RESEARCH ARTICLE

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Lag Spatial Modeling for Finding the Factors Affecting Infants Mortality Rate in East Java

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Background: Auto regressive spatial model or spatial lag is a model that combines a simple regression model with spatial lag dependent variable using cross section data. East Java Province was one of the five largest contributors to IMR in Indonesia. In 2014, the IMR in East Java was 9 per 1,000 live births. Thus, this research aimed to find the factors affecting IMR using the spatial lag. *Method*: This research was using a non-reactive or non-obstructive study method, by analyzing secondary data from the health profile and *Susenas* (National Social Economic Survey) of East Java Province in 2014. The dependent variable was the IMR and the independent variable were the coverage of pregnancy visit $K1$ (X_2), coverage of pregnancy visit $K4$ (X_3), delivery by health personnel (X_4), neonatal visit 1 (X_5), and complete neonatal visit (X_6), the ratio of midwives (X_7) and the ratio of *Posyandu* (X_8). *Results*: The result of the study showed: (1) Variables that affect the IMR were the coverage of the first antenatal visit or $K1$ ($p = 0.003$), the coverage of the fourth ante natal visit or $K4$ ($p = 0.01$), and the ratio of *Posyandu* ($p = 0.03$). (2) IMR model that being obtained was $= 1.68 *$ coverage of first ante natal visit $K1 - 1.20 *$ coverage of fourth ante natal visit or $K4 - 0.12 *$ *Posyandu* ratio $+ 0.29$ WY. *Conclusion*: Variables of coverage of the first ante natal visit or $K1$, coverage of the fourth ante natal visit or $K4$ and the ratio of *Posyandu* supported the IMR model by 67%.

Keywords: Spatial Lag Model, Infant Mortality Rate, IMR, Indonesia.

1. INTRODUCTION

Classical regression analysis is one statistical data analysis techniques that are often used to examine the relationship between several variables and predict a different variable.[1] Classical regression analysis is an analysis method that can be used to analyze the data and take meaningful conclusion about the relationship between dependence variable and other variable. If the relationship or the influence of two or more independent variables to the dependent variable need to be examined, the regression model that are used is the multiple linear regression model. If the terms of classical regression with assumptions that the variables are identical and independent, the regression models can be used, therefore, the model that being used tends to be spatial.[2]

Spatial method is a method to obtain information of the observation that influenced by the space or location, while the spatial regression is a development of classical regression based on the first law of geography.[3]

Infant Mortality Rate (IMR) is one indicator of the success of health development that have been implemented in the National Health System and used as a central indicator of the success of health development in Indonesia.[4] Millennium Development Goals (MDGs) states that in 2015, Indonesia targets the Infant Mortality Rate (IMR) will decrease to 17 babies per 100 live births.[5]

East Java Province is one of five provinces contributed nearly to 50% of the total amount of the highest infant mortality in Indonesia. IMR of 2014 in East Java was 9 babies per 1,000 livebirths.[6] This research aims to find the factors and its unique properties based on the location, East Java, Indonesia. Therefore, the spatial lag is being used because it is a model that has the specific location influence.

According to Filmer Theory,[7] factors that may affect the infant mortality can be divided into two sides, namely the demand and supply side. The demand side is divided into two levels, namely the household level (water sources) and individual ($K1$ coverage visit pregnant women, $K4$ coverage visit pregnant women, delivery by health personnel, neonatal visits, and completed neonatal visits). The supply side is also differentiated into two, namely the government policy and the quality of health care infrastructure (the ratio of midwives and *Posyandu* ratio). The demand side and the supply side are intertwined with each other and can have an impact on infant mortality.[7]

Due to many factors that influence infant mortality, this study aims to analyze the factors that affect the IMR and create spatial models lag to determine the factors that affect the IMR.

2. METHOD

The type of this research was a non reactive or non obstructive study, a study that did not require a response of the respondents or participants or respondents did not participate actively. This study held by analyzing secondary data from the Indonesia's

Health Profile[8] and *Susenas*[9] (National Social Economic Survey) of East Java Province, 2014.

