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THE RELATIONSHIP BETWEEN MALNUTRITION AND SEVERE PNEUMONIA AMONG TODDLERS IN EAST JAVA, INDONESIA: AN ECOLOGICAL STUDY

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ABSTRACT

Background: The case of toddler mortality in the world due to pneumonia is still relatively high. In community-acquired-pneumonia, severity was an independent risk factor for death. Malnutrition and infectious diseases have a mutually influential relationship with each other. The high cases of pneumonia and malnutrition in toddlers in East Java Province need to be considered because they will support the welfare of the 3rd Sustainable Development Goal, in this case, it is necessary to conduct research on nutrition and pneumonia in toddlers in East Java Province **Purpose:** To analyze the relationship between malnutrition and severe pneumonia in toddlers in East Java Province in 2019-2020 **Methods:** This research design used an ecological study with district/city in the East Java Province as the analysis unit. The data were taken from the health profile of East Java Province. The data analysis technique used was the Spearman test. **Results:** The study showed that there was a relationship between malnutrition and pneumonia in toddlers because p = 0.001 < = 0.05. **Conclusion:** There is a strong relationship between cases of severe pneumonia and malnutrition in toddlers in the East Java Province in 2019-2020 with a positive relationship direction.

Keywords: malnutrition, severe pneumonia, children under-five-years

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INTRODUCTION

Pneumonia among toddlers is currently the main focus of child health problems in the world. According to the WHO in 2019, pneumonia became the infectious disease that causes most deaths among toddlers in the world. The case of toddlers' mortality in the world due to pneumonia is still relatively high. In 2018, there were 800,000 toddlers' deaths due to pneumonia among infants every year, making approximately 2,200 children under five died from pneumonia every year. (UNICEF, 2018).

In Indonesia, pneumonia is an infectious disease that has the highest proportion of causes of death for post-neonatal age children (29 days-11 months) in 2019, which is 14,5% (Ministry of Health, 2021). In addition, pneumonia is also a cause of death for children aged 12-59 months in Indonesia in 2020 with a proportion of 5,05%. This figure shows that pneumonia is a disease that causes the death of toddler with the third largest proportion after parasitic infections and diarrhea (Ministry of Health, 2021).

In community pneumonia, pneumonia severity was an independent risk factor for death. Pneumonia sufferers who receive intensive care using a breathing apparatus are a risk factor for death from pneumonia with a magnitude of p = 0.029 (Hanifah, 2020). Research conducted on about 300 pneumonia toddler patients in a hospital in Indonesia stated that the indication of very severe pneumonia was a risk factor that could increase the mortality of pneumonia on toddler who received treatment at the hospital with an OR of 20.3 (Wulandari *et al*., 2013). So, it can be concluded that the severity of pneumonia in toddler has a directly proportional effect on mortality in toddler. The more severe the severity of pneumonia in patients, the higher the risk of death in pneumonia patients.

Malnutrition is considered to have a negative impact on the body's immunity, especially if you have a protein deficiency (Ranjit, 1997). One of the important components in increasing immunity is by adequate nutritional intake, in patients with poor nutritional status it will reduce the humoral immune system and will increase oxidative stress (Ranjit, 1997). The relationship between malnutrition and infectious diseases has a mutually influential relationship with one another. Malnutrition can cause infectious diseases while infectious diseases can cause disturbances in the metabolism of nutrients, resulting in malnutrition (Huriah, 2017). In addition, Susila *et al's* research in 2021 found that nutritional status had a significant relationship with the severity of pneumonia in toddler with information that children with malnutrition would be at higher risk of severe pneumonia (severe pneumonia) than children with normal nutritional status (Susila, 2010). Suryawan and Widi-, 2021).

