

The Relationship Between Referral Distance of Multiple Trauma And Its Mortality In Haji Adam Malik Hospital, Medan

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Abstract

Introduction : Trauma remains the leading cause of death in people aged 1-44 years in developed countries. In Indonesia, trauma is the main cause of death in the 15-24 year age group and number two in the 25-34 year age group. Multiple trauma patients have a 1.9 times greater chance of mortality than non-multiple trauma patients. Organized trauma centers and trauma systems, including prehospital triage criteria and transportation plans have been shown to significantly reduce trauma patient mortality. Previous studies have shown that increasing the distance from the location of the trauma to the trauma center can lead to increased mortality. Geographical variations in EMS services may contribute to the effect of the association between distance and mortality in trauma patients. The purpose of this study was to find out the relationship between multiple trauma referral distance and mortality at Haji Adam Malik General Hospital Medan. **Method :** This is an analytic study with independent variable is patient referral distance and dependent variable is predictor of mortality in multiple trauma. The approach used in this research design is a retrospective approach where the data taken is data from January 2019 to December 2019. **Result :** The majority of respondents were 31.08 ± 17.820 years old on average. The majority of patients were male, namely 68 (73.1%) people. Most of the patients died as many as 52 (55.9%) people. The average reference distance is 79.67 ± 63.244 km. The ISS score ≥ 16 was the majority, namely 48 (52.7%) people. There were 93 patients who experienced multiple trauma with a mortality rate of 55.9%. There is a relationship between referral distance and death in hospital with a P value < 0.05. Variable multiple trauma (categorical) with death in hospital (categorical) is a 2x2 table analysis which is analyzed using Fisher exact test because it does not meet the requirements of the Chi Square test. Based on this analysis, it was found that there was a significant relationship between multiple trauma and death in the hospital (p < 0.001). **Conclusion :** This study shows that patients with multiple trauma with a referral distance of > 79 km have a 108,571 times greater chance of dying compared to multiple trauma patients who are referred with a referral distance of less than 79 km. Therefore, it can be concluded that it is necessary to build a trauma center in every 79 km radius.

Keywords : *multiple trauma; referral distance; trauma.*

INTRODUCTION

In developed countries, trauma remains the leading cause of death in people aged 1-44 years (ATLS, 2018). In Indonesia, trauma is the main cause of death in the 15-24 year age group and number two in the 25-34 year age group (Ramadiputra et al., 2018). More than five million people worldwide are killed each year due to injuries resulting from traffic accidents, falls, drowning, burning, poisoning, violence, or war. These deaths account for 9% of global deaths, more than the combined cases of HIV/AIDS, malaria, and tuberculosis (Breugel et al., 2020). Multiple trauma patients have a 1.9 times greater chance of mortality than non-multiple trauma patients (95% CI 1.38-2.49; p < 0.001) (Rau et al., 2017).

Emergency Medical Services (EMS) in the United States has strict criteria regarding rescue intervals which are based on the concept that definitive medical treatment should be initiated within a certain time frame for trauma patients. The aim of trauma care is to transport critically injured patients to trauma centers for diagnosis, critical care and surgery during the "golden hour" period (Hu et al., 2017). Organized trauma centers and trauma systems, including prehospital triage criteria and transportation plans have been shown to significantly reduce trauma patient mortality (Crandall et al., 2013). There is a relationship between

transportation time from the location of the major trauma case to the trauma center and mortality which is also an important factor in the EMS planning system. Evaluating the effect of transportation time on survival of trauma patients can be complicated by the fact that ambulance staff may drive faster when trauma is deemed life-threatening. Perceived severity of the trauma can be a potentially important but unmeasured confounding factor and can bias the estimation of this effect. One way to avoid this bias is to focus on the distance from the trauma site to the trauma center which is associated with patient survival and may reflect the effect of transportation time (Karrison et al., 2018). Brown et al.'s study also showed that the farther the trauma center was, the higher the mortality of trauma patients due to motor vehicle accidents. One of the things that influence this situation is the pre-hospital care system which is related to the distance and time needed for trauma patients to reach the hospital. But there is still little research that discusses the relationship between the distance of the incident. This is what underlies the researchers to analyze the relationship between multiple trauma referral distances and mortality at Haji Adam Malik General Hospital Medan.