In Indonesia, 4 ante natal visits (once at the first trimester, once at the second trimester and twice at the third trimester) are the minimum for a pregnant mothers to determine that the ante natal visits were done properly. $K1$ is defined as the first ante natal visit in the first trimester and $K4$ is defined as the last visit in the third trimester.

Dependent variable was the IMR and Independent variable were the coverage of the first ante natal visit or $K1$ (X2), coverage of the fourth ante natal visit or $K4$ (X3), delivery helped by health personnel (X4), neonatal visit 1 (X5), and completed neonatal visit (X6), the ratio of midwives (X7) and the ratio of *Posyandu* (X8). Spatial regression models are models created from common regression models that have been influenced by the spatial (location). This study aimed to analyze the factors that affect the IMR of East Java, thus it used the Lag Spatial Regression.

It had been developed a spatial regression model (General Spatial Model) using cross section spatial data.[3] The forms of general spatial model are:

$$Y = \rho W_1 Y + X\beta + u$$

$$u = \lambda W_2 u + \varepsilon$$

$$\varepsilon \sim N(0, \sigma^2)$$

Whereas: Y is the vector of $p \times 1$, ρ is the coefficient from dependent variable of the spatial lag, u is the error vector, W is the matrix with the size of $n \times n$, β is $k \times 1$ vector, the regression parameter, X is a matrix with $n \times k$ size, the predictor variable, λ is a matrix with $n \times k$ size, the predictor variable.[3]

3. RESULTS

The highest infant mortality rate was in Probolinggo regency with 65.45 per 1,000 live births while the smallest IMR was in Probolinggo city that was equal to 20.94 per 1,000 live births. The average and standard deviation of infant deaths per 1,000 live births in East Java was 35.60 ± 12.95.

To know the several factors that affect infant mortality rate, it must be seen whether the infant mortality rate has variable with spatial patterns by looking at the quintile and percentile figure.

Figure 2 shows that there is a spatial pattern of the dependent variable (infant mortality rate). Adjacent areas tend to have the same value (similar).

Figure 2 shows the precentile map. It can be seen in the distribution pattern that the IMR variable have spatial patterns and identified areas have extreme values to the variables in infant mortality.

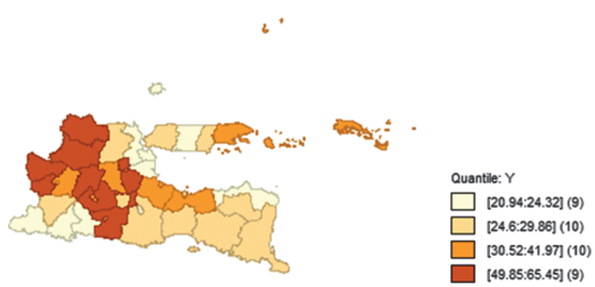

Fig. 1. Quintile map for infant mortality rate.

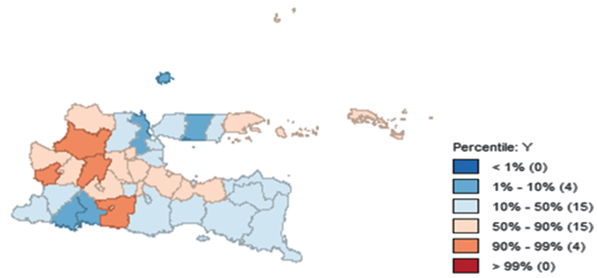

Fig. 2. Percentile map for infant mortality rate.

Table I. Analysis result of spatial lag regression model.

Variable	Coefficient	Std. error	Z-value	Prob
W_Y	0.2916	0.1130	2.5804	0.0099
Constant	−28.5077	38.4985	−0.74049	0.4590
X_1	−0.0155	0.0834	−0.1860	0.8524
X_2	1.6806	0.5668	2.9652	0.0030
X_3	−1.2037	0.4728	−2.5458	0.0109
X_4	−1.1177	0.6874	−1.6261	0.1039
X_5	0.0189	0.9809	0.0192	0.9847
X_6	1.1041	1.0326	1.06915	0.2850
X_7	0.0163	0.0233	0.6988	0.4847
X_8	−0.12052	0.0556	−2.1652	0.0304

Based on the condition stated in Figures 1, 2 and Table I, the result of this study found that variables that affect the IMR was the coverage of first ante natal visit or $K1$ ($p = 0.003$), the coverage of the fourth ante natal visit or $K4$ ($p = 0.01$), and the ratio of *Posyandu* ($p = 0.03$). Therefore, for further research at different location, this formula using the spatial lag regression can be used.

