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## **Spatial Distribution of Low Birth Weight Infants (LBW) on Neonatal Mortality in East Java Province in 2020-2022**

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### **ABSTRACT**

**Introduction:** Infants have the highest risk of health problems during the neonatal period due to their vulnerable bodies. Infants with low birth weight (LBW) are one of the causes of neonatal mortality. The Infant Mortality Rate (IMR) in Indonesia is still high compared to other developing countries.

**Objective:** The purpose of this study was to analyze the spatial distribution to determine the picture of LBW cases with neonatal deaths in East Java Province in 2020-2022.

**Method:** This study uses a descriptive spatial analytic method using secondary data sourced from East Java Health Profile data in 2020, 2021, and 2022. The population and samples in this study were 38 districts/cities in East Java Province. Data processing uses bivariate maps through the QGIS 3.32.3 application. To support the hypothesis, statistical analysis was conducted using SPSS with Kolmogorov-Smirnov normality test and Pearson correlation test.

**Result:** The results show that an increase in LBW will be followed by an increase in neonatal mortality cases. There is a significant relationship between neonatal mortality and LBW in East Java Province in 2020 (p value = 0.013 < 0.05); in 2021 (p value = 0.017 < 0.05), in 2022 (p value = 0.000 < 0.005).

**Conclusion:** The conclusion of the study is Low Birth Weight Infants (LBW) with Neonatal Mortality Cases in East Java Province in 2020, 2021, to 2022 showed significant results so that, it can be interpreted that there is a strong enough relationship between variables. The relationship between variables produces a positive relationship, so it can be interpreted that an increase in LBW babies is followed by an increase in neonatal mortality cases.

**Keywords:** LBW; Neonatal Mortality; Spatial Distribution

## INTRODUCTION

Neonatal is the early period of life in infants or referred to as the critical period due to the transition from intra uteri to ekstra uteri (1). From the first day to the first 28 days of life in newborns can be said to be a vulnerable time in survival (2). Infants have the highest risk of health problems during the neonatal period because their bodies are vulnerable to harm. Complications that can occur in the neonatal period, namely infection, LBW, asphyxia, and other diseases that cause death (3).

The Infant Mortality Rate (IMR) in Indonesia is still high compared to other developing countries. IMR is one of the indicators for assessing the degree of public health. Infant mortality indicators are divided into Neonatal Mortality (IMR) and Infant Mortality Rate (IMR). Neonatal Mortality Rate (NMR) is the number of children who are born in a given year and die within the first 28 days of life expressed as a rate per 1,000 live births (4).

Low Birth Weight Infants (LBW) is a condition of babies born with a body weight below 2500 grams (5). LBW is a health problem that currently requires special attention in many countries, especially in low-income or developing countries (6). WHO categorizes LBW into 3 types, namely LBW (1500-2499 grams), LBW (1000-1499 grams), LBW (<1000 grams) (7).

Based on the cause, infant mortality is categorized into two types: endogenous and exogenous. Endogenous infant mortality or neonatal mortality is caused by factors that the child is born with or acquired from his or her parents at the time of conception. Infant mortality due to the condition of the baby itself includes Low Birth Weight Infants (LBW), premature babies, and congenital abnormalities (8). Low birth weight can result from premature birth or short gestation <37 complete weeks, intrauterine growth restriction (fetal growth restriction), or both. The neonatal period plays a very important role in life as infants have a very high potential of contracting and developing life-threatening diseases.

Based on data generated by the United Nations Interagency Group for Child Mortality Estimation (UN IGME) in 2021, neonatal mortality is estimated to be around 2.4 million deaths in 2020. The Indonesian Ministry of Health in 2022 stated that the neonatal mortality rate was 18,281 per 1,000 live births (9). Based on data from the East Java Health Profile for 2020-2022, the trend shows a downward trend, from 5.1 per 1,000 live births in 2020 down to 4.5 per 1,000 live births in 2022(10)(11)(9). Meanwhile, the LBW data in East Java Province shows an increase from 2020-2022, from 3.7% in 2020 to 4.0% in 2022 (10)(11)(9).

The Ministry of Health in 2020-2022 stated that deaths during the neonatal period are mostly caused by LBW conditions. In 2021 it reached 34.5% and decreased to 28.2% in 2022. The East Java Health Profile in 2022 explains that the cause of death in infancy is more prevalent in neonatal age (0-28 days) when compared to post neonatal age (29 days-11 months). The highest cause of neonatal death is caused by Low-Birth-Weight Infants (LBW) with a percentage of 36% followed by asphyxia at 26%.

