

THE CORRELATION OF QUALITY OF ANTENATAL CARE, MATERNAL COVID, AND MATERNAL MORTALITY DURING THE PANDEMIC PERIOD IN EAST JAVA, INDONESIA

Dandy Candra Satyawan^{1,2*}, Wahyu Setyaningsih¹, Ririn Widyowati Supangat¹,
Ernawaty³, Ratna Dwi Wulandari³

¹ Magister program of Health Policy Administration Interest in Health Care Management, Faculty of Public Health, Airlangga University Surabaya, Indonesia

² Health Office of Jember District, East Java, Indonesia

³ Faculty of Public Health, Airlangga University, Surabaya, Indonesia

Correspondence address: Dandy Candra Satyawan

Email: dandy.can.satyawan-2021@fkm.unair.ac.id

ABSTRACT

Introduction: Indonesia's *maternal mortality rate* is still above the target of the *Sustainable Development Goals* (SDGs). Meanwhile, the trend of maternal mortality in Indonesia during the COVID-19 pandemic in 2021 increased sharply from 4,627 to 6,865 cases in 2021. **Aims:** This study was conducted to analyze the relationship between the quality of maternal health services on the incidence of *maternal COVID* and *maternal mortality* during the COVID pandemic in East Java, Indonesia. **Methods:** The research was conducted in East Java Province in 2021. The sample was randomly selected as many as 35 samples from a total of 38 samples of Regencies / Cities. The data used secondary data sourced from data from the East Java Health Office. Data analysis used *Person Correlation analysis* with *Chi-Square analysis* method. **Results:** The first hypothesis did not find a relationship between quality of *Antenatal Care services* and *Maternal COVID* cases (p-value: 0.195, r: -0.087). The second hypothesis has a significant relationship between the *Maternal COVID* and the *Maternal Mortality* (p-value: 0.040, r: 0.548). Also, the third hypothesis showed a substantial correlation between *Maternal Mortality* and quality of *Antenatal Care* (p-value: 0.001, r: -0.555). **Conclusion:** There is a strong relationship between the high *Maternal COVID* cases and the quality of access to *antenatal care* services to the high *Maternal COVID* cases during the pandemic. There needs to be a strategy to improve the quality and access of *antenatal care* services in reducing the high *maternal mortality rate*.

Keywords: Antenatal Care, Correlation Analysis, Maternal COVID, Maternal Mortality, Pregnancy.

INTRODUCTION

Antenatal care (ANC) is a monitoring and examination process that is important for the health of pregnant women and their babies. This process offers highly efficient medical interventions that can reduce maternal and newborn morbidity and mortality. The World Health Organization (WHO) recommended in 2002 that pregnant women with positive pregnancies undergo a minimum of four ANC visits during the course of their pregnancy (Kasagama, Todd and Renju, 2022). This is also stated in Regulation of the Minister of Health of the Republic of Indonesia No. 21 of 2021,

which specifies that K1 (An indicator of the first visit on the examination of pregnant women) coverage is a useful indicator for describing pregnant women's access to pregnancy services. A third of pregnancy issues will be discovered with the cooperation of pregnant women performing ANC. Meanwhile, indicators that can describe the quality of service are the coverage of K4 and K6 (4th visit and 6th visit) and subsequent visits if necessary (Regulation of the Minister of Health of the Republic of Indonesia Number 21 of 2021). According to the WHO statement, antenatal care that is both adequate and of high quality will effectively influence the promotion of

Cite this as: Satyawan, D.C., Setyaningsih, W., Supangat, R.w., Ernawaty and Wulandari, R.D. (2023). The Correlation of Quality of Antenatal Care, Maternal Covid, and Maternal Mortality During The Pandemic Period in East Java, Indonesia. *The Indonesian Journal of Public Health*, 18(3), 432-444. <https://doi.org/10.20473/ijph.v18i3.2023.432-444>

better maternal and fetal health outcomes (WHO, 2014). Utilizing maternal health care effectively can help lower MMR. Strengthening antenatal care (ANC) is a typical MMR intervention, particularly in impoverished nations (Nuryana, Viwattanakulvanid and Romadlona, 2022). According to a study conducted in Indonesia, fewer women are using ANC due to a number of variables, including low maternal education, poverty in rural areas, and relatively tight childbirth intervals (Kurniati et al., 2018).

The severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) pandemic, which is to blame for the 2019 coronavirus illness (COVID-19), has spread globally, causing a significant shift in health trends and big cases that happen very quickly. By the end of 2020, there were 61,869,330 confirmed cases of COVID worldwide, resulting in 1,448,896 fatalities (Suhariyanto, Rangkuti and Hartono, 2020). Pregnant women are a condition that is prone to developing more severe symptoms after experiencing this respiratory viral infection. This occurs as a result of the physiological modifications that every pregnant woman's immunological and cardiovascular systems go through during pregnancy (Cuñarro-López et al., 2021). The pandemic case had slowed down in early 2021, but along with the easing of the pandemic status and the many holidays that occurred which led to a decline in existing health protocols, finally in mid-2021, precisely in July and August there was a second spike, the peak of which far exceeded the peak of the first spike. . The spike in these two cases was in line with the discovery of a new variant, namely the Delta variant, which has a more infectious nature with a higher severity and mortality rate than the previous COVID variant. The Indonesian government was overwhelmed with the high occupancy rate of the hospitals which were *overloaded* at that time. The death rate has increased significantly, resulting in health workers and the public owning

many comorbid victims. There will be 1280 maternal deaths in Indonesia in 2021 as a direct result of this ailment, with a particular impact on the East JavCOVID-19) caused 793 of these deaths, and the remaining 487 instances weren't COVID-related (East Java Health Office, 2022).