METHODS

This study is an analytic study with the independent variable being patient 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 in which the data collected is pre-existing data. The research was conducted at the H. Adam Malik General Hospital after obtaining approval from the Health Sector Research Ethics Commission of the USU FK/H. Adam Malik General Hospital Medan. The time of the study was carried out in January 2022 – April 2022. The target population for the study were patients with multiple traumas, the reachable population were patients with multiple traumas who were treated at H. Adam Malik General Hospital Medan. The research sample is an affordable population that meets the inclusion criteria and does not meet the exclusion criteria. The sampling method in this study used total sampling. The sample of this study were all patients who were diagnosed with multiple trauma at Haji Adam Malik General Hospital in Medan and died in 2019-2020. The inclusion criteria for this study were patients diagnosed with multiple trauma based on anamnesis, physical examination and supporting examinations in the emergency room as well as complete patient medical record data (age, sex, death in hospital, referral distance, and multiple traumas). The exclusion criteria included patients with trauma in the form of burns, drowning, strangulation, isolated proximal femoral fractures, isolated traumatic brain trauma, and pregnancy and patients with incomplete medical record data. The type of data used in this research is secondary data. The data was obtained by researchers by looking at the contents of medical records at the Haji Adam Malik General Hospital in Medan. All data has been collected, recorded, grouped and then processed using a computer program that is in accordance with the research objective, namely to find out the relationship between multiple trauma referral distances and mortality at Haji Adam Malik General Hospital Medan in January 2019 to. December 2019.

RESULTS

The number of subjects in this study were 93 people. The mean age of the patients was 31.08 ± 17.820 years. The majority of patients were male, namely 68 (73.1%) people. Most of the patients died as many as 52 (55.9%) people. The average reference distance is 79.67 ± 63.244 km. The ISS score ≥16 was the majority, namely 48 (52.7%) people. There were 93 patients who experienced multiple trauma with a mortality rate of 55.9%. The frequency table for the characteristics of the research subjects is described in Table 1.

Tabel 1. Subjects Characteristics

Variabel	n (%)
Age (mean ± SD)	31,08 ± 17,820 years old
Gender	
Male	68 (73,1)
Female	25 (26,9)
Multiple trauma	

Trauma mayor	49 (52,7)
Trauma minor	44 (47,3)
Mortality in hospital	
Life	41 (44,1)
death	52 (55,9)
Distance reference (mean ± SD)	79,67 ± 63,244 km
ISS Score	
0-8	44 (47,3)
9-15	1 (1,1)
16-24	26 (28,0)
25-40	19 (20,4)
41-66	2 (2,2)
75	1 (1,1)
Total	93 (100)

The youngest patient was 1 year old while the oldest patient was 71 years old. The majority of patients aged 15, 19, and 29 years were 6 people each. The age distribution of research subjects is described in **figure 1**.