This case of LBW indicates that there are still many pregnant women with poor nutritional status and mothers do not routinely check their pregnancies, causing the incidence of LBW from year to year to increase and have an impact on neonatal mortality. Based on this explanation, researchers conducted a spatial distribution analysis to determine the picture of LBW cases with neonatal deaths in East Java Province in 2020-2022.

## METHOD

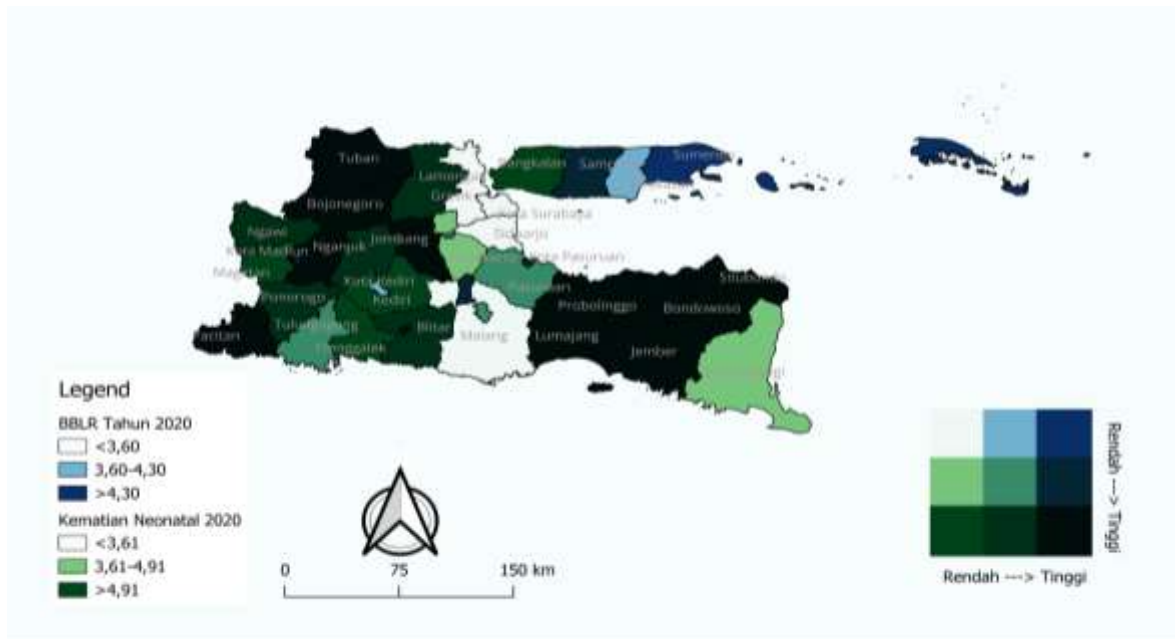
This study uses a descriptive spatial analytic method using secondary data sourced from East Java Health Profile data in 2020, 2021, and 2022. This study was conducted to describe the spatial distribution of cases of infants with Low Birth Weight (LBW) with the incidence of neonatal deaths in East Java Province in 2020-2022. The population and sample in this study were 38 districts/cities in East Java Province. The method used is to measure the relationship between the dependent variable and the independent variable with data analysis techniques using a mapping software application, namely Geographic Information System (QGIS 3.32.3). The data will be presented in a map of the incidence of neonatal deaths with low-birth-weight babies using an area distribution map.

Data were analyzed using spatial analysis and bivariate analysis. Spatial analysis was carried out to be able to describe the Regency / City area in East Java Province related to LBW cases on neonatal mortality. Spatial analysis will be seen based on color differences and categorized into 3 scales on each variable. Bivariate analysis was conducted using Pearson correlation test if the data was normally distributed and Spearman correlation test if the data was not normally distributed with the help of SPSS software to process the data. Bivariate analysis was used to find the correlation between the independent variable and the dependent variable. The dependent variable in this study was the number of neonatal deaths. The independent variable used was low birth weight (LBW) with the unit of analysis in this study being the aggregate.

