

Association of Multiple Trauma Referral Distance with Mortality in H. Adam Malik General Hospital Medan

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Abstract.

Introduction: The increasing distance from the location of the trauma to the trauma center can cause an increase in mortality. The farther the distance from the trauma center, the higher the mortality of trauma patients. Geographical variations in care may contribute to the effect of the relationship between distance and mortality in trauma patients. **Objective:** This study wanted to determine the relationship between multiple traumas referral distances and mortality based on ISS at Haji Adam Malik General Hospital Medan. **Methods:** The study design was an analytic study with the independent variable being the patient's referral distance and the dependent variable being the predictor of mortality in multiple traumas. The approach used in this research design is a retrospective approach. **Results:** The mean age of the patients was 31.08 ± 17.82 years. Most of the patients were male, most died, and the average referral distance was $79.67 \pm 63,244$ km. The majority of the ISS scores were 16. The relationship between referral distance and death in the hospital has a *P* value of < 0.05 . **Conclusion:** There is a significant relationship between multiple trauma patients' referral distance and hospital mortality.

Keywords: Multiple Trauma; Mortality; Patient Transport; Referral Distance

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1. Introduction

In developed countries, trauma remains the leading cause of death in people aged 1-44. In Indonesia, trauma is the leading cause of death in the 15-24 year age group and second in the 25-34 year age group.¹ More than five million people worldwide are killed yearly due to injuries from traffic accidents, falls, drowning, burns, poisoning, violence, or war. These deaths account for 9% of global deaths, more than cases of HIV/AIDS, malaria, and tuberculosis combined.²

A study from the University Hospital of Lausanne explains that the primary mechanism of trauma is due to road traffic incidents (RTI) (40.4%) and falls (34.3%). RTIs cause more than 1 million deaths annually worldwide. More than 90% of traffic accidents occur in developing countries.^{3,4} The Traffic Corps of the Republic of Indonesia Police (Korlantas POLRI) recorded the number of traffic accidents throughout 2018 was 109.21, with the number of seriously injured victims of 7.68% and the death toll of 17.00%. The value of material losses due to traffic accidents in 2018 was 213,866 million rupiah.⁵ A study at the VU Amsterdam university medical center showed

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that of 1073 patients who experienced multiple trauma, 205 patients died during hospitalization (19.1%) with an average Injury Severity Score (ISS) score of 30.4.⁶ Research conducted at the emergency department of the Sanglah Central General Hospital, Bali, also showed that from 60 cases of multiple trauma that came with an average patient age of 37 ± 19.61 years, the mortality rate was 11.7%.⁷

Emergency Medical Services (EMS) in the United States have strict criteria regarding rescue intervals based on the concept that we must initiate definitive medical care within a specific timeframe for trauma patients. Trauma care aims to bring severely injured patients to a trauma center for diagnosis, critical care, and surgery during the "golden hour" period.⁸ Trauma centers and organized trauma systems, including prehospital triage criteria and transport plans, have significantly reduced mortality in trauma patients.⁹ There is a relationship between the time of transportation from the location of severe trauma cases to the trauma center and mortality, which is also an essential factor in the EMS planning system.¹⁰ In 2012, the National Highway Traffic Safety Administration (NHTSA) reported a correlation between the distance from an accident to a trauma center and driver mortality by comparing the two groups.¹¹ Previous studies have shown that increasing the distance from the trauma site to the trauma center can lead to increased mortality. A study by Brown et al. also showed that the farther the distance from the trauma center, the higher the mortality of trauma patients due to motor vehicle accidents.^{12,13}

The figures above show that many victims of multiple traumas still cannot be saved. One thing that affects this situation is the prehospital care system related to the distance and time needed for trauma patients to reach the hospital. But little research still discusses the relationship between the length of the scene. This underlies the researchers' analysis of the relationship between multiple trauma referral distances and mortality at Haji Adam Malik General Hospital Medan.

2. Methods

The research design was an analytic study, with the independent variable being the patient's referral distance and the dependent variable being a predictor of mortality in multiple trauma. The approach used in this research design is a retrospective approach where the data taken are data that have existed before. The study was conducted at H. Adam Malik Hospital after obtaining approval from the Health Research Ethics Commission of USU Medical Faculty / H. Adam Malik Hospital Medan. The time of the study was carried out from January 2022 - April 2022.