In 2021, maternal *health services* will have problems related to the development of COVID, which is quite worrying. This condition affects the mobility of people, including pregnant women, to visit health facilities for routine check-ups. However, the government has initiated an indirect health check-up program, where pregnant women can still have their condition checked using existing communication tools to monitor their health. If you need immediate help, health workers will pick up the patient with standard prevention equipment according to the established COVID prevention protocol. With this condition, it was found that 536,669 (90.54%) pregnant women had made their fourth visit (K4) out of the total target of 592,735 pregnant women. This achievement is still below the national target where the central government targets 95% of pregnant women to receive pregnancy services four times (K4) during their pregnancy. Meanwhile, the development of COVID data in Indonesia grew rapidly in 2021 due to the spread of a new variant with the name of Delta. As a result of this variant, there was an explosion of extraordinary cases with a higher severity and death rate than in the previous variant. Multiple and Mixed variants of SARS-CoV-2 are circulating globally in all regions and countries. One of them is the B.1,617 lineage (Delta variant) which was first detected in India starting in 2020 (Monajjemi, Kandemirli and Mollaamin, 2021). This variant shows more severe symptoms and has a high mortality rate with a high transmission rate and is resistant to vaccination (Moghaddar, Radman and Macreadie, 2021). The increase in cases of the Delta variant of

COVID resulted in a significant increase in *maternal COVID cases* in East Java. As many as 5022 cases of pregnant women

exposed to COVID- 19 were recorded in all districts and cities in East Java in 2021 (East Java Health Office, 2022).

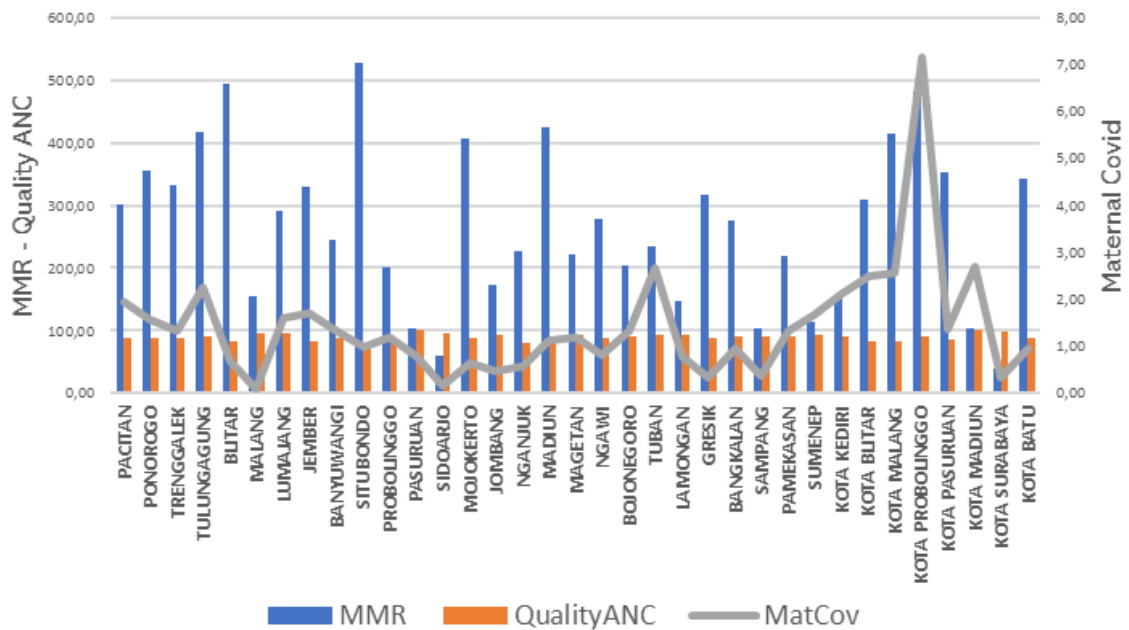


Figure 1. Distribution of MMR, K4, and Maternal COVID Cases in East Java 2021 (East Java Health Office, 2022).

The Sustainable Development Goals' (SDGs) target for maternal mortality in Indonesia is still being exceeded (Fadilah et al., 2019). According to estimates, 77% of Indonesian women between the ages of 15 and 49 had at least four ANC visits in 2017. Data indicate a gradual reduction from 88% coverage for this number since 2012. Maternal mortality ratio (MMR) of 126 per 100,000 live births in Indonesia remains quite high compared to high-income nations, despite the fact that national ANC coverage (minimum of four visits) can be deemed satisfactory at the current level of 77% (Unicef, 2021). Maternal mortality climbed from 4,623 instances in 2020 to 6,865 cases in 2021. East Java became the largest contributor to maternal deaths in 2021 with 1280 cases of death (Rustandi, 2022). A study in India also stated that national health policies are needed to pay attention to the health needs of everyone because maternal healthcare requires special attention. After all, women are

considered the most vulnerable group in society (Katyal, 2018).

