

Study on the Effect of Maternal Death Determinant in Lampung Province using Structural Equation Modeling-AMOS

Ratna Dewi Puspita Sari^{1,2}, Sutyarso³, Dyah Wulan Sumekar RW², Samsul Bakri⁴, Tisa Mahdiansari⁵

¹Department of Obstetrics and Gynaecology, Faculty of Medicine, Lampung University

² Faculty of Medicine, Lampung University

³Faculty of Mathematicss and Natural Science, Lampung University

⁴Department of Forest Development and Environmental Management, Lampung University²

⁵Faculty of Nursing, Padjajaran University.

Contact: dr. Ratna Dewi Puspita Sari, Sp. OG, address Jl. Soemantri Brodjonegoro No. 1, HP +6281367155786, e-mail ratnadps@gmail.com

Abstract

Background: Maternal mortality has become an indicator of health and socioeconomic development and reflected by all national health systems and intersectoral collaborations. High maternal mortality rate is caused by several factors such as environmental health, socioeconomic, mother health status, health services utilization, health services access and pregnancy complication.

Purpose: This study was identify the significant effect of the determinants maternal health and incidence of maternal death.

Research Methodology: This study was an observational study with crossectional design, This study was conducted in Province Lampung, Indonesia, in 2019. Population of this research consisted of situation maternal health in provience Lampung. Sampel in this study were 194 consisting of case group and control group. Data was collected and then analyzed using Structural Equation Modeling (SEM).

Results: Socioeconomy, environmental health, maternal health status, health services access, health services utilization, and pregnancy complication presented strong effects to maternal health. waste management ($\lambda=3.728$), food variety ($\lambda=0.860$), transportation ownership ($\lambda=7.568$), Antenatal care ($\lambda=0.917$) and preeclampsia ($\lambda=2.699$) were indicators which have the strongest correlation to their latent variables

Conclusion: This study results demonstrated that maternal mortality is closely related to the insufficiency of social determinants (occupation, income and social status) and environmental health (water quality and sanitation).

Keywords: access, complication, environmental, health services, health status, maternal death, socioeconomy.

1. INRODUCTION

Pregnancy related-death is one of the problems in any countries especially developing countries. Yearly estimation of maternal mortality rate was 358,000 cases and around 99% of them occurred in developing countries including Indonesia (Aeni, 2013). In the study conducted by Ibrahim (2016), it is explained that Maternal Death is the loss of life of a woman during pregnancy or

postpartum due to pregnancy issues or insufficient management. Maternal death incidence is one of the main indicators which reflect the health and welfare level of a country, (Kemenkes RI, 2014). Considering the high maternal mortality rate, such issue was ranked 5th in the target of Millennium Development Goals (MDGs) (Bappenas, 2012). According to the ministry of health, maternal mortality rate is a parameter indicator of how good health services in a country, especially the services related to maternal and child health.

In the study conducted by Respati et.al (2019), it is explained that maternal death is caused by poor and improper management as well as a factor called 3T delay, which might cause maternal death, which includes delay in identifying danger sign, delay in referring patient, and delay in getting optimal services. McCarthy & Maine, as cited by Astari et al., elaborate that maternal death is a complex problem due to several causes namely close, intermediate and far determinants. The intermediate determinants that can be associated with health factor include, among others, maternal health status, reproduction status, access in getting health services, as well as family behavior in using health service facilities (Muhdar et al., 2020). Further, Alvarez, Hernández, & Gil (2009) and Rogo, Oucho, & Mwalali (2006) explain that such determinants, on individual and community levels, have direct and indirect relations with the maternal death process.

Close determinant is a factor which might be directly related with maternal death and it includes various pregnancy complications. The determinant is directly affected by intermediate determinant that can affect health status while far determinant is associated with demographic, socioeconomic, cultural, economic, political, and social environment situations (Aeni, 2013; McCarthy & Maine, 1992; Meh, 2017). One of the most dominant factors affecting maternal death is socio-economy factor (Murti, 2010). The existence of stratification can cause health inequity which belongs to the majority of health problems (Solar & Irwin, 2010; Wardani et al., 2013; WHO, 2011a).