The study's target population was patients with multiple trauma; the affordable population was patients with various trauma treated at H. Adam Malik Hospital, Medan. Therefore, the research sample is a reasonable population that meets the inclusion criteria and does not meet the exclusion criteria. The sampling method in this study used a total sampling method. The sample of this study were all patients diagnosed with multiple trauma at Haji Adam Malik General Hospital Medan and who died in 2019-2020.

The inclusion criteria of this study were male and female, patients diagnosed with multiple trauma based on history, physical examination, and supporting investigations in the ER, and patient medical record data including (age, gender, death in hospital, referral distance, and multiple trauma). Exclusion criteria in the study of patients with trauma were burns, drowning, strangulation, isolated proximal femoral fractures, isolated traumatic brain trauma, and pregnancy and incomplete medical record data.

The type of data used in this research is secondary data. The data were obtained by researchers by looking at the contents of medical records at Haji Adam Malik General Hospital Medan. All data has been collected, recorded, grouped, and then processed using a computer program following the study's purpose, namely to determine the relationship between multiple trauma referral distances and mortality at Haji Adam Malik Hospital Medan in 2019/2020. Specifically to determine referral distance, patient family or patient accident witness were questioned about the location of the incident and simple GoogleMap calculations were used to determine the distance from the spot to Adam Malik General Hospital Emergency Department.

3. Results

The number of subjects in this study was 93 people. The mean age of the patients was 31.08 ± 17.82 years. The majority of patients were male, as many as 68 (73.1%). Most of the patients died, as many as 52 (55.9%) people. The average reference distance was $79.67 \pm 63,244$ km. ISS score of 16 is the majority, as many as 48 (52.7%) people. Ninety-three patients experienced multiple trauma with a mortality rate of 55.9%. The frequency table for the characteristics of research subjects is described in Table 1.

Table 1. Characteristics of research subjects

Variables	n (%)
Age (mean \pm SD)	31.08 \pm 17.82 year
Gender	
Man	68 (73.1)
Woman	25 (26.9)
Multiple trauma	
Major trauma	49 (52.7)
Minor trauma	44 (47.3)
Death in the hospital	
Life	41 (44.1)
Die	52 (55.9)
Reference distance (mean \pm SD)	79.67 \pm 63,244 km
ISS Score	
0-8	44 (47.3)
9-15	1 (1.10)
16-24	26 (28.0)
25-40	19 (20.4)
41-66	2 (2.20)
75	1 (1.10)
Total	93 (100)

Table 2. Relationship between Referral Distance and Hospital Mortality

	Mortality	Discharged	<i>p</i> -value
Distance \geq 76 Km	38	1	<0.01
Distance < 76 Km	14	40	

Regarding the relationship between referral distance and death in the hospital, there is a relationship between referral distance and death with a p -value <0.05 , as shown in Table 2, with the formula odds ratio $x : AxD/CxB : 38x40/1x14 : 108.57$, odds ratio is 108.57.

Multiple trauma variable (categorical) with death in hospital (categorical) is a 2x2 table analysis which was analyzed using Fisher's exact test because it did not meet the Chi-Square test requirements. Based on this analysis, it was found that there was a significant relationship between multiple trauma and death in the hospital ($p < 0.01$). The results of the study are described in Table 3.

Table 3. Relationship between Multiple Trauma and Death in Hospital

	Discharged	Mortality	p -value
Trauma mayor	0 (0.0%)	49 (52.7%)	<0.01
Trauma minor	41 (44.1%)	3 (3.2%)	

*Fisher's exact test

4. Discussions

The mean age of the patients in this study was 31.08 ± 17.82 years. This result is similar to the study of Greve et al. (2022) in Germany, which stated that the median age of the patients was 43 (29-51) years.¹⁴ However, this result is different from the study of Stengel et al. (2022) in Germany, which stated that the mean age was 52.9 ± 18.9 years.¹⁵ The CDC says unintentional trauma ranks first as the top 10 causes of death in the United States for ages 1-44 years.¹⁶ Meanwhile, trauma is the second highest cause in Indonesia's 25-34 year age group.¹

The majority of patients in this study were male, as many as 68 (73.1%). This is in line with general epidemiology, which states that men constitute most of the multiple trauma patients. This is shown by research by Ranti et al. (2016), which displays that the number of male patients is 81.98%, and by Ramadiputra et al. (2018), which state that 82.76% of multiple trauma patients are male.^{1,17} We can explain this because men generally have a higher level of mobility than women by using motorized vehicles, especially men of productive age.¹⁸

