

Risk Factor of Paediatric Community-Acquired Pneumonia in Wajo Regency, Indonesia

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ABSTRACT

Background: Pneumonia is the second highest cause of under-five mortality in Indonesia. This study aimed to analyse the risk factors for pneumonia among under-fives in Wajo Regency.

Methodology: This type of research was a quantitative study using a case-control study design. The population was all children in the working areas of Salewangeng Health Centre, Penrang Health Centre, and Belawa Health Centre. The sample size was 224 children consisting of 112 cases and 112 controls. The odds ratio test and logistic regression were used to evaluate the data.

Results: Risk factors associated with pneumonia were under-five nutritional status (OR=3.563; 95%CI=1.57-8.65; p=0.0008), indoor smoke exposure (OR=5.852; 95%CI=2.88-12.36; p=0.000), maternal age (OR=2.575; 95%CI=1.45-4.58; p=0.0005), and number of children in the family (OR=3.133; 95%CI=1.65-6.05; p=0.0002).

Conclusions: The most influential risk factor for under-five pneumonia was indoor smoke exposure. The probability of pneumonia among under-fives who were exposed to indoor smoke, had a maternal age 30 years, and had poor nutritional status was 89.8%. It is recommended for the community to reduce smoking activities in the house and reduce the use of mosquito coils to prevent smoke exposure to children at home.

Key-words: Pneumonia, risk factors, smoke exposure

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INTRODUCTION

Pneumonia is a form of acute respiratory infection that affects the lungs. The lungs are made up of small sacs called alveoli, which fill with air when a healthy person breathes. When a person has pneumonia, the alveoli fill with pus and fluid, which makes breathing painful and limits oxygen intake.¹

According to WHO in 2018 pneumonia claimed the lives of more than 800,000 children under five worldwide, or 39 children per second. Half of the under-five deaths from pneumonia were in five countries including Nigeria (162,000), India (127,000), Pakistan (58,000), Democratic Republic of Congo (40,000), and Ethiopia (32,000). In 2018, an estimated 19,000 children died from pneumonia. Global estimates show that there are 71 children in Indonesia who contract pneumonia every hour.²

In Indonesia, pneumonia is the second leading cause of death among under-fives after diarrhea, and in 2019 the percentage of pneumonia deaths among under-fives was 9.5% of all under-five deaths.³ The Indonesian Ministry of Health reported that there were 278,261 children under five who experienced pneumonia in Indonesia in 2021. This number decreased by 10.19% compared to the previous year (309,383 cases). Meanwhile, the under-five mortality rate due to pneumonia was 0.16% in 2021.⁴

A study in Worabe, Ethiopia showed that stunting, asthma and respiratory infections, ventilation problem in kitchen and holding children while cooking are strongly associated with an increased risk of pneumonia in children.⁵ Meanwhile, research showed that there is a direct positive influence between exposure to indoor smoke, pregnancy stress, and the number of children in the family on the incidence of pneumonia in toddlers in Karanganyar Regency.⁶ Moreover, a study in Bengkulu concluded that there was a significant relationship between immunization status, exclusive breastfeeding, history of acute respiratory infection (ARI), residential density, and the incidence of pneumonia in toddlers. While the most influential variable is exclusive breastfeeding.⁷

Based on data from South Sulawesi Province in 2019, the estimated number of pneumonia cases among children under five was estimated at 32,876 cases and the number of children under five with pneumonia found and treated was 5,682 (17.28%).⁸

In Wajo Regency, according to the Health Profile of the Wajo Regency Health Office in 2022, the number of under-five pneumonia cases in 2022 was 281 out of 5,787 live births.⁹

Of the total 281 pneumonia cases, there were three health centres with the highest cases, were Salewangeng Health Centre 53 cases (18.86%), Belawa Health Centre 40 cases (14.23%), and Penrang Health Centre 19 cases (6.76%)⁹. Based on

this data, the researcher chose the three health centres above as the research location.

This study aimed to determine the risk factors for pneumonia among under-fives in Wajo Regency.

METHODOLOGY

The study was quantitative research with a case control study design.

Population and Sample: The population in this study were children under five years who were registered in the health care centre of Salewangeng, Belawa and Penrang in 2022 with mother as respondents. The three health centres were selected due to the high number of pneumonia cases in their working areas based on data from the Wajo Regency Health Profile 2022.

The case group was under-fives who suffered from prolonged cough, fever and difficulty breathing and had been diagnosed with pneumonia by a doctor or health worker registered in the health centre registers in 2022. The total number of under-five pneumonia cases in the three health centres was 112. All of them were used as research samples.