East Java Province is one of the provinces with the highest percentage of malnutrition and severe pneumonia in Indonesia. The percentage of cases of malnutrition in children aged 0-59 months in East Java in 2019 was 8% and increased in 2020 to reach 10%. Meanwhile, cases of severe pneumonia in children aged 0-59 months in East Java in 2019 were 1727 cases and in 2020 there were 1571 cases (East Java Provincial Health Office, 2020). The high cases of pneumonia and malnutrition in children aged 0-59 months in East Java Province need to be taken into account. The high cases of pneumonia in toddler will be a nuisance in achieving the 3rd SDGs goals, which are good health and welfare, so that research on malnutrition and pneumonia in children aged 0-59 not in East Java Province needs to be done. This is in order to provide supporting information about malnutrition and pneumonia in children under five so as to increase the prevention of malnutrition and pneumonia in children aged 0-59 months. The purpose of this study was to analyze the relationship between severe pneumonia and malnutrition in children under five in East Java Province in 2019-2020. This research was expected to add insight and knowledge about the relationship between malnutrition and severe pneumonia so that prevention of severe pneumonia in children under five can be carried out from an early age through the fulfillment of toddler nutrition.

METHOD

This study used an ecological study design with the unit of analysis was the district/city in East Java Province. This study used secondary data obtained from the health profiles of East Java Province in 2019 and 2020 owned by the East Java Provincial Health Office. In this study, the data used were only

data for 2019-2020 considering that severe pneumonia is a new variable in the health profile of East Java Province so that in the previous year there was no data on the number of cases of severe pneumonia.

The outcome variable in this study was severe pneumonia, while the exposure variable was malnutrition. The severe pneumonia variable is the total number of cases of severe pneumonia in patients aged under five (0-59 months) in 38 districts/cities in East Java Province in 2019-2020. Cases of severe pneumonia were obtained from the results of reporting from the Public Health Center and hospitals in each district/city that had implemented standard pneumonia management. Severe pneumonia is pneumonia accompanied by symptoms in the form of rapid breathing and chest indrawing. The variable of malnutrition is the number of cases of malnutrition in children under five (0-59 months) in 38 districts/cities in East Java Province in 2019-2020. According to records in the health profile of East Java Province, malnutrition status is measured based on the calculation of weight/age.

The data were analyzed descriptively and statistically. Descriptive analysis was conducted to describe the number of cases of severe pneumonia and malnutrition, while statistical analysis was conducted to determine the relationship between variables. Descriptive and statistical tests in this study used SPSS software for testing applications. Statistical tests were carried out to test the normality of the data and analyze the relationship between variables. The normality test of the data used the Kolmogorov-Smirnov test and the results of the normality test of the data were normal, so that the relationship analysis used the Spearman correlation test.

RESULTS

From the map image below, the distribution of malnutrition cases is quite high in most areas in East Java Province (marked in red). In addition, in most districts/cities, it is shown that in each district/city that is included in the category of high nutritional status, there are quite several cases of pneumonia under five in the area, such as Jember Regency and Malang Regency in 2019 and Probolinggo Regency and Regency of Malang. Malang in 2020 (Figure 1 and Figure 2)

Map of the Distribution of Toddler Pneumonia Cases Based on Malnutrition Status in Toddlers in East Java Province in 2019-2020