Many theories mention the cause of *maternal death*. Maternal death is a condition that can be prevented by identifying high-risk patients, conducting quality antenatal check-ups, and identifying complications that may arise (Sulistyono and Joewono, 2020). One of these complications affects the increase in *sectio surgery caesarean section*, such as the research conducted by Debrabandere, Farabaugh and Giordano (2021).which stated that the COVID-19 pandemic caused an increase in *emergency cases so that cesarean delivery was unavoidable*. Numerous specialists have already investigated the pattern of causes of maternal death, which is impacted by a number of circumstances. One of the theories from McCarthy and Maine provides a detailed determinant framework for analyzing maternal mortality and morbidity. According to this idea, there are three different categories of determinants:

distant, intermediate, and proximal or direct. The direct causes of maternal mortality, which begin in pregnancy and may result in pregnancy-related problems such as hemorrhage, infection, pregnancy-induced hypertension, and obstructed childbirth, are influenced by the remote

determinants and the intermediate determinants (Karkee, 2012). The following figure is a theoretical framework for the incidence of maternal death according to McCarthy And Maine. We use this framework to develop a research framework.

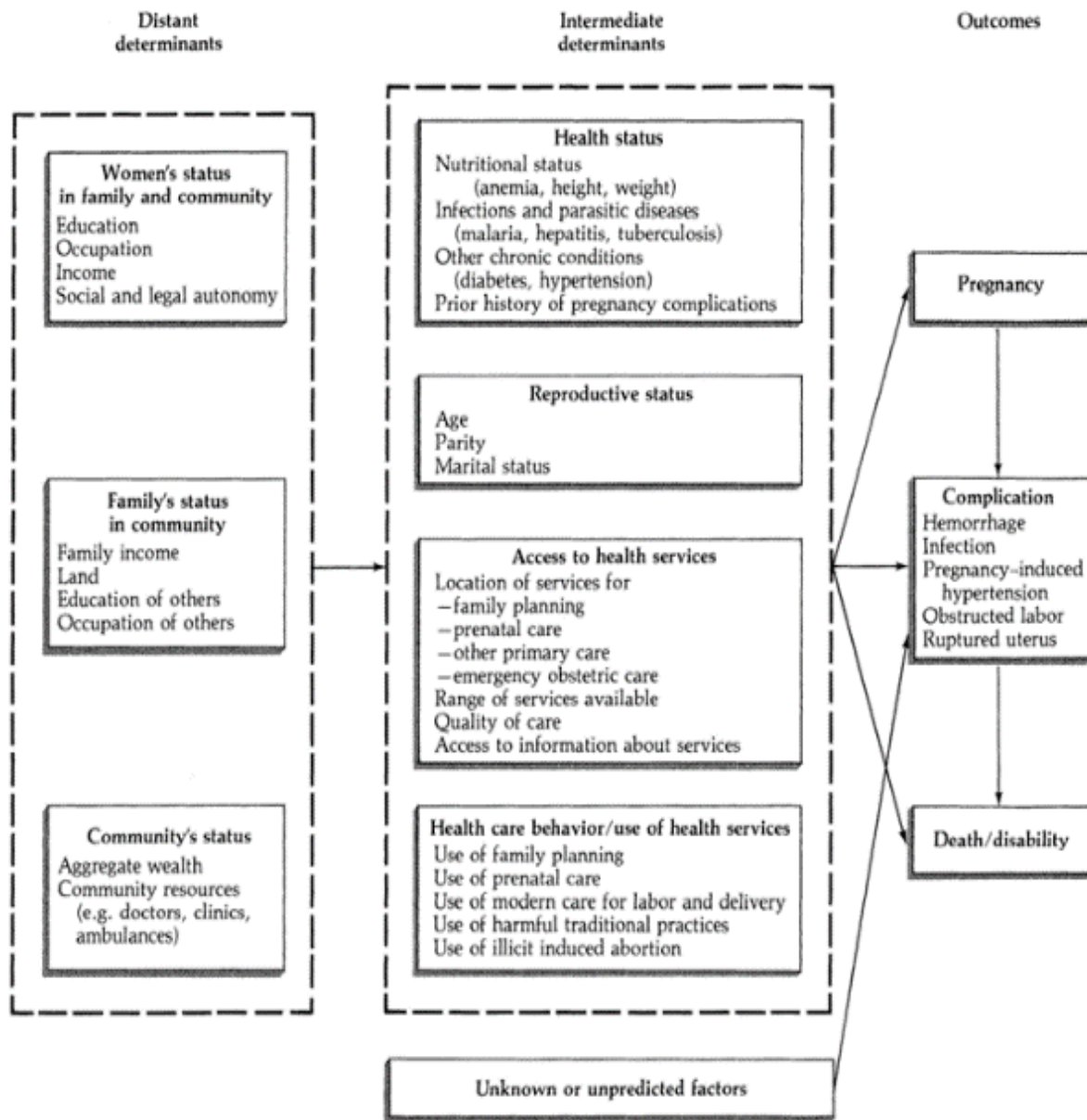


Figure 2. An extensive framework for divining the factors that influence maternal mortality and morbidity (McCarthy and Maine, 1992)

Improving the quality and access of services for pregnant women needs to be done to maintain the condition of pregnant women during the current COVID pandemic. It is hoped that maintaining the

condition of pregnant women, both in conditions of COVID infection and in other infectious conditions, will reduce the maternal mortality rate which is currently still an obstacle that needs to be solved. By

knowing the relationship between the quality of antenatal care service variables, the incidence of cases of pregnant women with COVID, and the maternal mortality rate, it is expected to formulate strategies and policies related to services for pregnant women in the future.