The control group was under-fives who were not diagnosed with pneumonia who were registered in the health centre registers in 2022. The control group was determined using a 1:1 ratio. So, the number of controls was 112 children. The control group included either healthy or sick children but do not suffer from any respiratory disease.

The sample exclusion criteria in this study were if the respondent was not willing to be interviewed. And if the respondent was not domiciled in the working area of the 3 health centers where the research was conducted

Research Variables: The dependent variable in this study was the incidence of pneumonia in children. The independent variables in this study were the nutritional status of children, exclusive breastfeeding history, prematurity, indoor smoke exposure, maternal age, maternal education, maternal occupation, and number of children in the family.

The children nutritional status was carried into two categories, which are normal and abnormal. Nutritional status was measured by dividing body weight (kg) by age (months). The result was a range of standard deviation values. Normal nutritional status if the standard deviation obtained was in a range from -2 SD to +1 SD, while others were abnormal.

In addition, the history of exclusive breastfeeding was divided into two categories, exclusive and non-exclusive breastfeeding. Exclusive breastfeeding means only giving breast milk to babies (under 6 months of age), not giving other food or fluids (including formula milk or water), except medicines or vitamin and mineral supplements. On the other hand,

non-exclusive means giving food of fluids other than breast milk.

In the prematurity variable, it was categorized as risky if the mother's gestational age at the time of delivery is <37 weeks. While said to be not at risk if the gestational age at the time of delivery is ≥37 weeks.

Moreover, indoor smoke exposure was divided into exposed and non-exposed. There were three indoor smokes determined in this study that were cigarette smoke, mosquito coil and firewood stoves. If it was found one of these three types of smoke in house, then it was categorized as indoor smoke exposed without considered the duration of exposure.

In the maternal age variable, if the mother's age was 30 years and above, it was categorized as at risk. And if the mother's age was below 30 years, it was categorized as not at risk.

Moreover, in the maternal education variable, it was categorized as low education if the mother has an education only up to junior high school. And if the mother has an education from high school to college, it was categorized as higher education.

In the maternal occupation variable, mothers were categorized as at risk if they had a job outside the home. While mothers who did not work, or as housewives, were categorized as not at risk.

The last independent variable was the number of children in the family. If the mother has more than 3 children, it was categorized as risky. Meanwhile, mothers who have less than 3 children been categorized as not at risk.

Data Processing and Analysis: Data processing and analysis in this study used the Stata version 17 program. The relationship and magnitude of risk factors between dependent and independent variables were analysed using the chi-square test. Multivariate analysis used was logistic regression test with 95% confidence level ($\alpha = 0.05$)

Research Ethics Approval: This study was approved by the Health Research Ethics Committee of Hasanuddin University with a recommendation for ethical approval number 5152/UN4.14.1/TP.01.02/2023 dated 7 September 2023

RESULTS

Wajo Regency is one of the regencies/cities in South Sulawesi Province with its capital in Sengkang. Wajo Regency is bordered by Luwu and Sidenreng Rappang Regencies to the north, Bone and Soppeng Regencies to the south, Bone Bay to the east, and Soppeng and Sidenreng Rappang Regencies to the west. Wajo Regency with an area of 2,506.19 km² or 4.01% of the area of South Sulawesi Province consists of 14 sub-regencies, with 142 villages and 48 sub-districts.¹⁰

Table 1: Distribution Based on Characteristics of Respondents in Wajo Regency in 2022

Respondent Characteristics	Respondent (%)
Health Centre Working Area	
Salewangeng	106 (47.32)
Penrang	38 (16.96)
Belawa	80 (35.71)
Children Age	
<12 months	81 (36.16)
12-35 months	98 (43.75)
≥36 months	45 (20.09)
Children Sex	
Male	138 (61.61)
Female	86 (38.39)
Maternal Education	
Elementary School	46 (20.54)
Junior High School	29 (12.95)
Senior High School	82 (36.61)
University	67 (29.91)
Maternal Occupation	
Housewife	174 (77.68)
Government Employee	28 (12.5)
Private Employee	2 (0.89)
Self-employed	20 (8.93)
Total	224 (100)

Source: Primary Data, 2023

Tabel 1 shows the most respondents were in the working area of Salewangeng Health Centre, were 106 respondents (47.32%). The age group of children is mostly in the 12-35 months age group, as many as 98 children (43.75%). Based on the sex of children, most are male, as many as 138 children (61.61%). In the characteristics of education and occupation, the most respondents' education was high school graduates, were 82 respondents (36.61%) and the most respondents' occupation was as housewives, were 174 respondents (77.68%).