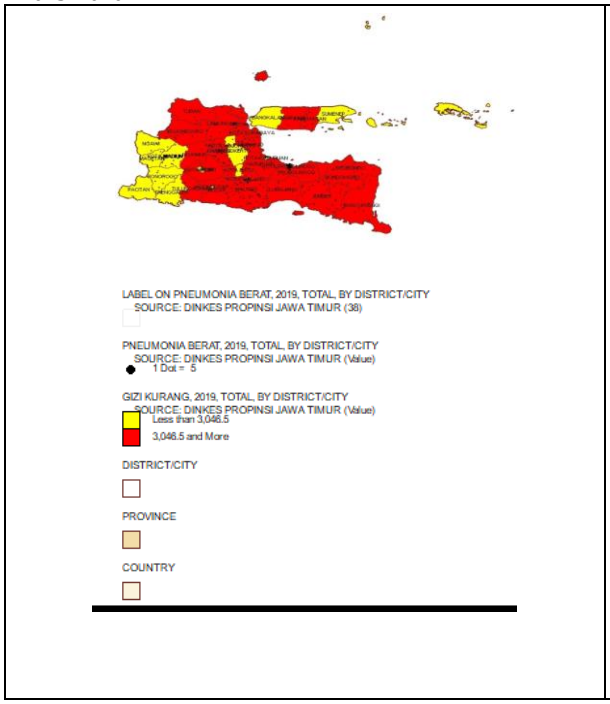

Figure 1. Distribution Map of Toddler Pneumonia Cases based on Malnutrition Status in Toddlers in East Java Province in 2019

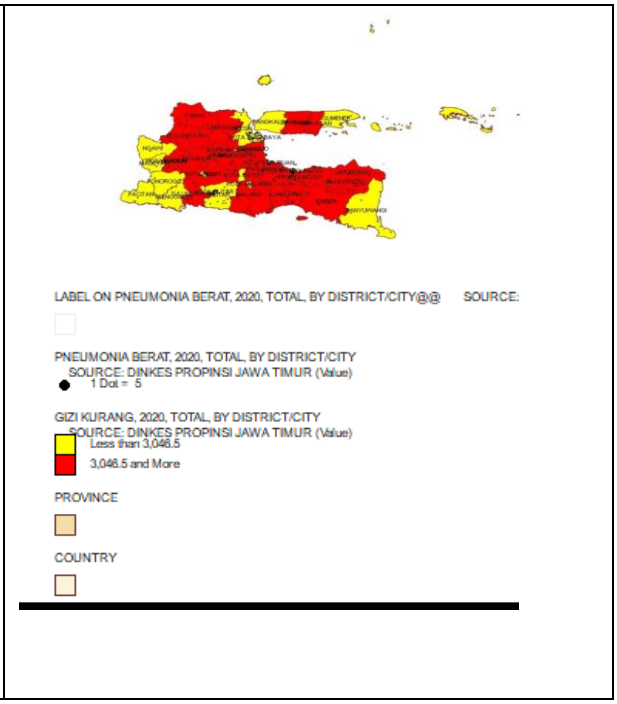

Figure 2. Map of the Distribution of Toddler Pneumonia Cases by Undernutrition Status in Toddlers in East Java Province in 2020

Table 1. Number of Severe Pneumonia Cases in East Java Province by Gender

Sex	Severe Pneumonia	
	2019	2020
Male	1.082	882
Female	645	689

Cases of severe pneumonia in men in 2019 were 1,082 cases and decreased in 2020 by 882 cases. While cases of severe pneumonia in children under five with female sex increased from 2019 to 2020. In 2019, there were 645 cases of severe pneumonia in women and increased to 689 cases in 2020. Severe pneumonia cases at the age of toddlers were mostly experienced by men. men compared to women (Table 1).

Table 2. Number of Malnutrition Cases in East Java Province

Year	Malnutrition Cases (W/A)
2019	167,515
2020	135,883

The number of cases of malnutrition in 2019 in East Java Province reached 167,515 cases and decreased in 2020 to 135,883 cases (Table 2).

Table 3. List of Regencies/Cities in East Java Province with the Highest Cases of Severe Pneumonia in Toddlers in 2019-2020

Year	Severe Pneumonia	Number of cases (people)
2019	Malang Regency	304
	Probolinggo City	226
	Jember	170
	Jombang Regency	147
	Malang city	63
2020	Surabaya City	180
	Probolinggo Regency	159
	Lumajang Regency	131
	Malang Regency	115
	Bondowoso Regency	94

The highest cases of severe pneumonia in children under five in East Java Province in 2019 were in Malang Regency with a total of 304 cases. Meanwhile, in 2020 the highest cases of severe pneumonia in children under five were in the city of Surabaya with a total of 180 cases (table 3). Several areas experienced a significant increase in cases from 2019-2020, including the Surabaya City.