**RESULTS**

**Univariate Analysis**

Bivariate Map of LBW Risk with Neonatal Mortality of East Java Province in 2020



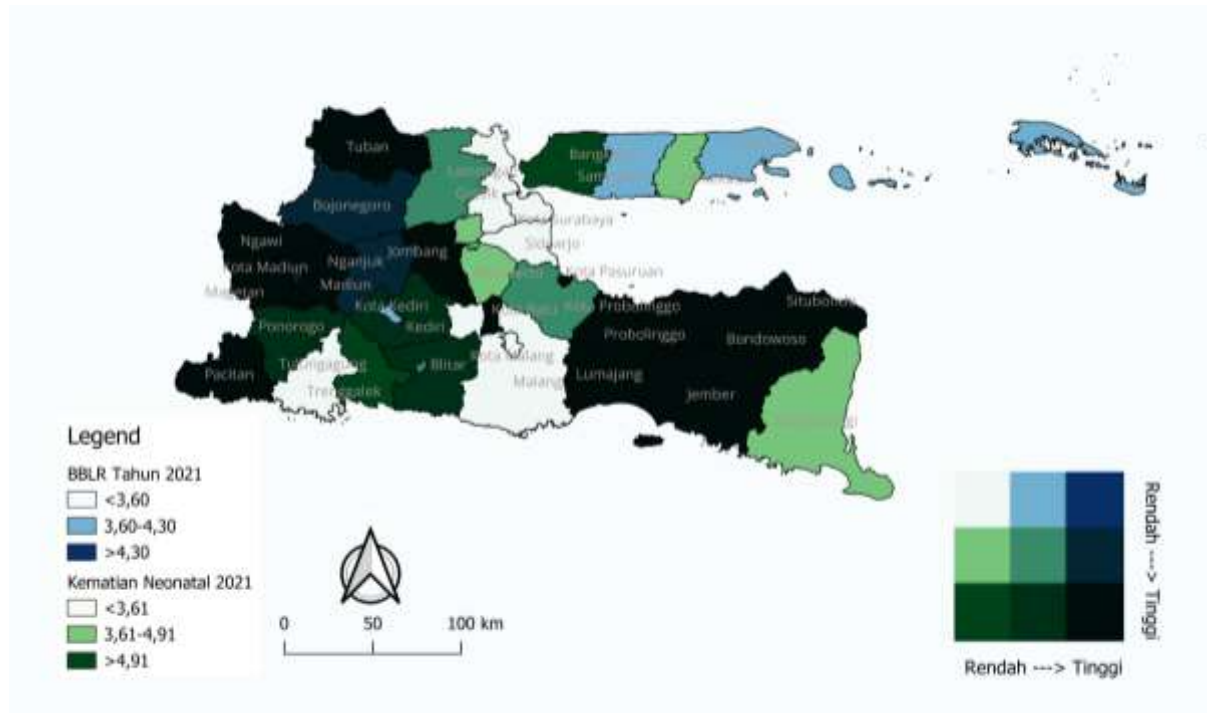
Based on the results of mapping the distribution of cases of neonatal death and LBW in 2020, it is known that zones with very high cases of LBW have a tendency to have very high neonatal deaths. This can be seen in East Java Island which has very high cases of LBW and neonatal deaths. The following is the category of LBW zone based on the distribution map of neonatal death cases and LBW in East Java Province in 2020:

**Table 1.** Distribution mapping zone of neonatal death cases and LBW in 2020

| Zone         | Number of Provinces | Province   |
|--------------|---------------------|--|
| White        | 4                   | Gresik, Surabaya City, Sidoarjo, Malang Regency  |
| Light Green  | 2                   | Banyuwangi and Mojokerto   |
| Green        | 4                   | Bangkalan, Kediri, Magetan, Trenggalek   |
| Light Blue   | 2                   | Kota Kediri dan Pamekasan  |
| Blue         | 1                   | Sumenep  |
| Bluish Green | 4                   | Malang City, Mojokerto City, Tulungagung, Pasuruan   |
| Dark Blue    | 3                   | Sampang, Madiun City, Batu City  |
| Dark Green   | 6                   | Lamongan, Nganjuk, Ngawi, Ponorogo, Blitar, Pasuruan City  |
| Black        | 12                  | Tuban, Bojonegoro, Nganjuk, Jombang, Pacitan, Blitar City, Probolinggo, Lumajang, Jember, Bondowoso, Situbondo, Probolinggo City, Madiun |

Based on the results of mapping the distribution of neonatal death cases and LBW in 2020, it has been divided into several zones according to the number of cases. Zones with white color have the lowest risk factors for LBW and neonatal death cases, namely in Gresik Regency, Sidoarjo Regency, Malang Regency, and Surabaya City. Zones with black color are interpreted as having risk factors for LBW and neonatal death cases, namely in Tuban, Bojonegoro, Nganjuk, Jombang, Pacitan, Blitar City, Probolinggo, Lumajang, Jember, Bondowoso, Situbondo, Probolinggo City and Madiun.