METHOD

The study used secondary data by comparing report data from all districts and cities in East Java Province. The data used are on the achievement of Maternal and Child Health (KIA) program activities from all districts/cities in East Java province in 2021. The data used for the sample are secondary data obtained from year-end reports from the East Java Provincial Health Office. The sample calculated using the Slovin formula was obtained from as many as 35 selected samples in East Java Province. Then the sample was chosen randomly from a total population of 38 regencies/cities in East

Java. All data have been verified at the Provincial Health Office level, which was carried out in early 2022. The data obtained were used in the variables in this study.

The data in this study represent three variables that are used to test the three hypotheses of the relationship between the quality of *Antenatal Care* (ANC) services with the incidence of pregnant women and maternal mortality. The three hypotheses are: (H-1) there is a relationship between the quality of *antenatal care* (ANC) services with the incidence of COVID-19 in pregnant women. (H-2) There is a relationship between the incidence of pregnant women and maternal mortality. (H-3) There is a correlation between the quality of ANC services and the maternal mortality rate. The three hypotheses are presented in the framework of conceptual research adapted from McCarthy and Maine’s theoretical framework, which can be described as follows.

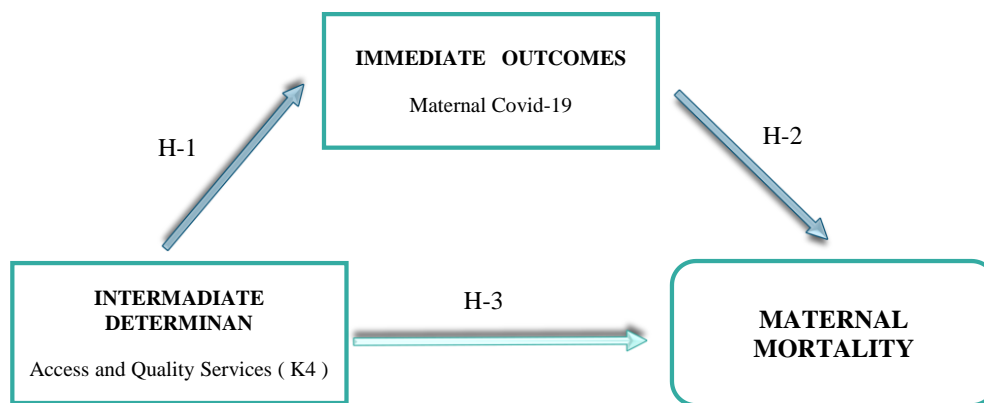


Figure 3. Research Conceptual Framework

As depicted in the figure, three variables will be analyzed to obtain the relationship between the three. The third variable, Maternal COVID-19, reflects the immediate factor. The fourth ANC visit variable (K4) describes the availability and quality of antenatal care (ANC) services. The number of maternal deaths serves as a proxy for the pandemic's outcomes and maternal mortality. After determining the

variables used, the next step is the operational definition of the variables.

The constraints and knowledge that the three variables have in accordance with the conceptual framework utilized are the operational definitions used in this study. The first is that the quality of antenatal care is a variable description of service health of mothers rated pregnant _ from the visit of pregnant women according to

the procedures contained in the report of the 4th ANC visit (K4). K4 is the contact of pregnant women with health workers who have the competence to get integrated and comprehensive antenatal care according to standards during pregnancy at least four times with an inspection interval of once in the first trimester (0-12 weeks), once in the second trimester (between 12 and 24 weeks) and twice in the third trimester (more than 24 weeks until delivery), divided by the total population of expectant women, multiplied by 100%, and then summarized at the puskesmas and district levels, followed by periodic reporting to the provincial health office (Regulation of the Minister of Health of the Republic of Indonesia Number 21 of 2021). The data are divided into two categories: data with a value greater than or equal to 95% are classified as *Low*, while data with a value less than or equal to 95% are classified as *High*. The second is the Maternal COVID Variable, which is a symbol for identifying a pregnant woman who has symptoms of the Corona virus by validating her diagnosis using an antigen swab or PCR swab. The data for this variable were collected in 2021 and then collected and recapitulated by each district to be reported to the Province East Java. The results of categorical data are divided into two categories, namely *Low*-value data if the incidence of maternal COVID-19 occurs below 1% and if the value above is equal to 1% it becomes a category with *High* value. The third is the Maternal Mortality variable, which is the maternal mortality rate divided by the number of live births multiplied by one hundred thousand which is recapitulated in one year in each district and city in East Java Province. The data are then categorized based on the national target of reducing maternal mortality, namely 183. The data are then divided into two categories: *Low* (data less than 183), which is included in the low category, and *High* (data over 183). The data are then analyzed by entering then in the analysis

table after being processed to create categorical type data. Then, the analysis is continued with a Pearson correlation test using the *Chi-Square test* on the three research hypotheses with an error rate (*error rate*) of 5% (= 0.05), and with a correlation coefficient (*r* value) ranging from -1 to 1. The research has also received ethical clearance from Unair University with the following number: 130/EA/KEPK/2022.

