



Relationship Geographical Access and Maternal Mortality: Spatial Analysis

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Abstract

AIM: Banjar District is included in the top 3 of highest maternal mortality rates in South Kalimantan, Indonesia. The purpose of the study is to analyze the relationship between accessibility (distance, time, and transportation) with the incidence of maternal mortality in Banjar District.

METHODS: The study is an observational analysis using a case-control approach with a retrospective. The population was mothers who gave birth in the Banjar district on January 2015–December 2018. Criteria for inclusion of cases are mothers who experience death during pregnancy, childbirth or within 42 days before the end of the pregnancy period recorded in 2015–2018 at the Health Office and births at health facilities in Banjar District, which is represented by the family who knows the best about the mother's condition, while controls are respondents who do not die in the same year. Sample for case group is 25, by taking the comparison case: control 1:2, then, the sample size of the control group is 50. Statistical test uses Chi-square test.

RESULTS: The results show that there is the relationship between transportation ($p = 0.034$) and distance ($p = 0.035$) with the incidence of maternal mortality with Odds ratio (OR) 3.58 and 3.27. However, there is no relationship between time ($p = 0.118$) with the mortality of maternal.

CONCLUSION: Increasing the accessibility of health services can reduce maternal mortality, one of which is the provision of transportation to bring mothers closer to health facilities.

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Introduction

Maternal death is the death of any woman during pregnancy, childbirth or within 42 days of the end of pregnancy caused by various factors, regardless of age, and location of the pregnancy, accompanied by or aggravated by pregnancy or its handling but not by accident or incidental (accidental factor) [1].

According to the International Conference of NGO Forum on Indonesian Development in 2013, the cause of maternal death is also inseparable from the condition of the mother herself and is one of the criteria 4 T "too," that is, too old at the time of childbirth (>35 years), too young at the time of childbirth (<20 years), too many children (>4 years), and too close pregnancy/parity distance (<2 years) [2].

Based on the results of the Indonesian Health Demographic Survey (IDHS) in 2012, the maternal mortality rate in Indonesia has increased significantly when compared to the IDHS in 2007, the Maternal

Mortality Rate (MMR) was 228/100,000 live births to 359/100,000 live births. One of the SDGs to be achieved by 2030 is to reduce the number of MMR to below 70/100,000 live births. Indonesia was unable to achieve the Millennium Development Goals target, lowering MMR to 102/100,000 live births in 2015 and also has not reached the SDG's target of reducing MMR to below 70/100,000 live births [3].

The maternal mortality rate (MMR) of South Kalimantan Province fluctuated where in 2014 as many as 120 cases and decreased in 2015 by 85 cases but increased again in 2016 as many as 92 cases. The top three highest MMR cases in South Kalimantan in 2017, respectively, were Kotabaru Regency and Banjarmasin City each as many as eight cases, Banjar Regency as many as seven cases, and Hulu Sungai Tengah Regency as many as six cases [4].

Maternal mortality rate (MMR) for Banjar Regency is fluctuating. In 2014 Banjar Regency had the number of cases of maternal mortality as many as 25 cases in 2015 to 12 cases and until 2016 to

11 cases and in 2017 to seven cases, consisting of Astambul District with the highest number of cases, in Martapura District 2 and Kertak Hanyar, there were two cases each, and the District of Beruntung Baru, East Martapura, Sungai Pinang, and Simpang 2 each, there is one case [2].

McCathy and Maine presented three factors that affect the occurrence of maternal death, namely near determinants, intermediate determinants, and distant determinants [5]. Access to health care is one part of the determinant between. Improving infrastructure, both roads and health facilities, needs to be done so that access to health facilities is easier and will reduce maternal mortality. According to Cromley and Mc Lafferty (2002) in Achmadi (2012: 58), spatial analysis is the general ability to arrange or process spatial data into different forms in such a way as to add or give new meaning or additional meaning. Spatial analysis can be used to conduct an analysis of the distribution of factors related to maternal mortality based on determinants between, particularly accessibility to health services such as time, distance, and transport status [6]. Determining the incident of maternal death has been widely done. However, there has not been much seeing this determinant spatially. Spatial approaches are important for finding problems that occur according to time and place.

Materials and Methods

Study population and sampling

This research design is an observational analytical study that uses case control design or also called case-control studies with a retrospective approach. Cases are respondents who experience the death, while control is respondents who do not experience death. The control-case traced its past to find out the distance, time, and status of the transport. In addition, researchers took the coordinate point of the respondent's residence that there was a case of maternal death in Banjar Regency that is using GARMIN-branded GPS (Global Positioning System) aids. Data processing is carried out by the Geographic Information System (GIS) using Arcview GIS software so that the final result is obtained in the form of a vulnerability map of maternal death distribution based on distance, time, and status of transportation.