Table 2, shows that there are four significant variables, is nutritional status of children (OR=3.563; 95%CI=1.57-8.65; p=0.0008), indoor smoke exposure (OR=5.852; 95%CI=2.88-12.36; p=0.000), maternal age (OR=2.575; 95%CI=1.45-4.58; p=0.0005), and number of children in the family (OR=3.133; 95%CI=1.65-6.05; p=0.0002). Four other variables were not associated with under-five pneumonia, were exclusive breastfeeding history (OR=1.433; 95%CI=0.82-2.51; p=0.813), prematurity (OR=1.528; 95%CI=0.35-7.56; p=0.5176), maternal education (OR=1.690; 95%CI=0.93-3.09; p=0.0657), and maternal occupation (OR=1.229; 95%CI=0.62-2.43; p=0.5210).

There were 6 variables with a p value <0.25, were the variables of nutritional status of children, exclusive breastfeeding history, indoor smoke exposure, maternal age, maternal education, and number of children in the family. These six variables will be continued in multivariate analysis.

Table 3 shows the result of multivariate analysis using logistic regression analysis, three variables with a p value of <0.05 were obtained, were the children nutritional status p=0.007, the indoor smoke expo-

sure $p=0.000$, and the mother's age $p=0.000$. This means that these three variables are associated with the incidence of pneumonia in children under five. Based on the AOR values of the three variables, indoor smoke exposure was the variable that was the greatest risk factor with an AOR value of 6.736 and the 95% CI value of LL-UL of 3.015-15.044, AOR value obtained was meaningful. This means that children exposed to indoor smoke are at risk of pneumonia 6.736 times compared to children who are not exposed to smoke.

In accordance with the results of the previous analyses, the variables that influence the incidence of pneumonia in children under five are the nutritional status of children under five, indoor smoke exposure,

and maternal age. So the regression equation is:

$$y = \text{const} + \text{coef}_{(x1)} + \text{coef}_{(x2)} + \text{coef}_{(x3)}$$

$$y = -2.27999 + 1.15548x + 1.31312x + 1.98679x$$

$$y = 2.17538$$

After obtaining the y value, the next step is to calculate the probability of the subject with the formula:

$$P = 1 / (1 + \exp^{-y})$$

$$P = 1 / (1 + \exp^{-2.17538})$$

$$P = 0.898267$$

Based on this value, it can be said that the probability of pneumonia among children under five who have abnormal nutritional status, are exposed to indoor smoke, and have mother aged ≥ 30 years is 89.8%

Table 2: Results of Bivariate Analysis of Risk Factors with the Incidence of Pneumonia in Under-Five in Wajo Regency 2022

Risk Factors	Cases (n=112)(%)	Controls (n=112) (%)	OR	p-value	95% CI
Children Nutritional Status			3.563	0.0008*	1.57-8.64
Abnormal	29 (25.9)	10 (8.9)			
Normal	83 (74.1)	102 (91.1)			
Exclusive Breastfeeding History			1.433	0.1803*	0.82-2.51
Not exclusively breastfed	57 (50.89)	47 (41.96)			
Exclusive breastfeeding	55 (49.11)	65 (58.04)			
Prematurity (Maternal gestational age)			1.528	0.5176	0.35-7.56
<37 weeks	6 (5.36)	4 (3.57)			
≥ 37 weeks	106 (94.64)	108 (96.43)			
Indoor Smoke Exposure			5.852	0.0000*	2.87-12.36
Exposed	98 (87.5)	61 (54.46)			
Not exposed	14 (12.5)	51 (45.54)			
Maternal Age			2.575	0.0005*	1.45-4.58
≥ 30 years old	68 (60.71)	42 (49.11)			
<30 years old	44 (39.29)	70 (50.89)			
Maternal Education			1.69	0.0657*	0.93-3.09
Low education	44 (39.29)	31 (27.68)			
Higher education	68 (60.71)	81 (73.23)			
Maternal Occupation			1.229	0.521	0.62-2.43
Working outside	27 (24.11)	23 (20.54)			
Housewife	85 (75.89)	89 (79.46)			
Number of Children in the Family			3.133	0.0002*	1.65-6.05
≥ 3 children	47 (41.96)	21 (18.75)			
<3 children	65 (58.04)	91 (81.25)			