Socioeconomic stratification can cause clustering in maternal death incidence. It is because maternal death incidence mostly occurs in middle lower socio-economy level (Olonade et al., 2019; Wayack Pambè et al., 2014). This study focused on factors affecting maternal death determinant. The writer wanted to see the most dominant factors which affected maternal death determinant in Lampung. However, maternal death determinant cannot be measured by numbers and the same goes to its causal factors too. Therefore, a special method is necessary in order to analyze it, such as a generally known method named Structural Equation Modeling (SEM). SEM is a multivariate analysis method that can be used to describe the simultaneous linear relationship between observation (indicator) variable and variable that cannot be measured directly (Sholiha & Salamah, 2015).

2. RESEARCH METHODOLOGY

Study site and sample

This study was conducted in Lampung Province. The research design, which was a case control design, was made using analytic descriptive method and the sampling technique was total sampling. The number of samples used in this study were 194 consisting of case and control group. Each group was occupied by 97 samples. Whereas, the method used in this study was Structural Equation Modeling. SEM is a statistical method frequently used by scientists in the field of social, economic and marketing science (Kocayaka & Kocayaka, 2014). Structural Equation Modeling (SEM)

is generally used to describe the simultaneous linear relationship between variables that can be measured directly (indicator) and variable that cannot be measured directly (latent variable) (Sunyoungahn, 2018). In short, SEM can be used to help with the test toward causal effect correlation between variables (Ozyer & Dunya, 2018). In general, SEM is employed so we can see if such model takes into account the value of the observed latent variable's variation and covariant (MacCaluum & Austin, 2000).