RESULT

In this study, the relationship between variables was determined using *Chi-Square analysis* or the Chi-Square test, which is a form of analytical technique to test the level of relationship between categorical variables (Negara, 2018). This Chi-Square correlation analysis produces a correlation conclusion in the form of a table which must be interpreted based on the rules of interpretation. The procedure for interpreting the *Chi-Square* correlation is as follows. If the value of $r < 0.05$ is found, then there is a significant correlation. On the other hand, if the *r* value > 0.05 , the measured variable has an insignificant correlation (Bramantoro, Alhaq and Prasetyo, 2020). While the *r* table is a formula that has been determined based on the number of samples and the level of significance. After mastering the interpretation technique, the next step is to analyze variables and research hypotheses.

The data obtained from the three variables in the early stages were analyzed descriptively and the results obtained are as listed in Table 1. According to the findings of the descriptive analysis, there were noticeably more areas and districts with high mortality categories for the Maternal Mortality variable. Meanwhile, in the ANC quality variable represented by the K4 variable, it was found that more regions/regencies had poor results in measuring their ANC quality. In the province of East Java, it was discovered that there were numerous regions/districts

with high categories of maternal COVID instances in each of them.

Table.1 Descriptive analysis of the three variables

Variable	Frequency	Percentage
Maternal Mortality Rate (MMR)		
High (> 183)	27	71.05
Low (< 183)	11	28.95
K4 visit		
Low (<= 90%)	20	52.63
High (> 90%)	18	47.37
Maternal COVID		
Low (<1%)	15	42.86
High (>=1%)	20	57.14

There are three hypotheses that the analysis process must carry out to get results that prove the truth of the hypotheses that have been made. The

analysis is carried out by contrasting the studied variables from the three prevailing hypotheses. The analysis technique uses *Chi-Square* and *Fisher exact* analysis test.

Table 2 . Chi-Square H-1. Correlation Test Results

Variable	Maternal COVID		Total	p value	r value
	Low	High			
K4 visit					
Low	11 (46.7%)	18 (53.3%)	29 (100.00%)	0.1954	-0.087
High	4 (15.0%)	2 (85.0%)	6 (100.00%)		

In the first hypothesis, correlation test measurements were carried out on two variables, namely the service quality variable (K4) with the incidence of *Maternal COVID*. As shown in the table below, the results of the *Chi-Square calculation* show that the correlation

relationship is not significant (P- value: 0.195). Unusual findings show there is a tendency in the other direction from the hypothesis where the higher quality ANC visit found upgraded case maternal COVID occurrences.

Table 3. Chi-Square H-2. Correlation Test Results

Variable	Maternal Mortality		Total	p value	r value
	Low	Tall			
Maternal COVID					
Low	7 (46.7%)	8 (53.3%)	15 (100.00%)	0.04015*	0.548
High	3 (15.0%)	17 (85.0%)	20 (100.00%)		

In the second hypothesis, a correlation test was conducted on the *Maternal COVID* variable and the *Maternal Mortality* variable. As shown in Table 3, in this hypothesis, trying to find

out the relationship between the two variables by calculating using the analysis method found a significant relationship (p-value: 0.04)

Table 4. Chi Square H-3. Correlation Test Results

Variable	Maternal Covid		Total	p value	r value
	Low	Tall			
K4 visit					
Low	5 (5.0%)	24 (95.0%)	29 (100.00%)	0.001106**	-0.555
High	5 (55.6%)	1 (44.4%)	6 (100.00%)		

In the third hypothesis, a correlation test was carried out on two variables of service access quality (K4) with *Maternal COVID*. As can be seen in Table 4, based on the results of processing the existing data, very significant results were found in testing this third hypothesis (p- value: 0.001, r-value: -0.555). So that a strong relationship was found between the Maternal COVID variable on maternal mortality.

DISCUSSION

The findings of calculations using the Chi-Square approach allow for an analysis of the association between the variables of the fourth visit (K4) to ANC on the incidence of pregnant women with COVID and cases of maternal death. From the analysis, it has been able to determine the three hypotheses in this study. The first hypothesis is related to the effect of the fourth ANC visit (K4) on pregnant cases with COVID that occurred in 2021 and showed no relationship was found regarding this first hypothesis. This is consistent with Pareek et al.'s (2020) research, which found that ethnicity has a major impact on the incidence of COVID, a condition that is also strongly influenced by cultural and behavioral aspects in how people react to the development of a disease. So individual decisions, including pregnant women, to check conditions at health facilities when symptoms of illness occur will determine how big the impact of the incidence of COVID-19 on pregnant women will be. Maternal mortality is influenced by determinants, such as quality and availability to services that affect outcomes and conditions of pregnant

women, which in turn shape the condition of maternal mortality, as stated in the context of McCarthy's and Maine's (1992) theory. The K4 sub-variable in this study served as a replacement for the quality and service access variables, while the occurrence of pregnant women served as a proxy for the complications variable. COVID brings up a different fact. The current coronavirus condition makes it particularly difficult to detect all pregnancy issues during antenatal care visits. Then, the psychological factors that were gripping during the high number of COVID-19 cases in mid-2021 had a tremendous psychological impact, so that pregnant women were afraid to be tested for reasons of fear of being diagnosed with COVID and carrying out a quarantine process. This is also most likely related to the officer's understanding of health services regarding *screening* and ANC service standards in COVID conditions are still lacking so that activities have not been carried out optimally. The relationship of other variables will be discussed through the next hypothesis analysis.