Bivariate Map of LBW Risk with Neonatal Mortality of East Java Province in 2021



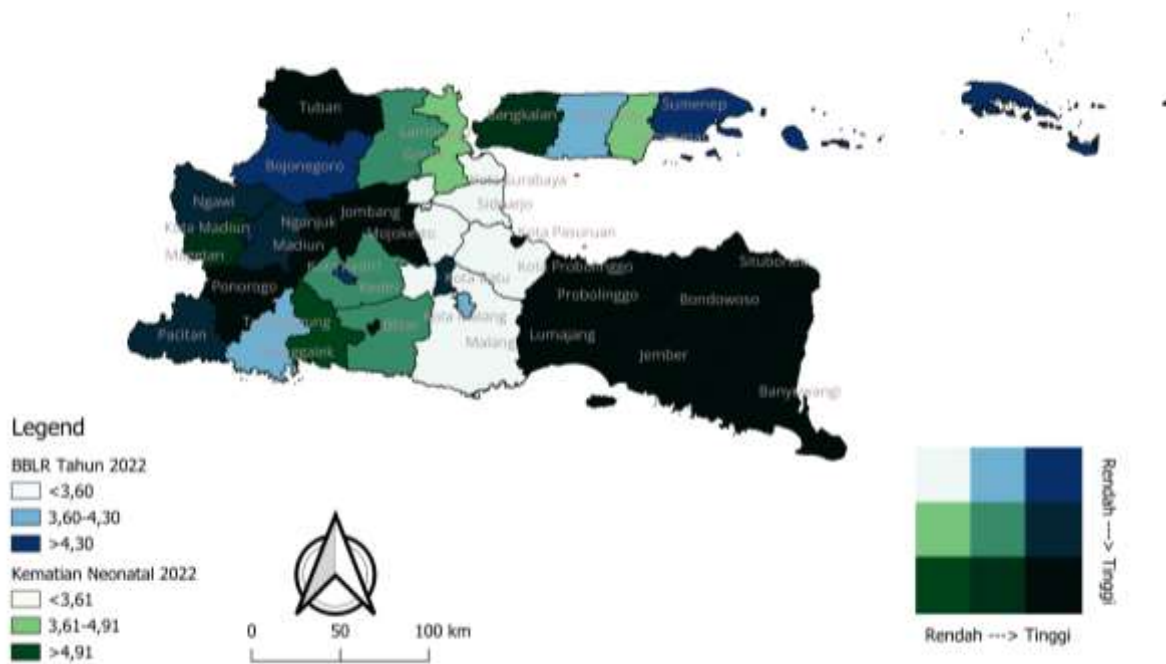
Based on the results of mapping the distribution of neonatal deaths and LBW cases in 2021, it is known that zones with very high LBW cases have a tendency to have very high neonatal deaths. The following is the category of LBW zone based on the distribution map of neonatal death cases and LBW in East Java Province in 2021:

**Table 2.** Distribution mapping zone of neonatal death cases and LBW in 2021

| Zone         | Number of Provinces | Province   |
|--------------|---------------------|--|
| White        | 6                   | Malang, Malang City, Trenggalek, Sidoarjo, Surabaya City, Gresik   |
| Light Green  | 4                   | Pamekasan, Banyuwangi, Mojokerto City, Mojokerto   |
| Green        | 2                   | Tulungagung dan Bangkalan  |
| Light Blue   | 3                   | Sumenep, Sampang, Kediri City  |
| Blue         | 0                   | -  |
| Bluish Green | 3                   | Lamongan, Pasuruan, dan Blitar City  |
| Dark Blue    | 3                   | Bojonegoro, Madiun City, Nganjuk   |
| Dark Green   | 3                   | Ponorogo, Kediri, dan Blitar   |
| Black        | 14                  | Tuban, Ngawi, Magetan, Madiun, Jombang, batu City, Pacitan, Pasuruan City, Probolinggo, Probolinggo City, Lumajang, Jember, Bondowoso, Situbondo |

Based on the results of mapping the distribution of neonatal death cases and LBW in 2021, it has been divided into several zones according to the number of cases. Zones with white color have the lowest risk factors for LBW and neonatal death cases, namely in Malang, Malang City, Trenggalek, Sidoarjo, Surabaya City, and Gresik. Zones with black color are interpreted as having LBW risk factors and neonatal death cases, namely in the regions of Tuban, Ngawi, Magetan, Madiun, Jombang, Batu City, Pacitan, Pasuruan City, Probolinggo, Probolinggo City, Lumajang, Jember, Bondowoso, Situbondo.

