-linear association with mortality could be assumed, such as age, systolic blood pressure, heart rate and time between injury and selective CT were modelled using restricted cubic splines with three knots placed at equally spaced percentiles (15). Modelling variables using splines is useful for variables that can be assumed to be non-linearly associated with another variable. It is a way of allowing flexibility in an association between two variables. For example, instead of categorizing a continuous variable, the variable is segmented with knots between the segments. The direction of the association is allowed to vary between the segments while being joined together at the knots. Restricted cubic splines have cubic functions joining the segments at the knots whereas the associations are restricted to be linear before the first and after the last knot. The first parameter represents the coefficient between the first and second knot and the second parameter represents the coefficient between the second and third knot.

**Statistical methods and analyses**

R, a language and environment for statistical computing, was used for all statistical analyses (16). Sample characteristics were presented using medians and inter-quartile ranges (IQRs) for quantitative variables and counts and percentages for qualitative variables. To assess the association between time to selective CT and mortality, a logistic regression model was used. A model including only time to selective CT modelled using restricted cubic splines was built to generate an unadjusted estimate of the association. A model including all covariates listed above in addition to time to selective CT was then built to generate adjusted estimates. Finally, we repeated the analyses in 1000 bootstrap samples of the same size as the original sample to generate a visual representation of the uncertainty associated with our findings. We used 95% confidence intervals (CI) and conducted a complete case analysis.

**Study size**

Simulation studies of logistic regression models’ sample size requirements indicate a need for at least ten events per parameter in the hypothetically most complex model for the model to produce reliable coefficient estimates (17). An event here was an observation with the outcome. Each of time to selective CT, age, SBP and HR contributed two parameters when modelled using restricted cubic splines with three knots. Sex, GCS, and ISS each accounted for one parameter. Mechanism of injury had five levels (road traffic accident, railway accident, fall, assault and burn), of which one was the reference category. This left four parameters to be estimated, and therefore mechanism of injury contributed four parameters. Taken together, the full model included 19 parameters and hence required 190 events. Assuming an outcome prevalence of 20% based on previous research, the sample had to include at least 950 observations.

**RESULTS**

**Participants**

The anonymised TITCO cohort included 16,000 patients (Figure 1). When the first inclusion criteria of direct admissions (excluding all transferred patients) had been applied, 4,629 cases remained. The second step of including patients ≥15 years of age left 3,880 cases. The third step was to only include patients who had undergone CT imaging within the first 24 hours of arrival to the participating centre, leaving 2,919 cases. In the last step of the recruitment, an estimation of missing data was conducted, revealing missing values of SBP, HR, GCS, ISS, time to CT, time in hospital, mechanism of injury and status in some cases. When incomplete cases were removed, 2,089 complete cases remained to form the study sample.

**Descriptive data**

Table 1 shows the study sample characteristics. The median age was 30 years. Survivors were younger than non-survivors. The study population consisted overwhelmingly of males (86%). The most common mechanism of injury was road traffic injury (54.8%), followed by falls, assaults and railway injuries. The first set of vital parameters after arrival to the participating centres had median values of SBP 120 mmHg, HR 88 beats per minute and GCS score 15. The median GCS was substantially higher in survivors compared to non-survivors (15 vs 6). The median ISS was 10 in in both survivors and non-survivors.

**Outcome data**

The exposure variable was time from injury to selective CT, with a median value of 3.2 hours (IQR 2.0-5.3) (Table 1). The 30-day mortality was 14.8% (n=309). Time in hospital had a median value of 6.7 days.