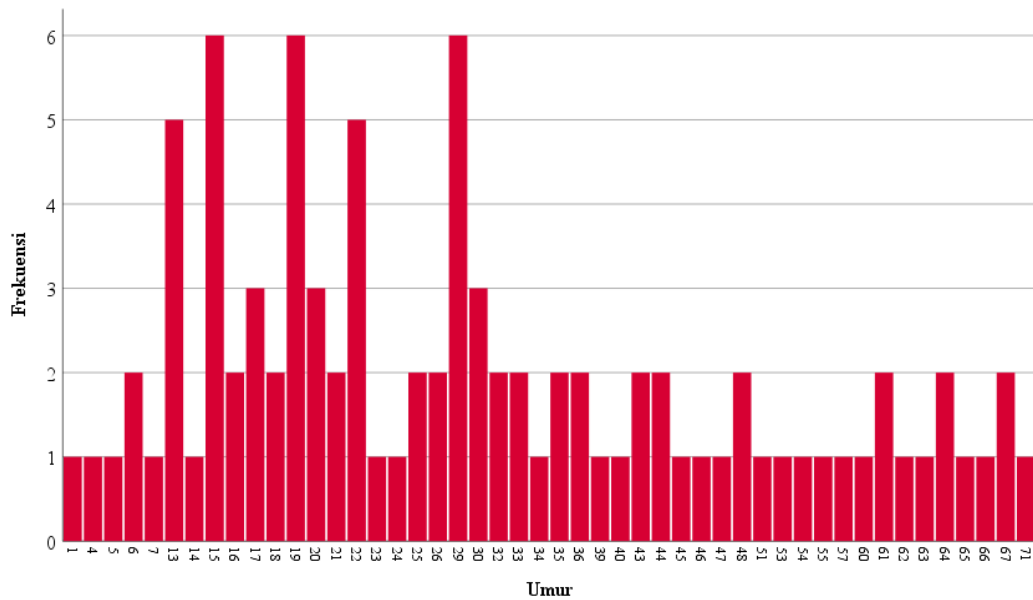


Figure 1. age distribution

There were 68 male patients. Meanwhile, there were 25 female patients. The sex distribution of the research subjects is described in figure 2.

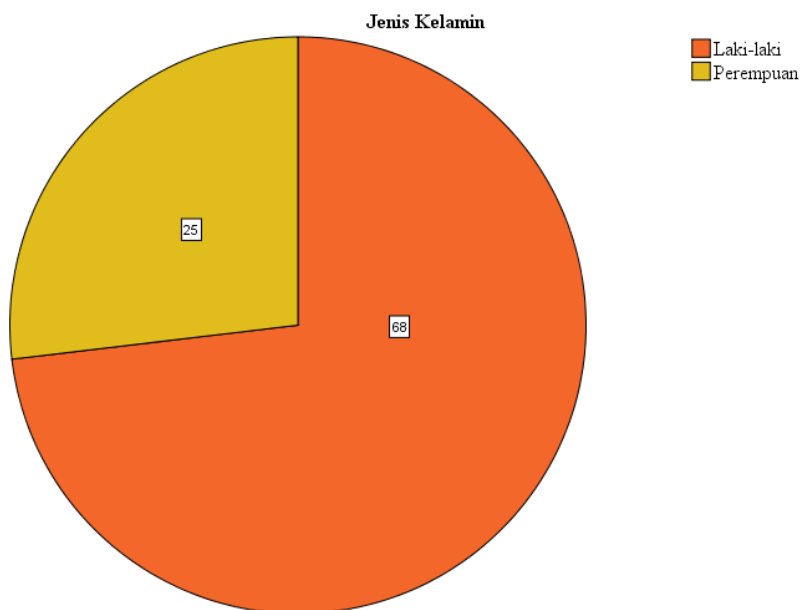


Figure 1. gender distribution

There were 49 patients who experienced major trauma. Meanwhile, there were 44 patients who experienced minor trauma. The distribution of multiple trauma research subjects is described in **figure 3**.

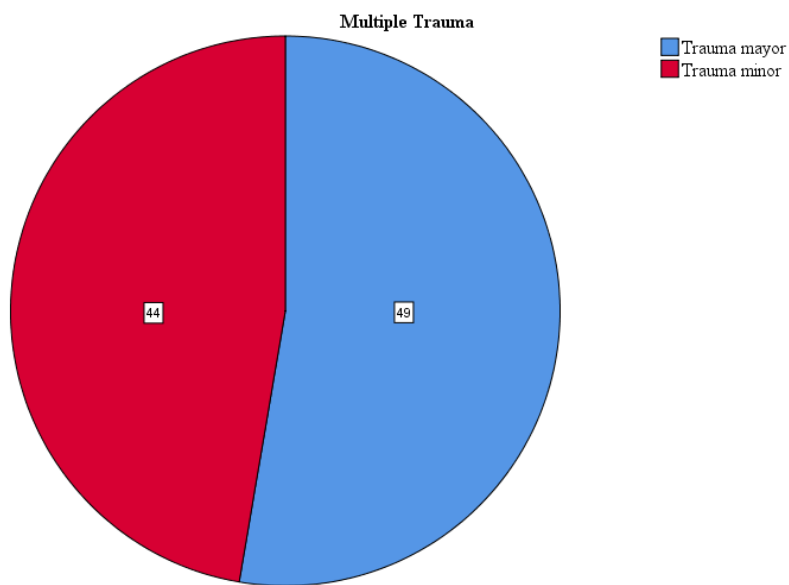


Figure 3. multiple trauma distribution

A total of 41 patients are still alive. Meanwhile, 52 patients have died. The distribution of deaths in the research subject hospitals is described in **figure 4**.