*Candidate variables ($p < 0.25$) that will be continued in multivariate analysis

Table 3: Results of Multivariate Logistic Regression Analysis of Risk Factors for Pneumonia Incidence in Under-Five Children in Wajo Regency 2022

Variables	p-value	OR	95% CI
Indoor Smoke Exposure	0.000	6.736	3.015 - 15.044
Children Nutritional Status	0.005	3.411	1.455 - 7.997
Maternal Age	0.017	2.620	1.185 - 5.791
Number of Children in the family	0.200	1.743	0.745 - 4.077
Exclusive Breastfeeding History	0.128	1.610	0.871 - 2.977
Maternal Education	0.946	0.977	0.498 - 1.913

DISCUSSION

Children Nutritional Status

Statistical tests showed that the nutritional status of under-fives was a significant risk factor for the incidence of pneumonia among under-fives in Wajo Regency.

Previous studies showed that there is a significant relationship between nutritional status and the incidence of pneumonia in infants.¹¹ Children with pneumonia had poor nutritional status compared to children without pneumonia who had normal nutritional status and statistically, there is a close relationship between nutritional status and the inci-

dence of pneumonia. The poorer a child's nutritional status, the greater the severity of pneumonia experienced by the child.¹² On the other hand, Kasim et al witnessed that there was no significant relationship between infectious diseases and nutritional status (body weight/age).¹³ This difference can be caused by different indicators used, some use the body weight/age while others are body weight/body length, body weight/height, or body mass index/age.

Exclusive Breastfeeding History

Statistical tests showed that exclusive breastfeeding was not a significant risk factor for pneumonia among under-fives in Wajo Regency.

Recent study mentioned that breastfeeding status (p-value 0.152) is not associated with the incidence of pneumonia.¹⁴ By contrast, studies experienced that the most significant variable for pneumonia among under-fives was exclusive breastfeeding⁷ and it was significantly related to pneumonia (p-value 0.009) at the Semplak Health Centre, Bogor City.¹⁵

Based on a report from the WHO, less than half of infants under 6 months of age are exclusively breastfed. Exclusive breastfeeding coverage in Indonesia in 2022 was recorded at only 67.96%, down from 69.7% in 2022.¹⁶

Data in Wajo Regency showed that infants aged <6 months who were exclusively breastfed in 2022 were lower than the national coverage, which was only 66.3% with a distribution in three health centres in the study location. Salewangeng Health Centre (61.9%), Belawa Health Centre (51.8%), and Penrang Health Centre (54.7%).⁹

In this study, the case group that was not exclusively breastfed was 50.89%, and the control group that was not exclusively breastfed was 41.96%. The control group in this study was mostly selected from diarrhoea case visits in children under five. So, in addition to the case group, the lack of exclusive breastfeeding coverage will also have an impact on the control group. Because children under five who are not exclusively breastfed will experience more severe effects of diarrhoea.¹⁷ So, this may be the reason why exclusive breastfeeding history is not statistically significant for pneumonia.

Prematurity

Statistical tests showed that prematurity was not a significant risk factor for pneumonia among under-fives in Wajo Regency. The similar result found at Jujun Health Centre, Kerinci Regency¹⁸ and contrary to study in Nigeria, mentioned that prematurity is a major determinant of pneumonia in children under five years.¹⁹

There are several short-term risks that can be experienced by babies born premature, such as lifelong disabilities, decreased cognitive abilities, low immune system and vision, respiratory, and hearing problems. While the long-term risks that may arise

are the increased risk of non-communicable diseases such as hypertension, obesity, and diabetes.²⁰

Indoor Smoke Exposure

Statistical tests showed that indoor smoke exposure was a significant risk factor for pneumonia among under-fives in Wajo Regency. Based on the multivariate analysis, indoor smoke exposure was the most significant risk factor among other variables with an OR of 6.736. There is a direct positive effect between indoor smoke exposure and the risk of pneumonia in children under five. High exposure to indoor smoke can cause a risk of pneumonia incidence of 2.63 times compared to low smoke exposure.⁶

Another study showed that cigarette smoke did not directly affect the incidence of pneumonia in children under five in Pontianak. A factor that influences toddler pneumonia is seasonality. This study divided it into 4 periods, because the incidence of haze is highly dependent on the season, especially during the dry season.²¹

Smoking indoors, as well as the use of mosquito coils and/or wood-burning stoves will have a direct impact on the quality of the air being breathed. Particles from the combustion of biofuels such as firewood, charcoal, agricultural residues and livestock manure have been considered as agents of respiratory disease in some developing countries. The use of firewood stoves is significantly associated with pneumonia and provides clear evidence of an increased risk of more severe pneumonia due to disruption of respiratory mechanisms.²²

In this study the use of mosquito coils inside the house was still widely used, even in rooms where children sleep. Mosquito coils also contain chemicals that are harmful to the respiratory system. There are still respondents who use firewood for cooking that common in villages. The use of firewood is usually to heat water that will be used as drinking water. However, respondents who use firewood to cook water still use gas stoves for other purposes.