The second premise of this study is to determine whether there is a connection between the prevalence of COVID-19 in pregnant women and the high rate of maternal mortality in East Java. It is well-documented that, during this pandemic, there was a spike in the number of COVID cases, which had an effect on how often COVID cases were transmitted to pregnant women. According to existing data, there is an explosion of COVID cases in pregnant women with 6190 cases, most of which appeared during the *spike* in cases in July and August 2021. Based on the analysis calculations, there was a significant correlation (P <0.05) related to

the variable incidence of cases of pregnant women with COVID to the increase in maternal mortality cases. This is in response to a number of studies, one of which was suggested by Allotey et al. (2020) in "*Clinical manifestations, risk factors, and maternal and perinatal outcomes of Corona virus disease*" that the presence of COVID in pregnant women will increase the likelihood that they will require intensive care in the ICU and will increase the likelihood that other complications, such as preeclampsia and eclampsia, will occur. According to study from Public Health England, which claimed that death is consequential, this is made even worse. Due to an increase in instances, COVID in expectant women will worsen.

Home care is needed during the increasing incidence of COVID cases. However, there are some differences in views on research conducted before 2021 and research conducted in 2021. As research conducted by Kotlar et al. (2021) in "*The impact of the Covid-19 pandemic ounces maternal and perinatal health: a scoping a review*" concluded that COVID cases did not carry an increased risk of contracting COVID which ended in death. This contradicts the findings of Villar et al.'s study (2021), "*Maternal and Neonate Morbidity, and Mortality among Pregnant Women with and Without Covid-19 Infection: The INTERCOVID Multinational Cohort Study*," which found that pregnant women with COVID have a higher risk of death and worse health outcomes than pregnant women without COVID-19 conditions. This condition indicates that, in 2021, there will be an increase in cases of the new COVID variant (Delta) which incidentally has different characteristics from the nature of the COVID infection in the previous year. So that the cases that occur in pregnant women with COVID in East Java in 2021 are a transmission of COVID caused by the Delta variant which, from research, shows a strong connection to the incidence

of maternal mortality. COVID-19 infection in pregnant women appears to have negative effects on both maternal and neonatal outcomes, according to a study conducted in Italy. It is crucial to note that the majority of maternal deaths include patients who have severe SARS-CoV-2 infection-related symptoms and significantly changed parameters (Di Guardo et al., 2021). So this conclusion is in line with research that concludes that COVID cases will directly increase maternal mortality cases.

In the third hypothesis, the fourth visit research variable. Antenatal Care (K4), represents the quality and access of services in terms of the association between maternal mortality cases and the quality and access of services provided to expectant women. From the results of the calculation of the relationship analysis using the Chi-Square technique, it was found that there was a fairly strong relationship between the two variables. This is related to a study conducted in Central Java by Prahutama et al. (2021), which found a strong relationship between the first visit (K1), fourth visit (K4), administration of vitamin Fe, delivery complications, and birth attendants on the rate of maternal mortality. These findings are consistent with Jones et al.'s (2021) research on the quality of ANC, which found that, even though the number of ANC visits is high, individuals do not always conduct ANC examinations promptly because they are afraid of the results. This results in subpar ANC quality, which raises the risk of maternal mortality. Aini, Purhadi and Irhamah (2020) did a similar study in Central Java Province the next year, and likewise demonstrated a substantial relationship between K1 and K4 on the risk for maternal death. The quality of *antenatal care services* is also inseparable from the role of health duties, especially midwives who also make an important contribution to preventing complications of death

during pregnancy and childbirth (Hiola and Badjuka, 2020).

Like research in general, this research also has strengths and weaknesses. The weakness of this research is it only aims to describe trends from the current picture of the condition of maternal health services during the pandemic so the data used are only secondary data. So that still needs research on direct targets to obtain more valid data. The data used are only in one province of East Java, so it does not fully describe the general conditions in Indonesia. The advantages of this research are in complete secondary data for all districts and cities in East Java Province. The data have also been verified at the provincial level so that the data presented are real and valid.

CONCLUSION

This study concludes from the three hypotheses regarding the relationship between quality and service access to *maternal COVID cases* and the occurrence of maternal deaths, which so far have been the Indonesian government's work to resolve. The results of *Chi-Square* analysis obtained that there was no significant relationship ($p > 0.195$) between the quality and access of pregnant women's services to the high cases of COVID that occurred in 2021. Then a significant result was found ($p = 0.040$) between the high *maternal COVID cases* and the high maternal deaths during the 2021 pandemic. There is a fairly significant correlation ($p = 0.0012$) between quality and access to services for pregnant women and high maternal mortality cases in East Java. From the results of these calculations, conclusions can be obtained.