The population in this study was mothers who gave birth in Banjar district from January 2015 to December 2018. The criteria for inclusion of cases in this study were mothers who experienced the incidence of death during pregnancy, childbirth or within 42 days after the end of the pregnancy period recorded in

2015–2018 in the health service and gave birth in health facilities in Banjar Regency represented by families who know the mother's condition best. The criteria for inclusion of controls in this study were mothers who did not experience the incidence of death during pregnancy, childbirth or within 42 days after the end of pregnancy in labor recorded in 2015–2018 in the Health Office and giving birth at health facilities in Banjar Regency which was determined by simple random sampling method or probability sampling.

Study instrument

Data collection uses primary and secondary data. Primary data were obtained by interviews and questionnaires and Garmin to retrieve coordinate points. Instruments used in the secondary data obtained from the Banjar District Health Office, midwife records, verbal documents, and Mother and Child Health (KIA) books.

Research procedure

At the preparatory stage, research, and licensing was carried out to the National Unity and Political Agency of Banjar Regency and the Banjar Regency Health Office. At the stage of the implementation of data collection is carried out with several steps, namely, the first step conducted a preliminary study conducted to see the data of maternal deaths in the working area of Banjar regency and preliminary studies to see the data of pregnant women, childbirth, and postpartum in health centers that experience maternal mortality in the working area of Banjar Regency, namely, Puskesmas Martapura 1, Puskesmas Martapura 2, East Martapura Health Center, Tabuk River Health Center 1, Puskesmas Beruntung Baru, and Puskesmas Astmabul. The next step is an interview, where the interviewer who has done the training will collect data with questionnaires to respondents both in the case group and the control group by visiting each respondent's home. Moreover, the final step, the interviewer takes to coordinate points on the sample of the case and the location of the health facility. At the reporting stage, the data acquisition of research results has done data analysis using computerized assistance.

Statistical analysis

Data analysis is conducted univariate, bivariate, multivariate, and spatial analysis. Analysis of univariate data are analyzed descriptively analytically through a quantitative approach. Bivariate data analysis was conducted with the Chi-square test with a 95% degree of confidence. Multivariate analysis was conducted to analyze the association of several factors together with the incidence of maternal mortality. Moreover, spatial analysis is done with the geographic information system

(GIS) using Arcview GIS software so that the final result is obtained in the form of a map of the vulnerability level of maternal mortality spread based on distance, time, and status of transportation.

Results

Table 1 shows that on the distribution of transportation frequencies showed that mothers had more means of transportation (73.3%) compared to mothers who did not have a means of transportation (26.7%). The distance and frequency distribution showed that more mothers had affordable distances (62.7%) than mothers with unaffordable distances (37.3%). In the distribution of travel time, more mothers with travel time are not long (86.7%) compared to mothers who have long travel time (13.3%). The affordability of the community, including the distance of health facilities, will affect the selection of health services. In addition, distance is the second component that allows a person to utilize treatment services [7].

Table 1: Distribution of transportation frequency, distance, and time to respondents in Banjar Regency

Variable	Frequency (n = 75), n (%)
Transportation	
Have	55 (73.3)
Did not have	20 (26.7)
Distance	
Affordable	47 (62.7)
Unaffordable	28 (37.3)
Time	
Not long	65 (86.7)
Long	10 (13.3)

Data are presented as n (%).

Access to health services is an overview of affordability of the location of the service place, the type, and quality of services available. Accessibility can be calculated from travel time, mileage, type of transportation, and conditions in health services, such as the type of service, available health workers, and opening hours. Distance to distant facilities becomes a protective factor against the incidence of maternal death. Mothers who have a distance to the nearest health facility do not necessarily take advantage of these health facilities for various reasons such as the unavailability of obstetric emergency facilities and choosing existing facilities in the city [7].

Table 2: Relationship between variables studied and maternal mortality

Variable	Death of mother		Total, n (%)	p	OR
	Case, n (%)	Control, n (%)			
Transportation					
Have	14 (56)	41 (82)	55 (100)	0.034*	3.579
Did not have	11 (44)	9 (12)	20 (100)		
Distance					
Affordable	11 (44)	36 (72)	47 (100)	0.035*	3.273
Unaffordable	14 (28)	14 (56)	28 (100)		
Time					
Not long	19 (76)	46 (92)	65 (100)	0.018	3.632
Long	4 (8)	6 (24)	10 (100)		

*p < 0.05. OR: Odds ratio.