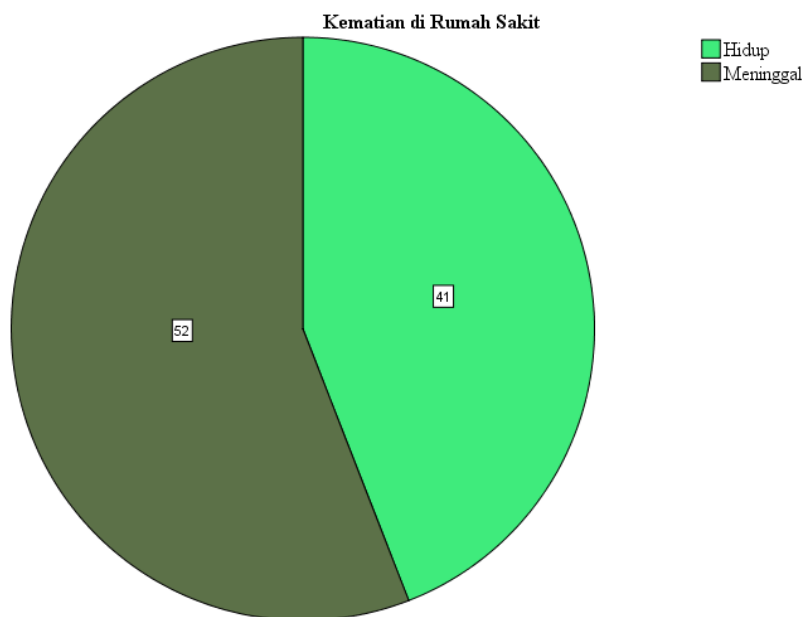


Figure 4. mortality in hospital

Reference distance Based on Figure 4.5. the majority of respondents with a distance of < 76 Km with 54 people, followed by ≥ 76



km with 39 people.

Figure 4. reference distance

The ISS score ≥ 16 was the majority, namely 48 (52.7%) people. Meanwhile, the ISS score of 75 was the least, namely 1 patient. The distribution of the ISS scores of the research subjects is described in **figure 6**.

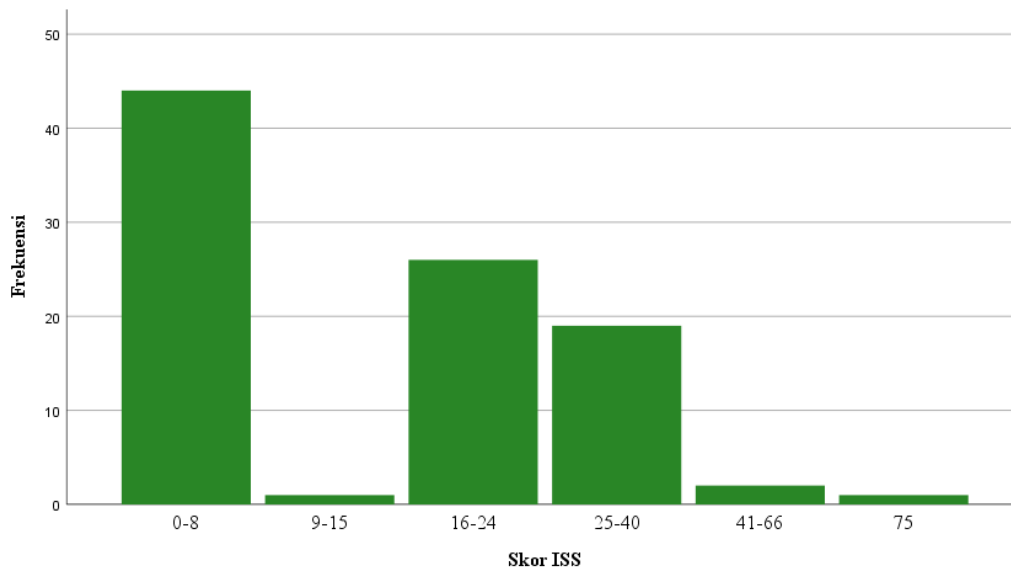


Figure 6. ISS score

There is a relationship between referral distance and death in hospital with a P value <0.05