Bivariate Map of LBW Risk with Neonatal Mortality of East Java Province in 2022



Based on the mapping of the distribution of neonatal deaths and LBW cases in 2022, it is known that zones with very high LBW cases have a tendency to have very high neonatal deaths. The following are the categories of LBW zones based on the distribution map of neonatal death cases and LBW in East Java Province in 2022:

**Table 3.** Distribution mapping zone of neonatal death cases and LBW in 2022

| Zone         | Number of Provinces | Province   |
|--------------|---------------------|--|
| White        | 6                   | Surabaya City, Sidoarjo, Mojokerto City, Mojokerto, Malang, Pasuruan   |
| Light Green  | 2                   | Gresik, Pamekasan  |
| Green        | 2                   | Tulungagung, Magetan   |
| Light Blue   | 3                   | Trenggalek, Sampang, Malang City   |
| Blue         | 4                   | Kediri City, Sumenep, Bojonegoro, Madiun City  |
| Bluish Green | 3                   | Blitar, Kediri, Lamongan   |
| Dark Blue    | 4                   | Batu City, Madiun, Ngawi, Pacitan  |
| Dark Green   | 1                   | Bangkalan  |
| Black        | 13                  | Tuban, Nganjuk, Jombang, Ponorogo, Probolinggo City, Probolinggo, Lumajang, Jember, Banyuwangi, Bondowoso, Situbondo, Blitar City, Pasuruan City |

Based on the results of mapping the distribution of neonatal death cases and LBW in 2022, it has been divided into several zones according to the number of cases. Zones with white color have the lowest risk factors for LBW and neonatal death cases, namely in the Surabaya City, Sidoarjo, Mojokerto City, Mojokerto, Malang, Pasuruan areas. Zones with black color are interpreted as having LBW risk factors and neonatal death cases, namely in the regions of Tuban, Nganjuk, Jombang, Ponorogo, Probolinggo City, Probolinggo, Lumajang, Jember, Banyuwangi, Bondowoso, Situbondo, Blitar City, Pasuruan City.

## Bivariate Analysis

### Relationship between Low-Birth-Weight Infants (LBW) and Neonatal Mortality Cases in East Java 2020-2022

**Table 4.** Normality Test for LBW Infants with Neonatal Mortality Cases in East Java Province 2020-2022

|         | LBW and Neonatal Mortality in 2020 | LBW and Neonatal Mortality in 2021 | LBW and Neonatal Mortality in 2022 |
|---------|------------------------------------|------------------------------------|------------------------------------|
| P-value | 0.932                              | 0.614                              | 0.972                              |

Based on the results of the Kolmogorov-Smirnov normality test on data on cases of LBW babies with neonatal deaths in 2020, 2021, and 2022, the results of P-value <0.05 are 0.932; 0.614; and 0.972, respectively. From these results it can be concluded that the data on LBW babies with neonatal death cases in East Java in 2020-2022 are normally distributed.

**Table 5.** Correlation Test for LBW Infants with Neonatal Mortality Cases in East Java Province 2020-2022

|                    | LWB in 2020 |         |       | LWB in 2021 |         |       | LWB in 2022 |         |       |
|--------------------|-------------|---------|-------|-------------|---------|-------|-------------|---------|-------|
|                    | N           | p-value | r     | N           | p-value | r     | N           | p-value | r     |
| Neonatal Mortality | 38          | 0,013   | 0,399 | 38          | 0,017   | 0,385 | 38          | 0,000   | 0,589 |

Based on the results of the correlation test (Table 1.2), out of 38 samples in 2020 there is a significant relationship between neonatal mortality cases and risk factors for low birth weight babies (LBW) in East Java Province with a p-value = 0.013 <0.05 with a coefficient value of 0.399 which means that the relationship between these variables is quite strong and produces a positive relationship, so it can be interpreted that an increase in LBW babies is followed by an increase in neonatal mortality cases.