Discussion

Based on Table 2, the results of the study showed that cases of maternal death were more common at a distance of < 3 km from existing health facilities. The maximum service distance of a health facility is 5 km with a maximum service range of 3 km. The results showed that 15 mothers (60%) died in hospital after receiving follow-up referrals, 80% of cases died in hospitals in Banjar regency, and 20% of cases died in hospitals in Banjarmasin city. As many as, 40% of cases of death occur in village health center, village midwives, and auxiliary health center. The position of pregnant women should not be more than 5 km away from the mother's health facility to prevent death due to delays in accessing the facility. This study is in line with research conducted in Nigeria that distance with nearby health facilities does not have a significant association with maternal mortality [4].

Table 2 shows that most cases are classified as unaffordable for maternity health facilities (56.0%) with p value of 0.035 with OR: 3.27 (1.20–8.92). Table 2 shows that the cases classified as unaffordable for maternity health facilities were more numerous (56.0%) than those of the control group (28.0%) with a difference of 28.0%. This difference is significant as indicated by p value of 0.035, which means that there is a link between distance to maternity health facilities and maternal mortality events.

The average distance and time in the control group were closer to closer travel time. Maternal mortality patterns in using the use of health facilities are not caused by the closest distance factor alone, but can be caused by other factors such as quality of service, type of services available, financing, and sociocultural factors. The health care that has difficult access is an important factor that influences pregnancy outcomes, including the death of a maternity mother. The referral system, especially in the emergency services of midwifery, must be done appropriately and must avoid three late, namely, delays in decision making, delays in reaching the point of referral, and delays in obtaining services at the referral site [2].

Most cases groups are classified as long travel times to maternity health facilities (24.0%) with p value of 0.075 with OR: 3.63 (0.92–14.34), as shown in Table 2. In addition, there were more cases of travel time taken to maternity health facilities (24.0%) than those of the control group (8.0%) with a 16.0% difference. This difference was not as significant as shown by p value of 0.075 which means that there was no association between travel time to a maternity health facility and the incidence of maternal death. The study used GPS to calculate in real terms the distance and travel time of cases and controls, leading to maternity health facilities being used. Data on distance and travel time were more objective than just asking respondents. Most of the respondents were classified as affordable distance

to maternity health facilities and travel time taken to maternity health facilities was classified as affordable.

Geographic access to health centers is embodied as a strong predictor of facility utilization [8]. Distance to maternity health facilities is one of the delays of the Thaddeus and Maine second type models [9]. Physical distance to health-care facilities has been widely recognized as an important determinant in accessing maternal health facilities [10], [11], [12], [13]. Geographic location is a major component in the utilization of maternal health-care services [14], [15], [16]. Patients tend to use health facilities closer than far away. The results of this study are that there is a link between distance to maternity health facilities and maternal mortality events in line with the Afrina Siska study in 2019 but differs from the Manyeh study (2018) [17], [18].

Travel time to maternity health facilities is one of the delays of the Thaddeus and Maine second type models [9]. Minimizing travel time to maternity health facilities is an important component of strategies to reduce maternal mortality as well as the availability of transportation, poor families need hours to walk to reach health facilities either because they cannot afford transportation costs or because they cannot wait for limited, slow and/or uncomfortable transportation services as a result of poor road conditions.

Activities carried out for labor planning are one of them by preparing a place of delivery and transportation. Based on access to health services with the longest distance of +15 km and closer to +1 km, ideally, the reach of the community (mileage and travel time) to health-care facilities should be as easy as possible so as to make it and the community easier to obtain health services [9].

Conclusion

There are more mothers who have transportation, more mothers who have affordable distances with health facilities and more mothers with travel time not long (86.7%). Cases of maternal death are more common at a distance of < 3 km from existing health facilities. The maximum service distance of a health facility is 5 km with a maximum service range of 3 km. The results showed that 15 mothers (60%) died in hospital after receiving follow-up referrals, 80% of cases died in hospitals in Banjar regency, and 20% of cases died in hospitals in Banjarmasin city. As many as, 40% of cases of death occur in village health center, village midwives, and auxiliary health center.

Improvement of road and bridge facilities is urgently needed to facilitate access to available health services and health facilities. In addition, the provision of easily accessible public transportation is also very

important in efforts to prevent maternal deaths. In addition to infrastructure, the importance of active and continuous communication, information, education for pregnant women and their families by health workers regarding what must be prepared before giving birth and what are the things that can prevent maternal death during the delivery process.

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