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### Malnutrition and Pneumonia among Under-five Children in Sadewa Maternal and Child Hospital, Yogyakarta, Indonesia

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#### ABSTRACT

**Background:** Pneumonia is one of the top causes of morbidity in children younger than 5 years old. In Indonesia, pneumonia was the second leading cause of death in children under five years in 2017. The most important risk factors for pneumonia in children are malnutrition, household air pollution, non-exclusive breastfeeding, low birth weight (2500 g), overcrowding ( $\geq 7$  or more person in the same household), and lack of measles immunization. This study aimed to determine the relationship between nutritional status and pneumonia in under-five children in Sadewa Maternal and Child Hospital, Yogyakarta, Indonesia. **Methods:** Analytical observational studies with a cross-sectional approach. A total of 191 subjects took part in the study. Observations of the nutritional status and degree of pneumonia were carried out in this study. Univariate and bivariate data analysis was carried out with the help of SPSS version 25 software. **Results:** The majority of study subjects with pneumonia had normal nutritional status. Meanwhile, study subjects with severe pneumonia conditions had malnutrition nutritional status. The results showed that nutritional status was associated with pneumonia, with a p-value of  $< 0.05$ . **Conclusion:** There is a relationship between nutritional status and the severity level of pneumonia in children under five years old in Sadewa Maternal and Child Hospital, Yogyakarta, Indonesia.

#### 1. Introduction

Pneumonia is one of the top causes of morbidity in children younger than 5 years old, which places a significant strain on the healthcare system. India, Nigeria, Indonesia, Pakistan, and China accounted for more than 54% of all pneumonia cases worldwide in 2015.<sup>1</sup> In 2019, pneumonia was responsible for the deaths of 740.180 children under-five, accounting for 14% of all fatalities. Children and families in every region of the world are at risk for contracting pneumonia; however, the mortality rate is highest in southern Asia and sub-Saharan Africa.<sup>2</sup>

In Indonesia, pneumonia was the second leading cause of death in children under five years in 2017.<sup>3</sup> In locations with lower incomes, infection-related mortality rates are much greater than in regions with higher incomes due to delayed care seeking (caused by

inadequate health education or geographical or financial obstacles to care), incorrect diagnosis, and unsuitable treatment.<sup>4</sup> *H. influenzae* non-type B and RSV were the most frequently identified viruses responsible for hospitalized CAP among 2–59-month-old Indonesian children.<sup>5</sup>

The most important risk factors for pneumonia in children are malnutrition, household air pollution, non-exclusive breastfeeding, low birth weight ( $< 2500$  g), overcrowding ( $\geq 7$  or more people in the same household), and lack of measles immunization.<sup>6</sup> Children with non-severe pneumonia and Weight-Age-Z less than  $-3$  SD and without severe acute malnutrition had a mortality risk that was nearly three times that of children with non-severe pneumonia. It is commonly believed that deficits in immunological function are associated with an increased risk of

mortality in children with inadequate nutritional status.<sup>7</sup>

In recent years, both the incidence and mortality of childhood pneumonia have declined. During the same time span, hospitalization rates have climbed while hospital mortality rates have declined significantly.<sup>1</sup> These trends in childhood pneumonia are presumably the result of earlier hospital presentations and increased quality of services. Despite this improvement, the study found little evidence of a significant change in the risk of death among malnutrition children over the past decade. Children with malnutrition have a significantly increased risk of dying from pneumonia, which increases with the severity of malnutrition.<sup>8</sup>

22%–40% of children with severe pneumonia are also malnutrition. With a mortality rate of 23%, they are up to 15 times more likely to die than children without severe malnutrition. Contributing factors to the increased mortality risk are immunodeficiency linked with malnutrition, high rates of co-morbidities, delayed health-seeking behavior among families of children with malnutrition, and possible delays in diagnosis due to the insensitivity of clinical symptoms.<sup>9-10</sup>

Malnutrition is a condition of under or excessive nutrition, manifested by a shortage or excess of important nutrients. It is the consequence of a complicated interaction between the availability, accessibility, and utilization of food and healthcare services.<sup>11</sup> This study aimed to determine the relationship between the incidence of malnutrition and pneumonia in children aged less than five years.

## 2. Methods

This study was an analytic observational study with a cross-sectional approach and used secondary data using medical records obtained from the medical record installation at Sadewa Maternal and Child Hospital, Yogyakarta, Indonesia. A total of 191 research subjects participated in this study. The research subjects met the inclusion criteria in the form of pediatric patients aged less than 5 years with a

diagnosis of pneumonia at Sadewa Maternal and Child Hospital, Yogyakarta, Indonesia, for the January-December 2022 period and had complete medical record data. This study was approved by the medical and health research ethics committee at Sadewa Maternal and Child Hospital, Yogyakarta, Indonesia.