Table 2. referral distance and death in hospital

	death	Live	P score
Distance ≥ 79 Km	38	1	<0,001
Distance < 79 Km	14	40	

Using the odds ratio formula $x: AxD/CxB : 38x40/1x14 : 108,571$, the odds ratio is 108,571.

Variable multiple trauma (categorical) with death in hospital (categorical) is a 2x2 table analysis which is analyzed using Fisher's test because it does not meet the requirements of the Chi Square test. Based on this analysis, it was found that there was a significant relationship between multiple trauma and death in the hospital ($p < 0.001$). The results of the analysis are described in Table 3.

Table 3. relationship between mortality and trauma

	death	live	P score
Trauma minor	41 (44,1%)	3 (3,2%)	<0,001
Trauma mayor	0 (0,0%)	49 (52,7%)	

*uji Fisher

DISCUSSION

The mean age of the patients in this study was 31.08 ± 17.820 years. These results are similar to a study by Greve et al (2022) in Germany which stated that the median age of patients was 43 (29-51) years. However, these results are different from the study of Stengel et al (2022) in Germany which stated that the average age was 52.9 ± 18.9 years. The CDC states that accidental trauma ranks first as the top 10 causes of death cases aged 1-44 years in the United States (CDC, 2011). Meanwhile, trauma is the second highest cause in the 25-34 year age group in Indonesia (Ramadiputra et al., 2018).

The majority of patients in this study were male, namely 68 (73.1%) people. This is in line with general epidemiology which states that men constitute the majority of multiple trauma patients. This was shown by the study of Ranti et al (2016) which stated that the number of male patients was 81.98% and the research by Ramadiputra et al (2018) which stated that 82.76% of multiple

trauma patients were male. This can be explained because men generally have a higher level of mobility than women when using motorized vehicles, especially men of productive age (Novianty, 2017).

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 the more accompanying trauma will increase mortality in multiple trauma patients. Head trauma accompanied by pulmonary contusion will exacerbate gas exchange disorders so that breathing becomes disrupted and life threatening (Setiawan, 2019). Ramadiputra et al (2019) stated that 90% of deaths due to motorcyclist traffic accidents are found in developing countries (Ramadiputra et al., 2018). Low lactate clearance levels, severe shock index, and persistent base deficit at 6 hours are significant for multiple trauma mortality (Cortés-Samacá et al, 2018).

The average patient referral distance in this study was 79.67 ± 63.244 km. This is different from the research by Heriani and Wahyuni (2019) at the Ulin Hospital in Banjarmasin which stated that the majority of patient referral distances were ≤ 1 km, namely 21 patients (41.4%). The farther the referral distance, the longer the patient gets more adequate care.

The ISS score ≥ 16 was the majority, namely 48 (52.7%) people. This is in line with the study of Burkhardt et al (2012) which stated that ISS scores ≥ 16 were experienced by 344 patients (85.6%). The greater the ISS score experienced, the higher the mortality rate that occurs.

This study shows that there is a significant relationship between referral distance and hospital mortality ($p < 0.001$). This result is in line with the study of Hu et al (2017) which showed that the farther the accident location was from the trauma center, the higher the mortality of patients who had an accident. The mortality rate increased for every additional 1 mile or 1.609 km of distance to the trauma center with an OR of 1.002 per mile. Distance to the trauma center was a more significant factor influencing mortality in trauma patients ($p < 0.0001$) compared to age ($p > 0.05$) and gender ($p < 0.0001$).