**Table 1: Sample characteristics**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Characteristic | Level | Alive | Died | Overall |
| n (%) |  | 1780 (85.2) | 309 (14.8) | 2089 (100.0) |
| Age in years (median [IQR]) |  | 30.0 [24.0, 42.0] | 35.0 [25.0, 50.0] | 30.0 [24.0, 45.0] |
| Sex (%) | Female | 249 (14.0) | 44 (14.2) | 293 (14.0) |
|  | Male | 1531 (86.0) | 265 (85.8) | 1796 (86.0) |
| Mechanism of injury (%) | Assault | 191 (10.7) | 13 (4.2) | 204 (9.8) |
|  | Fall | 421 (23.7) | 73 (23.6) | 494 (23.6) |
|  | Railway injury | 129 (7.2) | 57 (18.4) | 186 (8.9) |
|  | Road traffic injury | 984 (55.3) | 160 (51.8) | 1144 (54.8) |
|  | Other | 55 (3.1) | 6 (1.9) | 61 (2.9) |
| Centre (%) | 1 | 179 (10.1) | 59 (19.1) | 238 (11.4) |
|  | 2 | 45 (2.5) | 3 (1.0) | 48 (2.3) |
|  | 3 | 164 (9.2) | 74 (23.9) | 238 (11.4) |
|  | 4 | 1392 (78.2) | 173 (56.0) | 1565 (74.9) |
| SBP (median [IQR]) |  | 120.0 [110.0, 130.0] | 110.0 [100.0, 130.0] | 120.0 [110.0, 130.0] |
| HR (median [IQR]) |  | 88.0 [78.0, 98.0] | 90.0 [80.0, 108.0] | 88.0 [79.0, 98.0] |
| GCS (median [IQR]) |  | 15.0 [12.0, 15.0] | 6.0 [4.0, 12.0] | 15.0 [9.0, 15.0] |
| ISS (median [IQR]) |  | 10.0 [5.0, 14.0] | 10.0 [9.0, 18.0] | 10.0 [8.0, 14.0] |
| Time to CT (median [IQR]) |  | 3.2 [2.0, 5.3] | 3.2 [2.0, 4.8] | 3.2 [2.0, 5.3] |
| Time in hospital in days (median [IQR]) |  | 7.3 [3.9, 14.9] | 3.3 [1.0, 7.8] | 6.7 [3.5, 13.8] |

Abbreviations and explanations: GCS, Glasgow coma scale; HR, Heart rate; ISS, Injury severity score; SBP, Systolic blood pressure in mmHg; Time to CT, Time from injury to computed tomography in hours; IQR, inter-quartile range

**Main results**

Tables 2 and 3 show unadjusted and adjusted logistic regression models with unadjusted and adjusted estimates of the association between time to selective CT and 30-day mortality. Time to selective CT and 30-day mortality was not clearly associated with mortality, as indicated by the CIs for both time to selective CT spline terms. There was however a trend towards reduced odds of mortality if selective CT was performed during the first five hours after injury, compared to immediately after injury. The CI does however include a null effect, albeit with little margin, in this period. This is visualized in Figure 2, which shows a non-linear association between time to CT and odds ratio of 30-day mortality, with a downward slope in the odds ratio of 30-day mortality up to five hours after injury and then an upward slope, indicating increasing odds of 30-day mortality as time to selective CT increases.

**Table 2: Unadjusted logistic regression model.** Time to selective CT modelled using restricted cubic splines to generate an unadjusted estimate of the association with 30-day mortality.

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | OR | CI (95%) | P-value |
| (Intercept) | 0.209 | 0.145-0.297 | <0.001 |
| Time to CT | 0.942 | 0.829-1.070 | 0.356 |
| Time to CT’ | 1.086 | 0.847-1.386 | 0.511 |

Abbreviations and explanations: OR, Odds ratio; CI, Confidence interval; Time to CT, Time from injury to computed tomography in hours. The ’ denotes different restricted cubic spline functions for variables assumed to be non-linearly associated with mortality.

**Table 3: Adjusted logistic regression model.** Time to selective CT modelled using restricted cubic splines as well as all covariates to generate an adjusted estimate of the association with 30-day mortality.

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | OR | CI (95%) | P-value |
| (Intercept) | 42.513 | 4.932-383.382 | 0.001 | | |
| Time to CT | 0.877 | 0.741-1.038 | 0.126 | |
| Time to CT’ | 1.297 | 0.944-1.779 | 0.107 | |
| Age | 0.992 | 0.960-1.025 | 0.630 | |
| Age’ | 1.060 | 1.004-1.119 | 0.036 | |
| Systolic blood pressure | 0.977 | 0.966-0.989 | < 0.001 | |
| Systolic blood pressure’ | 1.019 | 1.007-1.030 | 0.001 | |
| Heart rate | 0.986 | 0.968-1.004 | 0.121 | |
| Heart rate’ | 1.030 | 1.005-1.055 | 0.017 | |
| Male sex | 0.972 | 0.643-1.493 | 0.894 | |
| Mechanism of injury |  |  |  | |
| Fall | 1.565 | 0.777-3.376 | 0.229 | |
| Railway injury | 2.781 | 1.271-6.436 | 0.013 | |
| Road traffic injury | 1.313 | 0.677-2.752 | 0.444 | |
| Other | 1.227 | 0.374-3.707 | 0.723 | |
| Glasgow Coma Scale | 0.779 | 0.752-0.807 | < 0.001 | |
| Injury severity score | 1.045 | 1.024-1.066 | < 0.001 | |
| Centre 2 | 0.397 | 0.086-1.319 | 0.172 | |
| Centre 3 | 2.285 | 1.308-4.036 | 0.004 | |
| Centre 4 | 0.784 | 0.481-1.296 | 0.336 | |