Maternal Age

Statistical tests showed that older maternal age was a significant risk factor for pneumonia among under-fives in Wajo Regency.

The results of this study are supported by a study conducted by Bazie, et al, which stated that children under five with older mothers were found to be a risk factor for the incidence of pneumonia in North-east Ethiopia.²³

The different results of the study by Setyoningrum & Mustiko showed that younger maternal age in this study was not proven to be a risk factor for severe pneumonia. Children with younger mothers tended to have very severe pneumonia compared to children born to older mother.²⁴

An explanation for this is that younger mothers may have easier access to health information, identifying

upper respiratory tract infections earlier and preventing pneumonia from developing. In addition, younger mothers may have the opportunity to care for their children with a peer group compared to older mothers, which may lead to the prevention of pneumonia. This difference in results could be due to the different age categories of mothers and the different studies used and the different sample sizes.

Maternal Education

Based on the results of the analysis, it was found that children under five who had mothers with low education had more pneumonia as many as 44 children (39.29%). However, statistical tests showed that maternal education was not a significant risk factor for pneumonia among under-fives in Wajo Regency and this result was supported to another study in Indonesia.²²

In contrast to this result, there was a significant relationship between maternal educational status and the incidence of pneumonia in children under five years of age in the Dinoyo Health Centre working area with a p-value of 0.021 and a risk of 2.122 times greater for children under five years of age to develop pneumonia in the group of mothers who had low educational status.²⁵

Mothers who are young and illiterate tend not to attempt disease prevention strategies such as not behaving responsively in seeking care for their children's health. This is in contrast to mothers with higher education who will be able to care for their children from various possible diseases.

Maternal Occupation

Statistical tests showed that maternal occupation was not a significant risk factor for pneumonia among under-fives in Wajo Regency.

The results of this study are in line with a study by Veridiana, which showed that the results of the analysis of the relationship between maternal occupation and the incidence of pneumonia among under-five children in Indonesia did not show a significant relationship.²⁶

The results of this study differed from a study conducted by Chanie et al who stated that there was a significant association between mothers who worked as employees or government employees with the incidence of pneumonia in toddlers in Amhara Region, Ethiopia.²⁷

Unemployed mothers, in this case housewives, will have more time to monitor their children's growth and development, so they have a readiness behavior when their children are sick. Unemployed mothers also try to prevent pneumonia through the cleanliness and health of the home environment, in this case the habit of cleaning the house every day without any constraints because mothers do not have to work outside the home.

Several studies and research have been conducted to find out the impact of working mothers on their children. To date, there are several studies that show that there is no negative impact of working mothers on their children.²⁸⁻³⁰

Number of Children in the Family

Statistical test results showed that the number of children in the family was a significant risk factor for the incidence of pneumonia among under-fives in Wajo Regency.

Similar results were also shown by Getahun et al who reported that dense family size showed a significant correlation with community-acquired under-five pneumonia in Tehulederie District, Northeast Ethiopia.³¹

Different results were shown in a study by Hidayah et al, which stated that density did not have a significant relationship with pneumonia cases among under-fives in Bujel Kediri Village.³²

Many children in a family can cause health problems due to overcrowded housing conditions. These conditions can trigger the transmission of infectious diseases such as pneumonia.

LIMITATIONS

In this study, there are several limitations. This study focuses on host, social, and environmental factors. Variables related to infectious disease agents, and access to health services were not studied. The indicator for measuring the nutritional status of children only uses body weight for age. The measuring tool used (questionnaire) has limitations in exploring respondents' memories, especially in terms of history of exclusive breastfeeding and history of prematurity.

CONCLUSION

Indoor smoke exposure, children nutritional status, maternal age, and number of children in the family were risk factors associated with the incidence of pneumonia in Wajo Regency. The most influential risk factor for under-five pneumonia was indoor smoke exposure. It is recommended for the community to reduce smoking activities in the house and reduce the use of mosquito coils to prevent smoke exposure to children under five at home.

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