The distance between the crash site and the trauma center has a median value of 39.2 miles for all drivers who have had fatal crashes. Mortality of motorized vehicle passengers who have fatal accidents with the distance from the accident location to the trauma center has a significant relationship. However, this significance is not as strong as the relationship between driver mortality and the distance from the accident location 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 (Hu et al, 2017).

The study of Kristiansen et al (2011) stated that mortality was higher at a referral distance of > 100 km reflecting the different phases of care when arriving at the trauma center. Interhospital transfers after severe trauma may only be feasible for younger patients as transport distances increase. The distance between the crash site and the nearest regional trauma center may be long and prehospital transport is often affected by weather and topographical considerations. This enhances the role of local hospitals in resuscitation, stabilization, and promptly transferring critically injured patients to higher levels of care. The optimal timeframe for admission to a trauma center and initial stabilization at a local hospital has not been determined, so there are no specific guidelines.

Risk factors associated with a trauma center such as distance to the nearest trauma hospital are strong predictors of fatal injuries in motorists. The study by Wiratama et al (2021) in Taiwan stated that a multivariate logistic regression model showed that motorcyclists who were involved in accidents located ≥ 5 km from the nearest trauma hospital were five times more at risk of experiencing fatal injuries (AOR = 5.26; 95% CI : 3.69-7.49). Distance, level, and area of the nearest trauma center are critical risk factors for fatal injuries among motorcyclists. To reduce trauma case fatality rates among motorcyclists, interventions should focus on increasing access to trauma hospitals.

The results of this study are also in accordance with the research of Crandall et al (2013) which linked the severity of trauma, age, race, gender, and insurance status from gunshot wounds. Shooting > 5 miles from a trauma center independently increased the risk of mortality (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 higher in locations far from the TSR. Mortality from motor vehicle accidents is also increasing in rural areas. This can be caused by the distance to the location of emergency medical services and hospitals. Distance to the hospital is a factor that can be related to mortality in accidents.

This study shows that there is a significant relationship between multiple trauma and death in hospital ($p < 0.001$). The more trauma experienced, the higher the risk of mortality that can occur. Stoutenbeek's study (2007) stated that the mortality rate in multiple trauma patients with selective decontamination of the digestive tract (SDD) was 20.9%. The overall late death was 15.3% because 29 patients died from brain injury. The OR of late death for SDD relative to controls was 0.75 (0.40-1.37). The overall infection rate was reduced in the test group (48.8% vs 61.0%). SDD reduced lower respiratory tract infections (30.9% vs 50.0%) and bloodstream infections due to aerobic Gram-negative bacilli (2.5% vs 7.5%). Meanwhile, no differences in organ dysfunction were found.

Various other causes of death in multiple trauma patients have also been demonstrated by several studies. Research by Frohlich et al (2014) showed that 15.3% of patients died due to multiple organ failure. Meanwhile, a study by Wafaisade et al (2011) stated that 16.2-22.0% of patients died from sepsis. A systematic review by Pfeifer et al (2016) showed that there was an increase in the mean age of the included study population. The rate of male trauma patients has been reported to be between 55% and 88%. In addition, injury severity has been shown to range widely among studies. The lowest ISS value is 9 and the highest is 62.3. Penetrating trauma rates also show a wide range from 4% to 38%. Almost all studies have shown consistent results regarding causes of death. Brain injury is still the leading cause of death over a 30 year period. Exsanguination and combined brain injury and hemorrhagic shock were reported in 6 of 15 studies.

Research by Giannoudis et al (2009) states that high-energy injuries are the cause of most of the multiple traumas in elderly patients. The death rate in older patients is more than double that seen in the adult population. Age, ISS and GCS were predictors of death in older patients. Elderly patients without physiological disorders upon admission to the hospital have a relatively high risk of inpatient death. This is in contrast to younger patients making it more difficult to predict which older patients might benefit from more aggressive monitoring or treatment. Significant survival rates can be achieved in old age even though the risk of death increases so that active treatment should not be stopped based on age itself.

REFERENCE

This study shows that patients with multiple trauma with a referral distance of > 79 km have a 108,571 times greater chance of dying compared to multiple trauma patients who are referred with a referral distance of less than 79 km. Therefore, it can be concluded that it is necessary to build a trauma center in every 79 km radius.

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