Abbreviations and explanations: OR, Odds ratio; CI, Confidence interval; Time to CT, Time from injury to computed tomography in hours. The ’ denotes different restricted cubic spline functions for variables assumed to be non-linearly associated with mortality.

**DISCUSSION**

**Key results**

This study aimed to assess whether time to selective CT is associated with mortality in adult trauma patients in an urban Indian setting. Our results do not suggest a clear association between time from injury to selective CT and mortality when selective CT is performed within 24 hours of arrival to a hospital in directly admitted patients. The estimated associations are imprecise and should be interpreted with some caution, as they are compatible with both a positive and negative association between time to selective CT and mortality. These findings do not support a clinical policy to push for performing selective CT as early as possible in the management of adult trauma patients in this setting.

**Limitations**

There are several limitations to take into consideration. First, a limitation in the dataset was that there was no way of knowing if an earlier selective CT had been performed in transferred patients and if the results might have changed the management of the patient in the transferring hospital. Since approximately 70% of the admitted patients were transfers, a large proportion of the data were lost when excluding these. Another limitation in the dataset was that 30-day mortality was only recorded until discharge, causing patients who were discharged before day 30 to be assumed alive at day 30. Survival analysis was initially considered but logistic regression was chosen as the authors did not consider the assumption that censoring was independent of the outcome as being met.

An additional limitation in the dataset was that time to first selective CT was recorded within the first 24 hours of arrival to a participating centre. CTs done later than during the first 24 hours were not captured. This systemically excludes patients who received their first selective CT more than 24 hours after arrival. Another potential limitation in the dataset was that part of the data was prospectively collected when the project officers were present and that parts of it was retrospectively collected from patient records when they were not present. There was also a significant amount of missing data (830 cases) that potentially could have introduced bias. The missing data was most likely not random across the whole sample.

One word of caution is mandated regarding the interpretation of ISS. As noted previously it is rather low compared to other research, patients in REACT-2 had for example a median ISS of 20. One hypothetical explanation could be that the ISS in our study is falsely low, potentially because of missed injuries. To calculate the ISS we used all available information including notes from physical examinations, imaging reports, and intraoperative notes, but we did not have access to post mortem findings.

Finally, the different anatomical regions of the injury were not sub-grouped and evaluated separately in this study. It is possible that an association between time to selective CT and mortality for a specific anatomical region could go unnoticed when generalizing all selective CT examinations instead of sub-grouping them.

**Interpretation**

The results of our study suggest no clear association between time to selective CT and mortality. Previous studies suggest that trauma patients with the most severe injuries have the most to gain from the diagnostic accuracy of an early CT (18). A retrospective, multicentre study comparing WBCT to non-WBCT had inclusion criteria such as blunt trauma, direct admissions and available information about WBCT during trauma-room treatment. Additionally, an ISS of at least 16 was required. With a mean ISS of almost 30, it suggested integration of WBCT into early trauma care significantly increased the probability of survival in patients with polytrauma (19). However, it should be noted that trauma facilities with WBCT also come with well-organized trauma teams that are able to make rapid clinical decisions based on the WBCT findings.

In contrast, the patients in this study had a median ISS of 10 (IQR, 8-14), which is below the limit for what is defined as major trauma in the literature (20). Additionally, the clinical praxis at the participating trauma centres was that haemodynamically unstable patients go directly to surgery, while more stable patients go to selective CT. It could be noted that since haemodynamically unstable patients usually did not undergo selective CT before surgery in our study sample, they did not include those with the most severe injuries that would have the most to gain from a timely selective CT.