In 2021, there is a significant relationship between neonatal mortality cases and the risk factor for low-birth-weight babies (LBW) in East Java Province with a p-value = 0.017 <0.05 with a coefficient value of 0.385, which means that the relationship between these variables is quite strong and produces a positive relationship, so it can be interpreted that an increase in LBW is followed by an increase in neonatal mortality cases.

In 2022 there was a significant relationship between neonatal mortality cases and the risk factor of low-birth-weight babies (LBW) in East Java Province with a p-value = 0.000 <0.05 with a coefficient value of 0.589 which means that the relationship between these variables is strong and produces a positive relationship, so it can be interpreted that an increase in LBW is followed by an increase in neonatal mortality cases.

## DISCUSSION

Neonatal death cases with LBW risk factors in East Java in 2020, 2021, and 2022 resulted in an association between an increase in LBW and neonatal death cases. This is in line with research conducted in Mentawai Padang Regency resulted that LBW obtained a p-value = 0.00, meaning that there is a significant relationship between LBW and the incidence of neonatal mortality (p-value <0.05) with an OR value of 41.11 (95% CI; 4.64- 364.00), meaning that neonatal LBW is 41.1 times at risk of death when compared to neonatal with normal birth weight (12). This is supported by research Dwi Kusumawati & Dewi Yunadi (2020) which showed a significant relationship between birth weight and early neonatal death at Cilacap Hospital in 2018 (p=0.000 <0.05; OR=0.026; CI 95% = 0.006-0.121) (13).

Adolescent pregnancy status, age, and nutritional economic status are factors for LBW. Maternal age under twenty years old is a risk factor for the birth of LBW babies. Pregnancies that occur at an age under twenty years old have a strong nutritional tendency for fetal growth, which has an impact on the incidence of LBW. The age of the mother during pregnancy is related to the condition of the mother's pregnancy, because in addition to the maturity of the reproductive organs, it is also related to the maturity of the fetus (14). Another factor affecting low birth weight is the frequency of maternal antenatal care (ANC) during pregnancy, there are still many pregnant women who do ANC not according to the minimum standards in accordance with government recommendations, namely 4 times during pregnancy (15).

Epidemiological observations show that low birth weight babies have a 20 times greater risk of dying early in life compared to babies born with normal birth weight. The high mortality rate in LBW is caused by complications such as hypothermia, hypoglycemia, asphyxia, fluid and electrolyte imbalance, hyperbilirubinemia, anemia, malnutrition, and other species (16). The increasing cases of LBW can also be caused by high-risk pregnant women,

who are too young, too old, too short in gestational age, and have too many children (17). This statement is in line with research Sukoco (2020) which explained that the most common cause of neonatal death was LBW as many as 29 cases (47.4%) (18).

The high incidence of LBW and the impact on neonatal mortality, and the various problems that can occur in the long term, require efforts to ensure that every baby is born in a healthy condition. In addition, it can be done by identifying risk factors that have the potential to cause LBW. Prevention and control measures for LBW can be carried out by ensuring the provision of health education, supervision and monitoring, prevention of hypothermia in infants, nutritional status of pregnant women, and conducting antenatal care (19). These actions are expected to reduce the incidence of low birth weight, so it is hoped that efforts to reduce LBW rates can be a step to reduce neonatal mortality and achieve the Sustainable Development Goals (SDGs) program target in 2030 (20).

## CONCLUSION

Low Birth Weight (LBW) is a condition of infants who have a low birth weight of less than 2500 grams which is one of the causes of neonatal infant mortality. Neonatal mortality per 1,000 live births is still a problem in East Java, because the incidence of cases until 2022 is still fluctuating. The results of the analysis of Low-Birth-Weight Infants (LBW) with Neonatal Mortality Cases in East Java Province in 2020, 2021, to 2022 showed significant results so that, it can be interpreted that there is a strong enough relationship between variables. The relationship between variables produces a positive relationship, so it can be interpreted that an increase in LBW babies is followed by an increase in neonatal mortality cases. Neonatal mortality can be prevented by improving the nutritional status of pregnant women and routine examinations during pregnancy.

## SUGGESTION

The incidence of Low Birth Weight (LBW) with neonatal mortality is caused by many factors and requires cross-sector support from the government to the community. This can be applied in the form of regulations to programs that can be implemented to prevent neonatal deaths by reducing the number of Low-Birth-Weight Infants (LBW).

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