This study observed sociodemographic data of patients, anthropometric data, and the medical history of the study subjects. Nutritional status is assessed based on anthropometric data, namely Z-scores. Nutritional statuses were defined as: wasting if the weight for age < -3 SD, undernutrition if -3 to <-2 SD, normal nutrition if -2 to +2 SD, and overnutrition if >+2 SD. In this study, there were divided into two groups, malnutrition and normal. A child was considered malnutrition if it either was wasting, undernutrition, or overnutrition. The severity of pneumonia is divided into two groups. Pneumonia was defined as fast breathing and/or chest indrawing: lower chest wall indrawing (i.e., lower chest wall goes in when the child breathes in). Severe pneumonia was defined as cough or difficulty in breathing, plus at least one of the following: central cyanosis or oxygen saturation < 90% on pulse oximetry, severe respiratory distress (e.g., grunting, very severe chest indrawing), signs of pneumonia with a general danger sign: inability to breastfeed or drink, lethargy or unconscious, convulsions. Data analysis was performed with SPSS software version 25. Univariate analysis is performed to present the frequency distribution of each test variable. Bivariate analysis was carried out to determine the relationship between nutritional status and the severity of pneumonia, with a p-value <0.05.

## 3. Results

Table 1 presents the baseline characteristics of the research subjects. The majority of research subjects were aged 13-24 months and were male. The majority of research subjects have normal nutritional status. In addition, the majority of study subjects did not experience severe pneumonia.

Table 1. Baseline characteristics of research subjects.

<b>Age (month)</b>	<b>Frequency (N)</b>	<b>Percentage (%)</b>
0 – 12	62	32,5
13 – 24	40	20,9
25 – 36	22	11,5
37 – 48	26	13,6
49 – 60	41	21,5
<b>Gender</b>	<b>Frequency (N)</b>	<b>Percentage (%)</b>
Male	123	64,4
Female	68	35,6
<b>Nutritional status</b>	<b>Frequency (N)</b>	<b>Percentage (%)</b>
Malnutrition	64	33,5
Normal	127	66,5
<b>Severity of pneumonia</b>	<b>Frequency(N)</b>	<b>Percentage (%)</b>
Pneumonia	144	75,4
Severe pneumonia	47	24,6

Table 2 presents the relationship between nutritional status and pneumonia. The majority of study subjects with pneumonia had normal nutritional status. Meanwhile, research subjects with

severe pneumonia had the nutritional status of malnutrition. The results of the study show that nutritional status is associated with pneumonia, with a p-value <0.05.

Table 2. Relationship between nutritional status and pneumonia.

<b>Variable</b>	<b>Pneumonia</b>		<b>p-value*</b>
	Pneumonia	Severe pneumonia	
Nutritional status:			0,000
Malnutrition	31	33	
Normal	113	14	

\*Chi-square test, p<0,05.

#### 4. Discussion

Range of 0 - 12 months old is most age samples occurrence pneumonia. The results of this study are in line with the research, which states that children aged 2-12 months were four times as likely to acquire pneumonia than older children.<sup>12,13</sup> Other studies conducted also revealed that the majority (61.67%) of children with pneumonia were infants younger than one year old.<sup>14</sup> This can be attributed to their undeveloped immune systems, tiny airways, and restricted access to vaccinations, which makes them susceptible to pneumonia and other illnesses.<sup>13,15</sup>

The study's findings showed that most cases of pneumonia in children were dominated by males (64,4 %) cases, which is in line with the previous research that showed significantly more cases in males than in the female.<sup>16</sup> The high susceptibility of male children may be due to genetics or a higher reporting rate for

male children by their mothers due to gender bias, which may cause mothers to notice symptoms due to a greater focus on male children, especially for seeking medical attention much earlier than female children. Boys are more likely than girls to be affected by or to seek medical attention for common acute respiratory infections. The testosterone's ability to inhibit the immune response may also contribute to male children's heightened susceptibility to infection.<sup>17</sup>

Another research also explained that parents are more likely to bring their male children to the hospital for pneumonia than their female children and that female children suffer from more severe pneumonia than male children when they are admitted to the hospital. The study has also documented that the risk of death from pneumonia is higher among females than males and that female children with very severe pneumonia are four times more likely to die than

males and other females despite no sex disparity in treatment in the hospital.<sup>18</sup> But on the contrary, other studies stated there was no significant difference between male and female death rates.<sup>19</sup>

In this study, 16,2 % of pneumonia patients in children under five years old treated at Sadewa Maternal and Child Hospital, Yogyakarta, were malnutrition, and 17,3 % of severe pneumonia were malnutrition, consistent with findings from other studies.<sup>20</sup> Based on previous studies showed that undernutrition is a significant risk factor for severe pneumonia and is related to mortality. It can increase the incidence, severity, and mortality of pneumonia due to weaker host defense mechanisms and impaired respiratory muscle performance.<sup>20,21</sup> Similarly. Previous studies have shown that children with non-severe pneumonia and WAZ less than -3 SD and without severe acute malnutrition had an approximately threefold increased risk of death compared to children with non-severe pneumonia.<sup>7</sup> The relationship between nutrition and infection is a vicious circle. Malnutrition causes infections, whereas infections cause malnutrition through anorexia, malabsorption, diversion, loss, and increased food requirements.<sup>22</sup>

## 5. Conclusion

There is a relationship between nutritional status and the severity level of pneumonia in children under five years old in Sadewa Maternal and Child Hospital, Yogyakarta, Indonesia.

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