Table 4. List of Regencies/Cities in East Java Province with the Highest Cases of Malnutrition in Toddlers in 2019-2020

Year	Poor Nutrition	Number of cases (people)
2019	Surabaya City	16,006
	Jember Regency	13,864
	Pasuruan Regency	10,840
	Malang Regency	8,998
	Probolinggo Regency	8,949
2020	Jember Regency	16,006
	Probolinggo Regency	13,864
	Jombang Regency	10,840
	Malang Regency	8,998
	Tuban District	8,949

The highest cases of malnutrition in children under five in East Java Province in 2019 were in the city of Surabaya with a total of 16,006 cases. Meanwhile, in 2020 the highest cases of malnutrition in children under five were found in Jember Regency with a total of 20,205 cases (Table 4). Several regions experienced a significant increase in cases from 2019-2020, including Jember Regency and Probolinggo Regency.

Table 5. Calculation of the data normality test using the Kolmogorov-Smirnov test

	Severe Pneumonia	Poor Nutrition
Asymp. Sig. (2-tailed)	0.001	0.034

This research used the Kolmogorov-Smirnov test with Lilliefors significance correlation adjustments. In this normality test, the researcher uses the SPSS application in the calculation. The normality test that has been carried out shows that the data on cases of severe pneumonia and malnutrition have an abnormal distribution with a significance value of 0.001 for severe pneumonia and 0.034 for malnutrition, where the value is less than the value of = 0.05 (Table 5). Because the data used in this study are not normally distributed, then the test of correlation between variables in this study will use the Spearman correlation test

Table 6. Analysis of correlation between severe pneumonia and malnutrition using the Spearman correlation test

			Severe Pneumonia	Poor Nutrition
Spearman's rho	Severe Pneumonia	Correlation coefficient	1,000	0,551
		Significance value		0,001
		N	38	38
	Poor Nutrition	Correlation coefficient	0,551	1,000
		Significance value	0,001	
		N	38	38

The results of the Spearman correlation test analysis to determine the correlation between the number of cases of severe pneumonia and the number of cases of malnutrition in East Java Province in 2019-2020 resulted in a significance value of 0.001 where the value was less than the alpha value (α = 0.05). This means that there is correlation between cases of severe pneumonia and cases of malnutrition in children under five in East Java Province in 2019-2020. The strength of the correlation between severe pneumonia and malnutrition is 0.551 which shows a strong correlation between cases of severe pneumonia and cases of malnutrition. In addition, the coefficient number in the analysis test results is positive, which means that the higher the cases of malnutrition in children under five in East Java Province, the higher cases of severe pneumonia in children under five in East Java Province, and vice versa (Table 6).

DISCUSSION

Cases of severe pneumonia at the age of toddlers are more experienced by men than women. The results of this study are in accordance with research by Shan et al., 2019 which stated that the male gender was more commonly found in pediatric pneumonia patients who were hospitalized, which was 62.4% (Shan *et al*., 2019). Patients with pneumonia under five have a severe degree of severity if they have been referred to the hospital. Research by Permatasari, 2018 also stated that the same thing was that pneumonia patients aged under five who were hospitalized were more male than female, which was 60.7%. (Permatasari, 2018).

Patients with pneumonia who are declared to have a severe degree of severity will have signs/symptoms, namely chest indrawing. In accordance with the Integrated Management of Childhood Illness policy, patients with pneumonia with symptoms/signs of TDDK should be immediately referred to the hospital. So that pneumonia sufferers under five who have been hospitalized tend to have a severe degree of severity. Based on the description of the data used in this study, the toddlers who were the subjects had been given standard management of pneumonia, so that the number of patients with symptoms/signs of TDDK had been identified.