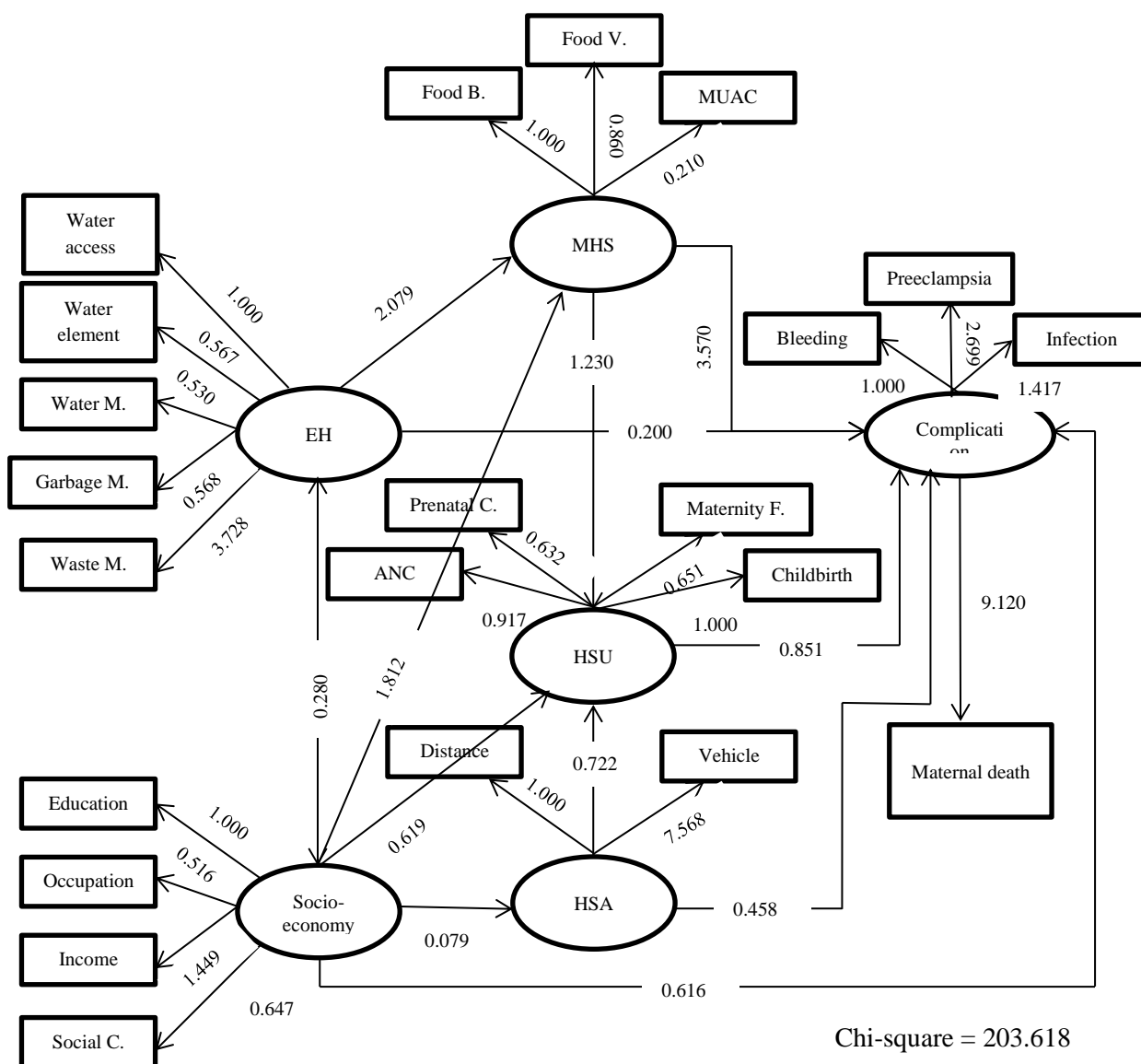
Research Variables

Whereas, the employed research variables include: Socio-economy, environmental health, maternal health status, access to health services, health services utilization, and pregnancy complication. Each variable consists of various indicators which include, among others, socioeconomic determinant (education, occupation, income and social class) (CSDH, 2011; Solar & Irwin, 2010); environmental health determinant (water quality; access to clean water and the quality water contained, as well as household sanitation: healthy toilet behavior, wash hands, drinking and eating water management, household garbage management and household liquid waste management); maternal health status determinant (food budget adequacy, food variety, weight increase during pregnancy, Mid-Upper Arm Circumference (MUAC), and anemia status; health services utilization determinant (Antenatal Care, prenatal class, birth guide and facility); as well as access to health services determinant which is affected by transportation ownership and distance to health services.

3. RESULT

SEM path model of maternal health has been developed to identify relationship between latent variable and indicators as well as correlation among the concerned variabels namely environment, health behavior, and health services (**figure 2**). In this path model, environment, health behavior, and health services are predicted to affect maternal health directly. The significances of predicted simultaneous path were then analyzed during the model running (measurement model and structural model evaluation). The path coefficient of the structure model and bootstrapping results test for outer loding of measurement model are presented at **Table 3** and

Table 4.



Model Evaluation

In SEM analysis, there are several stages in evaluating the best model, namely:

a. Normality

Data normality evaluation was conducted to see the value of critical ratio skewness which should be ± 2.58 at 10% significance. The data are said to be normally distributed if the critical ratio skewness value and kurtosis value are under the absolute value of 2.58, and it can be rounded to 3. In general, c.r. skew and c.r. kurtosis were between -3 to 3. Hence, it can be said that the data in this study were normally distributed.

b. Outlier Evaluation

Outlier evaluation was conducted to see the condition of observation toward some data which have unique characteristics that seem to be so different from any other observations and appear in extreme form, either for a single variable or combined variable (Ghozali, 2008). Outlier evaluation was implemented to discover univariate outliers or multivariate outliers. As for the evaluation toward multivariate outlier, it was conducted with mahalanobis distance value.

This test was conducted by observing the *mahalanobis distance* value. If the value of d-squares is $< X^2_{p(\alpha)}$ then no outlier occurred. The Chi-square value (the p (multi-indicators) was = 22 and α was = 0.001), was 48.268. As for the overall *mahalanobis d-squared* value, it was showed that such value was below 48.268 so it can be concluded that there was no multivariate outlier in the data of this study.

Table 1. Test result of test toward *Mahalanobis d-squared* value

Observation Number	<i>Mahalanobis d-squared</i>	p1	p2
154	47.323	0.000	0.000
74	47.289	0.000	0.000
79	46.493	0.000	0.000

c. Goodness of Fit (GOF) Criteria Evaluation

Goodness of fit testing was conducted with some methods namely χ^2 , goodness of fit index (GFI), adjusted goodnessof- fit index (AGFI), Tucker Lewis Index (TLI), comparative fit index (CFI), and root mean square error of approximation (RMSEA) with predetermined measurement value criteria. Here is the result obtained.