Most of the patients in this study died as many as 52 (55.9%) people. This result is different from the study of Torabi et al. (2018), which stated that 18 (6.4%) patients died in hospital. Mortality in multiple trauma will increase if the patient experiences thoracic trauma. The more severe and concomitant trauma will increase mortality in multiple trauma patients.¹⁹ Head trauma accompanied by pulmonary contusion will aggravate gas exchange disorders so that breathing becomes disrupted and life-threatening.²⁰ Ramadiputra et al. (2019) stated that 90% of deaths due to traffic accidents by motorcyclists were found in developing countries.¹ Low lactate clearance levels, severe shock index, and persistent base deficit at 6 hours are significant for multiple trauma mortality.²¹

The average patient referral distance in this study was $79.67 \pm 63,244$ km. This is different from the research by Heriani and Wahyuni (2019) at the Ulin Hospital Banjarmasin, which stated that the majority of the patient referral distance was 1 km, which was 21 patients (41.4%). The farther the referral distance, the longer the patient will receive adequate treatment. ISS score of 16 is the majority, as many as 48 (52.7%) people. This is in line with the research of Burkhardt et al. (2012), which stated that the ISS score of 16 was experienced by 344 patients (85.6%). The greater the ISS score experienced, the higher the mortality rate.^{22,23}

This study showed a significant relationship between referral distance and hospital mortality ($p < 0.01$). This result is in line with the research of Hu et al. (2017), which showed that the farther the distance from the accident site to the trauma center, the higher the mortality of patients who had accidents. The mortality rate increased every 1 mile or 1,609 km extra distance to the trauma center with an OR of 1,002 per mile. Distance to trauma center was a more significant factor in influencing mortality in trauma patients ($p < 0.01$) than age ($p > 0.05$) and gender ($p < 0.01$).⁸

The distance between the accident site and the trauma center has a median value of 39.2 miles for all drivers who have had a fatal accident. The mortality of motorized vehicle passengers who had a fatal accident with the distance from the accident site to the trauma center had a significant relationship. However, this significance was not as vital as the relationship between driver mortality and the distance from the accident site to the trauma center. Meanwhile, there is no significant relationship between the mortality rate and the distance to the trauma center for other road users who are neither drivers nor passengers.⁸

Risk factors associated with trauma centers, such as distance to the nearest trauma hospital, are strong predictors of fatal injury to motorists. Wiratama et al. (2021) in Taiwan stated that a multivariate logistic regression model showed that motorcyclists involved in accidents located 5 km from the nearest trauma hospital were five times more likely to suffer fatal injuries (AOR = 5.26; 95% CI = 3.69-7.49). Distance, extent, and region of the nearest trauma center are critical risk factors for fatal injury among motorcyclists. To reduce the mortality rate of trauma cases among motorcyclists, interventions should focus on increasing access to trauma hospitals.²⁴ It is postulated that the longer the distance are, the longer the necessary care would be administered thus creating unnecessary complication.

The results of this study also follow the research of Crandall et al. (2013), which links the severity of the trauma, age, race, gender, and insurance status from gunshot wounds. Shooting at a distance of >5 miles from the trauma center increased the risk of mortality independently (OR = 1.23; 95% CI = 1.02-1.47; $p = 0.03$). Research by Brown et al. (2017) shows that the rate of fatal motor vehicle accidents is more common in locations far from the TSR. Mortality in motor vehicle accidents is also increasing in rural areas. This could be due to the distance between emergency medical services and hospitals from the location. Distance to the hospital is a factor that can be associated with mortality in accidents.^{9,13}

5. Conclusion

Based on the study's results, we can conclude that several things are as follows. First, there is a significant relationship between multiple trauma patients' referral distance and hospital mortality. The mean age of the patients was 31.08 ± 17.82 years. Most patients were male, most of the patients died, and the average referral distance was 79.67 ± 63.24 km. Most of the ISS scores were 16. It is necessary to conduct further research involving other variables to obtain comprehensive results. Education related to driving safety needs to be applied to the community as a form of preventing traffic accidents.

Ethics approval: Sumatera Medical Journal (SUMEJ) is a peer-reviewed electronic international journal. This statement below clarifies ethical behavior of all parties involved in the act of publishing an article in Sumatera Medical Journal (SUMEJ), including the authors, the chief editor, the Editorial Board, the peer-reviewer and the publisher (TALENTA Publisher Universitas Sumatera Utara). This statement is based on COPE's Best Practice Guidelines for Journal Editors.

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