Further research is needed regarding the relationship between ANC quality and the incidence of maternal COVID-19 which shows results that are contrary to the theory that has been put forward. It is hoped that there will be empirical evidence of the real conditions

that occur in health services in Indonesia. The strong relationship between the quality of ANC services and efforts to reduce maternal mortality is expected to be implemented immediately. It is hoped that knowing the relationship between the quality of ANC, the incidence of COVID infection, and maternal mortality, can provide input on policy recommendations at all levels of policy makers from the central and regional levels so that there is an improvement in the quality of services for pregnant women, maternity and postpartum mothers during the increasing threat of global infection that occurs.

ACKNOWLEDGMENT

Our gratitude goes to the East Java Provincial Health Office for providing access to the required data and thanks to Airlangga University Surabaya for providing the opportunity to improve the experience of conducting research. We thank the contributors who have helped examine the details carefully and for their useful comments and suggestions to improve the quality of this paper.

REFERENCES

- Aini, Q., Purhadi and Irhamah, 2020. Bivariate zero inflated generalized Poisson regression model in the number of pregnant maternal mortality and the number of postpartum maternal mortality in the Central Java Province in 2017. *Journal of Physics: Conference Series*, [online] 1511(1), p.12055. <https://doi.org/10.1088/1742-6596/1511/1/012055>
- Allotey, J., Stallings, E., Bonet, M., Yap, M., Chatterjee, S., Kew, T., Debenham, L., Llavall, A.C., Dixit, A., Zhou, D., Balaji, R., Lee, S.I., Qiu, X., Yuan, M., Coomar, D., Sheikh, J., Lawson, H., Ansari, K., Wely, M. van, Leeuwen, E. van, Kostova, E., Kunst, H., Khalil, A.,

- Tiberi, S., Brizuela, V., Broutet, N., Kara, E., Kim, C.R., Thorson, A., Escuriet, R., Oladapo, O.T., Mofenson, L., Zamora, J. and Thangaratnam, S., 2020. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. *BMJ*, [online] 370, p.m3320. <https://doi.org/10.1136/bmj.m3320>
- Bramantoro, T., Alhaq, A.M.G. and Prasetyo, N., 2020. *Jurus Statistik Dasar dan R Commander.pdf*. Purwokerto: CV. Pena Persada.
- Cuñarro-López, Y., Larroca, S.G.-T., Pintado-Recarte, P., Hernández-Martín, C., Prats-Rodríguez, P., Cano-Valderrama, Ó., Cueto-Hernández, I., Ruiz-Labarta, J., Muñoz-Chápuli, M. del M., Martínez-Pérez, Ó., Ortega, M.A. and De León-Luis, J.A., 2021. Influence of the Human Development Index on the Maternal-Perinatal Morbidity and Mortality of Pregnant Women with SARS-CoV-2 Infection: Importance for Personalized Medical Care. *Journal of Clinical Medicine*, [online] 10(16), p.3631. <https://doi.org/10.3390/jcm10163631>
- Debrabandere, M.L., Farabaugh, D.C. and Giordano, C., 2021. A Review on Mode of Delivery during COVID-19 between December 2019 and April 2020. *American Journal of Perinatology*, [online] 38(04), pp.332–341. <https://doi.org/10.1055/s-0040-1721658>
- East Java Health Office, 2022. *Health Profile of East Java Province 2021*. Surabaya: East Java Health Office.
- Fadilah, F.W.R., Handajani, S.S., Zukhronah, E. and Pratiwi, H., 2019. Geographically weighted negative binomial regression model to analysis of factors that influence on maternal mortality in Central Java Province. *AIP Conference Proceedings*, [online] 2202(1), p.20105. <https://doi.org/10.1063/1.5141718>
- Di Guardo, F., Di Grazia, F.M., Di Gregorio, L.M., Zambrotta, E., Carrara, G., Gulino, F.A., Tuscano, A. and Palumbo, M., 2021. Poor maternal-neonatal outcomes in pregnant patients with confirmed SARS-Cov-2 infection: analysis of 145 cases. *Archives of Gynecology and Obstetrics*, [online] 303(6), pp.1483–1488. <https://doi.org/10.1007/s00404-020-05909-4>
- Hiola, T.T. and Badjuka, B.Y.M., 2020. The Analysis Of Village Midwife Performance In Reducing Maternal And Infant Mortality Rate. *Jurnal Administrasi Kesehatan Indonesia*, [online] 8(2), pp.141–150. <https://doi.org/10.20473/jaki.v8i2.2020.141-150>
- Jones, L., Damayanti, N.A., Wiseman, N. and Harris, N., 2021. Factors Shaping Uptake of Antenatal Care in Surabaya Municipality, Indonesia: A Qualitative Study. *Kesmas: National Public Health Journal*, [online] 16(3). <https://doi.org/10.21109/kesmas.v16i3.4849>
- Karkee, R., 2012. How did Nepal Reduce the Maternal Mortality? A Result from Analysing the Determinants of Maternal Mortality. *Journal of Nepal Medical Association*, [online] 52(186). <https://doi.org/10.31729/jnma.77>
- Kasagama, E., Todd, J. and Renju, J., 2022. Factors associated with changes in adequate antenatal care visits among pregnant women aged 15-49 years in Tanzania from 2004 to 2016. *BMC Pregnancy and Childbirth*, [online] 22(1), p.18.