The highest cases of severe pneumonia in toddlers in East Java Province in 2019 were in Malang Regency with a total of 304 cases. Meanwhile, in 2020 the highest cases of severe pneumonia in children under five were in the city of Surabaya with a total of 180 cases. The results of this study indicate that there is an even distribution of severe pneumonia cases in every region in East Java Province. The results of this study are in line with secondary data in various other provinces in Indonesia. One example is that North Sumatra Province in 2020 had the highest cases of severe pneumonia in children under five in Deli Serdang Regency, Medan City and Pematang Siantar City (North Sumatra Provincial Health Office, 2019). The area of residence can be a risk factor for severe pneumonia. Urban areas tend to have higher air pollution than rural areas. Urban areas with heavy traffic with vehicles that use fossil fuels will have a high concentration of SO2 in the air. SO2 air pollution can affect the incidence of pneumonia under five (p = 0.001), because the higher the concentration of SO2 that enters the inhalation system, it will worsen inflammation in the respiratory tract so that it can facilitate the entry of pathogens that cause pneumonia (Al Farisi, Budiyono and Setiani, 2018).

The degree of health of toddlers cannot be separated from the factors of the caring parents. Pneumonia can progress to severe pneumonia if there is a delay in seeking treatment. Research conducted by Pajuelo et al., 2018 found a relationship between delays in handling pneumonia and an increase in

mortality due to pneumonia with a percentage of 33.2% (Pajuelo *et al.*, 2018). The delay in seeking treatment may be influenced by the lack of education level of the parents caring for the toddler. Urban and rural areas of residence also differ in terms of the people's education level. Residents living in urban areas tend to be at a higher level of education than those living in rural areas (Mantao *et al*., 2018).

The highest cases of malnutrition in children under five in East Java Province in 2019 were in Surabaya city, with a total of 16,006 cases. Meanwhile, the highest cases of malnutrition in children under five were found in Jember Regency, with a total of 20,205 cases in 2020. The results of this study indicate a relatively even distribution of cases of malnutrition in each region in East Java Province. This study's results align with secondary data in several other provinces in Indonesia. One example was that North Sumatra Province in 2020 had the highest cases of malnutrition in children under five in North Padang Lawas Regency, South Labuhanbatu Regency, and Nias Regency (Dinas Kesehatan Provinsi Sumatera Utara, 2019). The area where children live can be one of the risk factors for malnutrition. Based on the calculation of BMI in rural and urban areas, it was found that urban areas had a higher average BMI than rural areas with a ratio of 20.08 ± 4.49 kg/m2 compared to 19.23 ± 3.30 kg/m2 (Nadra, Siregar and Rusly, 2019). This research is reinforced by research by Rahmad, 2016. The results of the prevalence of nutritional problems in children under five were higher in rural areas than in urban areas, both in indicators of being underweight (59.7%), stunting (51%), and wasting (52.3%) (Rahmad, 2016). The risk factors for undernutrition that show differences between urban and rural areas are parental income, parental education, and parental occupation. Parents' income, education, and occupation are better in urban areas than in rural areas (Huriah *et al*., 2014).

One of the factors associated with cases of poor nutrition is an infectious disease. According to research by Sholikah, Rustiana and Yuniastuti, 2017, infectious disease is a factor related to the nutritional status of children under five in both urban and rural areas with a p-value of <0.05 (Sholikah, Rustiana and Yuniastuti, 2017). This is in line with research conducted by Huriah, 2017 stated that malnutrition could cause infectious diseases while infectious diseases can cause disturbances in nutrient metabolism, resulting in malnutrition (Huriah, 2017).

Poor nutritional status can impact the immune system of toddlers. This is reinforced by research by Efni, Machmud and Pertiwi, 2016 which stated that malnutrition can cause inhibition of specific antibody systems and can interfere with the defenses of the lungs in infants (Efni, Machmud and Pertiwi, 2016). In addition, undernutrition that can affect toddlers' immune systems will also have an impact on toddlers' immunity against pathogens that cause pneumonia, viruses, and bacteria (Rusepno, 2008 in Arny, Putri and Abadi, 2020).