Interestingly, the REACT-2 trial found that immediate WBCT scan significantly reduced time of imaging by seven minutes compared to standard radiological work-up, but found no significant effect on mortality (21). REACT 2 was conducted in five level 1 trauma centres in Europe, four in the Netherlands and one in Switzerland. The CT in those centres was located in the trauma room itself or very close to the emergency department (21). In contrast, the CT in the centres participating in our study could have the CT located several buildings from the ED. Therefore, only stabilized patients will go to CT, and some of the more severely injured patients may never reach there.

Another possible explanation for the lack of association between time to selective CT and mortality in our study, is that the patients might have been so severely injured to begin with that the outcome would have been the same in spite of what the time to selective CT was. The median ISS of 10, which is assumed to be accurate, would argue against this point. However, the 30-day mortality outcome of 14.8% (n=309) suggests otherwise. In urban university hospitals in India, the 30-day in-hospital trauma mortality rate has been shown to be 21.4%, twice that found in similar cohorts from HICs (11). This could explain why patients with supposedly mild to moderate trauma in our study had about the same mortality rate as major trauma patients in HICs. Potential reasons for this high mortality figure may be perioperative mortality rates depending on the type of surgery being undertaken, as well as late phase deaths due to for example, sepsis, multiple organ failure (22), post-operative infections, re-bleeding and disseminated intravascular coagulation. Unfortunately, we did not have data on these late complications and therefore cannot comment on the definitive cause of death.

A potential reason for the difference in mortality in this study compared to previous research in urban university hospitals in India (11) may be that unstable patients were less likely to have undergone CT. Also, by excluding the referral/transferred patient group (due to the limitation in the dataset) and only evaluating direct admissions, we may have missed the higher-risk, potentially incompletely imaged or assessed trauma patients that may go on to develop complications.

Comparing this study to studies from HICs on the topic of timely CT, the most obvious difference is that this study investigated selective CT imaging rather than WBCT. Immediate WBCT after initial examination compared to selective CT imaging according to the ATLS guidelines has been associated with improved probability of survival of severely injured patients in HICs (8). In the cited study, transferred patients were excluded, and time in the emergency department was significantly shorter for the WBCT group. According to the authors of the study, this was due to more rapid decision making. In our study, we found no clear association between time to early selective CT and mortality. Whether this is true for early WBCT in LMICs needs further research. Further research should also assess the benefits of selective CT compared to no CT in trauma patients in this setting.

In conclusion, this study aimed to assess whether time to selective CT is associated with mortality in adult trauma patients in an urban Indian setting. Our results do not suggest a clear association between time from injury to selective CT and mortality when selective CT is performed within 24 hours of arrival to a hospital in directly admitted patients. These findings do not support a clinical policy to push for performing selective CT as early as possible in the management of adult trauma patients in this setting. By knowing that the first valuable minutes of emergency trauma care can be calmly devoted to resuscitating and stabilizing the patient, instead of rushing to selective CT, these findings will aid understaffed and resource-constrained hospitals in similar settings on how to best distribute their resources when handling a disproportionate burden of trauma. This study is among the first to investigate the time aspect of selective CT imaging, especially in a low- to middle- income setting.

**Generalizability**

The findings in this study can be argued to be generalizable to other busy tertiary care hospitals in urban areas of LMICs with similar population characteristics as Indian megacities. However, the external validity needs to be tested before the results can be generalized to all of India or LMICs in general.

**OTHER INFORMATION**

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**Figure 1: Recruitment of study population.** The steps show application of inclusion criteria and removal of incomplete cases. GCS, Glasgow coma scale; HR, Heart rate; ISS, Injury severity score; SBP, Systolic blood pressure in mmHg; CT, Computed tomography (selective)

**Figure 2: Graph of adjusted association between time to selective CT and 30-day mortality.** The plot includes the results with 95% confidence intervals (CI), represented by the solid black line with the blue interval. The blue lines represent associations estimated during the bootstrap procedure used to calculate the confidence intervals. The dotted line shows an odds ratio of 1, i.e., no difference in odds. For example, according to this plot, compared to having a selective CT less than one hour after injury, having it 10 hours after injury was associated with a mortality odds ratio of XX (CI YY-ZZ).

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