- <https://doi.org/10.1186/s12884-021-04350-y>
- Katyal, S., 2018. Patterns of Utilization of Maternal Healthcare Services in Haryana, India. *Asia Pacific Journal of Health Management*, [online] 13(1), pp.i31–i31. <https://doi.org/10.24083/apjhm.v13i1.29>
- Kotlar, B., Gerson, E., Petrillo, S., Langer, A. and Tiemeier, H., 2021. The impact of the COVID-19 pandemic on maternal and perinatal health: a scoping review. *Reproductive Health*, [online] 18(1), p.10. <https://doi.org/10.1186/s12978-021-01070-6>
- Kurniati, A., Chen, C.-M., Efendi, F. and Berliana, S.M., 2018. Factors influencing Indonesian women's use of maternal health care services. *Health Care for Women International*, [online] 39(1), pp.3–18. <https://doi.org/10.1080/07399332.2017.1393077>
- McCarthy, J. and Maine, D., 1992. A Framework for Analyzing the Determinants of Maternal Mortality. *Studies in Family Planning*, [online] 23(1), pp.23–33. <https://doi.org/10.2307/1966825>
- Moghaddar, M., Radman, R. and Macreadie, I., 2021. Severity, Pathogenicity and Transmissibility of Delta and Lambda Variants of SARS-CoV-2, Toxicity of Spike Protein and Possibilities for Future Prevention of COVID-19. *Microorganisms*, [online] 9(10), p.2167. <https://doi.org/10.3390/microorganisms9102167>
- Monajjemi, M., Kandemirli, F. and Mollaamin, F., 2021. Delta Variant of Covid-19 Study, and Why it is a Concern: An Overview. *Biointerface Research in Applied Chemistry*, [online] 12(5), pp.5797–5810. <https://doi.org/10.33263/BRIAC12.5.57975810>
- Negara, I.C., 2018. The Use of Chi-Square Test to Determine the Effect of Education Level and Age on IDU Knowledge About HIV-Aids in DKI Jakarta Province. [online] p.8.
- Nuryana, D., Viwattanakulvanid, P. and Romadlona, N.A., 2022. Maternal health services utilization and its contributing factors among adolescent mothers. *International Journal of Public Health Science (IJPHS)*, [online] 11(1), pp.77–87. <https://doi.org/10.11591/ijphs.v11i1.21041>
- Pareek, M., Bangash, M.N., Pareek, N., Pan, D., Sze, S., Minhas, J.S., Hanif, W. and Khunti, K., 2020. Ethnicity and COVID-19: an urgent public health research priority. *Lancet (London, England)*, [online] 395(10234), pp.1421–1422. [https://doi.org/10.1016/S0140-6736\(20\)30922-3](https://doi.org/10.1016/S0140-6736(20)30922-3)
- Prahutama, A., Suparti, Munawaroh, D.A. and Utami, T.W., 2021. Modeling bivariate Poisson regression for maternal and infant mortality in Central Java. *AIP Conference Proceedings*, [online] 2329(1), p.60007. <https://doi.org/10.1063/5.0042142>
- Regulation of the Minister of Health of the Republic of Indonesia Number 21 of 2021.*
- Rustandi, K. (ed.), 2022. *Penangan AKI/AKB dan Stunting di Indonesia. Tinjauan Komprehensif Penurunan angka Kematian Ibu dan Pencegahan Stunting.*
- Suhariyanto, Rangkuti, H. and Hartono, A., 2020. Profil Kesehatan Ibu dan Anak 2020. *Badan Pusat Statistik.*
- Sulistyono, A. and Joewono, H.T., 2020. Maternal death at Dr. Soetomo General Hospital Surabaya – Indonesia according to McCarthy and Maine's model 2013-2015.

- EurAsian Journal of BioSciences*, p.6.
- Unicef, 2021. *Antenatal care*. UNICEF DATA.
- Villar, J., Ariff, S., Gunier, R.B., Thiruvengadam, R., Rauch, S., Kholin, A., Roggero, P., Prefumo, F., do Vale, M.S., Cardona-Perez, J.A., Maiz, N., Cetin, I., Savasi, V., Deruelle, P., Easter, S.R., Sitchitui, J., Soto Conti, C.P., Ernawati, E., Mhatre, M., Teji, J.S., Liu, B., Capelli, C., Oberto, M., Salazar, L., Gravett, M.G., Cavoretto, P.I., Nachinab, V.B., Galadanci, H., Oros, D., Ayede, A.I., Sentilhes, L., Bako, B., Savorani, M., Cena, H., García-May, P.K., Etuk, S., Casale, R., Abd-Elsalam, S., Ikenoue, S., Aminu, M.B., Vecciarelli, C., Duro, E.A., Usman, M.A., John-Akinola, Y., Nieto, R., Ferrazi, E. and Bhutta, Z.A., 2021. Maternal and Neonatal Morbidity and Mortality Among Pregnant Women With and Without COVID-19 Infection: The INTERCOVID Multinational Cohort Study. *JAMA Pediatrics*, [online] 175(8), pp.817–826. <https://doi.org/10.1001/jamapediatrics.2021.1050>
- WHO, 2014. *Maternal mortality, fact sheet*. World Health Organization.