Table 2. Goodness Off Fit Criteria

Goodness of Fit Index	Cut off Value	Model Result	Remark
RMSEA	0.05 – 0.08	0.062	Good
GFI	Approaching 1	0.955	Good
CFI	Approaching 1	0.905	Good
TLI	$0.80 \leq AGFI \leq 0.9$	0.953	Good
AGFI	Approaching 1	0.913	Good

It can be seen in the Table 2 (regarding the goodness of fit criteria) that the obtained RMSEA value was 0.062. The value was between 0.05-0.08, thus it can be said that the model produced was good. Then, on the whole, the values of GFI, CFI, TLI, and AGFI were above 0.9. Hence, it is concluded that the model produced is good.

d. Test result of test toward SEM path model of maternal health

Table 3. Bootstrapping Test for Path Coefficients

Indicators	Estimate	S.E.	C.R.	P-Value
Socio-economy → Maternal health status	1.812	1.248	-1.452	0.016*
Socio-economy → Health services access	0.079	0.143	-0.552	0.081*
Socio-economy → Health services utilization	0.619	0.346	-0.632	0.027*
Socio-economy → Pregnancy complication	0.616	0.066	-0.240	0.010*
Environmental health → Maternal health status	2.079	1.442	1.442	0.049*
Environmental health → Pregnancy complication	0.200	0.054	-0.590	0.033*
Maternal health status → Maternal health status	1.230	0.0032	-0.469	0.039*
Maternal health status → Health services access	3.570	0.001	0.024	0.023*
Health services access → Maternal health	0.722	0.594	-0.373	0.019*
Health services utilization → Health services utilization	0.458	1.275	0.359	0.019*
Health services utilization → Pregnancy complication	0.851	0.087	-0.585	0.048*
Pregnancy complication → Maternal death	9.120	14.777	-0.617	0.037*

*p value <0.05

Table 4. Bootstrapping test for outer loadings

Indicators	Estimate	S.E.	C.R.	P-Value
Socio-economy → Occupation	0.516	0.072	1.171	0.000*
Socio-economy → Income	1.449	0.184	1.882	0.000*
Socio-economy → Social class	0.647	0.159	4.067	0.000*
Environmental health → Water quality	0.567	0.163	1.043	0.002*
Environmental health → Water management	0.530	0.040	1.328	0.018*
Environmental health → Garbage management	0.568	0.692	0.460	0.045*
Environmental health → Waste management	3.728	1.344	-2.774	0.006*
Maternal health status → Food variety	0.860	0.201	0.427	0.046*
Maternal health status → Mid-Upper Arm Circumference	0.210	0.414	0.499	0.018*
Health services access → Transportation ownership	7.568	3.727	-0.551	0.042*
Health services utilization → Maternity facility	0.651	0.110	1.930	0.000*

Health services utilization → Prenatal class	0.632	0.089	0.362	0.017*
Health services utilization → Antenatal care (ANC)	0.917	0.052	0.329	0.037*
Pregnancy complication → Preeclampsia	2.699	3.608	-0.748	0.025*
Pregnancy complication → Infection	1.417	2.171	-0.653	0.014*

*p value <0.05

Table 3 shows that all the paths in the model were considered significant, indicated by their *p-value* which was less than 0.05 (significant level = 0.05). Each of the eleven path lines have origins and destinations except “Socio-economy → health services access”. Referring to the results above, which are schematized in **Figure 1**, it can be learned that socioeconomic, environmental health, maternal health status, health services access, health services utilization, and pregnancy complication presented strong effects to maternal health.

Figure 1 and **Table 3** also show that the standardized path coefficients of such determinant were positive, which means that the effects of socio-economy, environmental health, maternal health status, health services access, health services utilization, and pregnancy complication on maternal health were also associated as positive.

Both Figure 1 and **Table 4** show that most loading factors, except the Service of maternal complication, were considered prominent to explain their latent variabel at 0.05 significant level (*p-value* > 0.05). It means that most indicators were representative to explain their latent variables. **Figure 1** and **Table 4** also show that income was an indicator with highest loading factor value ($\lambda = 1.449$) compared to any other indicators in socio-economy. The fact that one indicator has the highest loading factor value indicates that such indicator also has the strongest correlation to the latent variabel. Meanwhile, waste management ($\lambda = 3.728$), food variety ($\lambda = 0.860$), transportation ownership ($\lambda = 7.568$), Antenatal care ($\lambda = 0.917$) and preeclampsia ($\lambda = 2.699$) were indicators which have the strongest correlation to their latent variables, which were health behavior and health services respectively.