IMR $= 1.68 *$ coverage of pregnancy visit $K1 - 1.20 *$ coverage of pregnancy visit $K4 - 0.12 *$ *Posyandu* ratio $+ 0.29$ WY $+$ Residual.

With an R^2 of 67%, the variations in IMR can be explained by the coverage of the first ante natal visit or $K1$, coverage of the fourth ante natal visit or $K4$ and the ratio of *Posyandu*, by 67%. Log Likelihood is -130.29 ($p = 0.02$), and Sigma-Square is 54.3058.

4. DISCUSSION

Based on the study results, the factors that influence the infant mortality rates (IMR) are $K1$ coverage, $K4$ coverage and *Posyandu* ratio coverage. A decree of the Minister of Health No. 1457/Menkes/SK/X/2003 on Minimum Service Standards in the field of health in the county or city in an effort to reduce maternal mortality through health services for mothers and children in the form of coverage of four times antenatal visits ($K4$) of pregnant women had a target of 95% in 2015.

The efforts to reduce mortality among infants was implement through ante natal visits from $K1$ to $K4$. The coverage of $K4$ in Indonesia currently ranged between 60–70%.[8] The coverage of antenatal care included the service of ante natal visit $K1$ to $K4$. Antenatal health service is usually given before week 14, 28 weeks and after 36 weeks.[10]

Posyandu as one health care facility has a strategic role in the efforts of improving the health of the public at large scale. *Posyandu* role is to provide quality services to individuals, families, groups and communities to achieve maximum health status. As the efforts in lowering the infant mortality rate, *Posyandu* can also help by continually increased the quality of antenatal care.[11] *Posyandu ratio* of one for 100,000 population in a certain area are needed in order to increase the service facilities for ante natal care.[7]

5. CONCLUSION

It was concluded that the first ante natal visit or $K1$ coverage, the fourth ante natal visit or $K4$ coverage and *Posyandu* ratio had influence on infant mortality rate.

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References and Notes

1. M. H. Kutner, C. J. Nachtsheim, and J. Neter, Applied Linearn Regression Models, 4th edn., McGraw-Hill Companies, Inc., New York **(2004)**.
2. N. Draper and H. Smith, Applied Regression Analysis, John Wiley & Sons, Inc., New York **(1985)**.
3. L. Anselin, Spatial Econometrics: Methods and Models, Academic Piblishers, Dordrecht **(1988)**.
4. C. Bachroen and S. Soemantri, Study on the "proxy" indikator of the infant mortality rate, Indonesia's Department of Health—Health Care Research and Development, Bakti Husada, Surabaya **(1988)**.
5. MDG: Health and the Millennium Development Goals, World Health Organization, WHO:, Geneva **(2005)**.
6. The Central Bureau of East Java Statistics, and East Java Provincial Government, The Economic and Social Indicators East Java in 2012. The Central Bureau of Statistics East Java Province, Surabaya **(2012)**.
7. D. Filmer, Determinants of Health and Education Outcomes Background Note for World Development Report 2004: Making Service Work for Poor People, Worldbank **(2003)**.
8. East Java Provincial Health Office, East Java Provincial Health Profile 2014 **(2015)**.
9. The Central Statistics Agency (BPS), National Social Economic Survey (SUSENAS), BPS, Jakarta **(2015)**.
10. Saifudin, Practical Handbook for Maternal and Neonatal Health Care, Publisher: Yayasan Bina Pustaka Sarwono Prawiharjo, Jakarta **(2002)**.
11. Indonesia's Departement of Health, *General Guideline of Posyandu,* Depkes RI, Jakarta **(2006)**.

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