The analysis result of the variables of severe pneumonia and malnutrition showed that there was a relationship between cases of severe pneumonia and cases of malnutrition in children under five in East Java Province in 2019-2020 with a positive correlation value, namely the higher cases of malnutrition, the higher cases of severe pneumonia. This study is in line with research by Kurniawati, 2020 which stated that toddlers with poor nutritional status were 38.235 times more at risk of developing severe pneumonia than toddlers with good nutritional status (Kurniawati, 2020). Another study that can strengthen this research is Permatasari, 2018 which stated that nutritional status was related to the severity of pneumonia in toddlers with a significance value of 0.000 (Permatasari, 2018). Research by Hemagiri *et al*., 2014 also stated that there was a significant relationship between malnutrition and severe pneumonia, with a p-value = 0.000 (Hemagiri *et al*., 2014).

Nutritional status is a condition in a person's body that is influenced by the intake of nutrients consumed and obtained from food or nutritional sources. Each individual has different nutritional needs depending on age, gender, physical activity, weight, and others (Kementerian Kesehatan, 2017). Problems that occur in a person's nutrition are a description of the consumption of insufficient nutrients. A person who consumes fewer nutrients will be at risk of experiencing malnutrition. Likewise, if people consume excessive nutrients, they will be at risk of experiencing excess nutrition. One of the crucial components in increasing immunity is by providing adequate nutrition. The more balanced the nutritional intake

consumed, the better the effect on nutritional adequacy and body immunity. The body will be stronger against pathogens that can cause infectious diseases with an optimal immune system. Research conducted by Ranjit, 1997 reinforces that there was an influence of nutritional status on immune status. When patients experience protein-energy deficiency (PEM) or poor nutrition, it will reduce the humoral immune system and increase oxidative stress (Ranjit, 1997).

Some of the weaknesses of this study are that the nutritional measurement used in this study uses a measurement of nutritional status by assessing the indicators of body weight and body weight. The BB/U indicator is quite sensitive to small changes in toddlers. For example, if a toddler accidentally has edema during the measurement, it will affect the toddler's weight. In addition, the indicators of BW/U tend to describe the nutritional status at the time of the toddler being measured only. This study uses a population analysis unit, namely district/city, and not an individual analysis unit, so the results do not explain the individual characteristics and nutritional status of each patient with severe pneumonia.

Meanwhile, the strength of this study uses the severe variable pneumonia, where this variable is one of the new variables in the health profile of East Java Province. Thus, this study is a reasonably high novelty associated with using severe pneumonia variables. In this case, it is hoped that the reader will gain new knowledge and information about severe pneumonia and its relationship to undernutrition status.

The results show a relationship between severe pneumonia and malnutrition in children under five in East Java Province. Hopefully, this study can bring readers, especially parents of children under five, a better understanding of severe pneumonia and its relationship with malnutrition so that prevention can be done early on for children under five by fulfilling nutritional intake in children. Besides that, the results of this study can be used as material and input to the Health Office and health facilities in making programs/policies related to pneumonia and malnutrition in children under five.

CONCLUSION

Based on the results of data analysis, it can be concluded that there is a strong relationship between cases of severe pneumonia and malnutrition in children under five in East Java Province in 2019-2020, with the direction of the relationship being positive, i.e. the higher cases of malnutrition in children under five in East Java Province, the higher the number of cases of malnutrition in East Java Province. The higher cases of severe pneumonia in children under five in East Java Province and vice versa.

SUGGESTION

Future researchers who will examine the same research area can develop the unit of analysis into individuals and add nutritional variables such as overweight, overweight, obesity, and so on associated with severe pneumonia variables in toddlers.

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CONFLICT OF INTEREST

Authors have no conflict of interest.

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Faculty of Public Health, Airlangga University.

AUTHOR CONTRIBUTION

Author Milistia Kristi Prastika as data collector, data analysis, manuscript writing, review library, and looking for references. Author Erni Astutik as study design, supervision, and manuscript revision.

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