4. Discussion

Socio-economy can affect individual health status through some factors in every level of environment such as individual behavior and lifestyle, social and community influence as well as residential environment. These factors are correlated and inseparable in the effort of health realization (Adler & Newman, 2002; Dhalgren & Whitehead, 1991). Income will be directly proportional to the fulfillment of daily needs, either in the form of food, house, or clothes, that can affect physical and psychological welfare (Puspitasari et al., 2017; United Nations Population Fund, 2012). Economic limitation has negative impact on maternal health because such limitation might indirectly affect food quality and bring influence on maternal nutrition status during pregnancy (Cornelia et al., 2013).

By using social determinant model, household income would be the key factor in maternal nutrition welfare. Household income and poverty prevent mothers in acquiring sufficient nutrition intake (Bhanbhro et al., 2020). This statement is in line with the study conducted by Andini (2020), where the amount of income received by respondents can affect dietary habit and indirectly affect

mother's and baby's nutritional condition during pregnancy. The higher the household income, the more capable the families will be in fulfilling good nutrition intake.

In this study, the results of analysis test revealed that environmental health has significant correlation with maternal health status and pregnancy complication ($p = 0.049$ and $p = 0,033$). This result showed that the better the environmental health a woman lives, the better her health status and the lesser the pregnancy complication risk will be. The study conducted by Campbell in 2015 showed that good water quality and sanitation will affect maternal health in terms of anemia status and nutritional sufficiency indicators. Meanwhile, in the study conducted by Songa et al. (2015), it is argued that several months before childbirth, maternal health status may be affected by some variables such as distance between clean water source and house, quantity of the water used, clean water quality, as well as clean toilet possession and usage.

In pregnant women, the health status can be seen from their nutrition statuses which are measured from the food variety and nutrition status value. The number of daily food variety includes nine food categories namely starchy food, green vegetables, vegetables and fruits, meat and fish, innards, egg, beans and seeds as well as milk and dairy products (FAO, 2010). In this study, it was found out that there was a close relationship between food variety and nutrition status. This was in parallel with most studies revealing the relationship between food variety and underweight risk in developing countries (Ghattas, 2014).

A study in India showed that malnutrition status and anemia in preconception women are more likely to occur to lower socioeconomic population and those with food insecurity (Mastiholi et al., 2018). A study in Indonesia found that most respondents suffering from food insecurity have higher risk to Chronic Energy Deficiency (CED) (Wulansari, 2020) and another study by (Nurdini & Mahmudiono, 2020) also showed a significant relationship between food variety and anemia risk in pregnant women. The same was also found in the study conducted by Puspita et al. (2020) showing a result that higher food security and household food expenditure level will affect the nutrition status in pregnant women, where, in this study, it was obtained that percentage of pregnant women with underweight status who were suffering from food insecurity was 75%, while the number of pregnant women with normal nutrition status bur suffered from food insecurity was 6.1% (Puspita et al., 2020).

Pregnancy complication is the closest determinant to the risk of maternal death. In this study, it was found out that there was relationship between pregnancy complication and maternal death incidence was with p value = 0.037. The estimation value was formed in model $\lambda = 9.120$ (table 4.12). It meant that pregnancy complication was strongly correlated with maternal death incidence. Pregnant women with pregnancy complication have 9.1 times higher risk of death compared to healthy pregnant women. From the affecting indicator, there were two pregnancy complication indicators correlated with maternal death incidence namely preeclampsia/eclampsia and infection. This statement was similar with that of the study conducted by Respati et al. (2019) that women with pregnancy complication have 4.2 times higher risk of death compared to pregnant women without pregnancy complication.

5. Conclusion

We have demonstrated that maternal mortality is closely related to the insufficiency of social determinants (occupation, income and social status) and environmental health (water quality and sanitation) which then also affect maternal health factors such as inadequacy of maternal health status, health services utilization, and health services access. The findings regarding social determinants and risk-factors significance can be used to support decrement of maternal mortality rate and increment of maternal health.

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