Analysis of risk factor for pneumonia in children less than five years in Makassar

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Abstract:

BACKGROUND: Pneumonia is one of the main causes of mortality in children less than five years worldwide and in Makassar City. The aim of this study was to investigate the risk factors for pneumonia in children less than five years in Makassar City.

MATERIALS AND METHODS: A case–control study design was used in this research. A total of 210 children with consent from the parents were included in this study, which consisted of 70 children's cases, and the data of the control group were taken by the random sampling method. All related data such as immunization record, nutritional status, birth body weight, vitamin A intake in the last six-month record, and parents' education, occupation, and monthly income were registered as independent and control variables. Data analysis was performed by the Chi-square and logistic regression model with a P value of 0.005 and odds ratio (OR) with a 95% confidence interval (CI).

RESULTS: Incomplete diphtheria–pertussis–tetanus–hepatitis B and Haemophilus influenzae type B (DPT-HB-Hib) immunization at the age of 2 months, 3 months, and 4 months, which had adjusted OR (AOR = 9,680; P = 0,001) and malnutrition condition (weight for age) (AOR = 5,486; $P < 0,005$), were associated with the incidence of pneumonia in children less than five years, whereas incomplete measles–rubella (P = 0,770), low birth weight history (P = 0,403), lack of vitamin A intake (P = 0,720), parents' education (P = 0,163), and presence of smoker inside the household (P =) were not associated with the incidence of pneumonia in children less than five years ($P > 0.005$) in Makassar City.

CONCLUSIONS: Incomplete DPT-HB-Hib immunization for three doses at the age of 2 months, 3 months, and 4 months and malnutrition were associated with pneumonia and the highest risk factors for developing pneumonia in children less than five years in Makassar City, Indonesia.

Keywords:

Children, Hib, immunization, malnutrition, measles–rubella, pneumonia

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Introduction

Pneumonia is one of the main causes of mortality in children less than five years globally (n = 740.180, 14%) among all children in 2019.[1] An estimated 120 million cases of pneumonia annually worldwide caused 1.3 million death cases between 2010 and 2015. In developing countries, pneumonia is found to be a cause of mortality incident, accounting for 80% of the total number of deaths in children less than five years.[2] The Indonesia National Survey in 2018 showed that the pneumonia prevalence in children less than five years in Indonesia was 2.1% for the age of 12–23 months. The prevalence of pneumonia was found to be 1.2% in South Sulawesi Province.[3] Pneumonia is still one of the causes of infant mortality in Makassar City, and the trend prevalence of pneumonia has decreased in the last three years, that is, 574 cases in 2019, 223 cases in 2020, and 136 cases in 2021.[4]

Pneumonia in children less than five years is caused by multifactors such as viruses, bacteria, or fungi, which infect the nose or throat when the dust is inhaled.[1] Children less than five years with compromised immune systems are at risk of infection with pneumonia, and one of the influencing factors is incomplete basic immunization.[1] Immunization of Bacillus Calmette–Guérin (BCG) is given at birth, and pentavalent vaccine that consists of diphtheria–pertussis–tetanus–hepatitis B and Haemophilus influenzae type B (DPT-HB-HiB) are given at 2 months, 3 months, and 4 months, whereas measles–rubella is given at the age of 9 months.[5,6] The percentage of immunization coverage in Indonesia for BCG (86.9%), HB-0 (83.1%), measles (77.3%), polio (67.6%), and the lowest is DPT-HB-HiB (61.3%).[3] South Sulawesi Province had basic immunization coverage from 2013 to 2018 (58%), and the Municipal Health Office in Makassar City has held a measles and rubella immunization program as a substitute for measles immunization since 2017.[5] A significant (60%) reduction in Hib infection in the nasopharynx was found in healthy children less than five years after receiving HiB vaccination.[7] A contrary result was found in the previous study that shows the incomplete immunization status ($P = 0.56$) and nutritional status ($P = 0.06$), which were not related to the incidence of pneumonia in children less than five years.[29]

Pneumonia can be prevented by increasing protective measures that are the daily nutritional intake, completing immunizations, and promote healthy environment.[1] Immunization in early childhood is a globally important protection practice for public health and can save two to three million lives every year, but still many children do not receive complete immunizations as recommended To help parents understand the benefit of vaccines, the educational intervention by face to face are existing used widely.[8] Besides the hesitance of parents for giving their children immunizations, the demographic factors such as no or lower education was associated with the hesitance to the vaccination. ($P < 0,001$).[11] The environmental factor, such as indoor air pollution where the carbon monoxide is found in itself, the substance can lead to a higher global risk of pneumonia,[2] but that finding is contrary to the results of a previous case–control study conducted on the same group of age population, which found that the indoor air pollution was not associated with pneumonia in children less than five years ($P = 0.25$).[10] Also, a relationship between education level and pneumonia was found in a study by comparing the group of children less than five years with mothers with a lower education level and the same group with mothers with a higher education level ($P < 0.01$).[9] However, a different result was found that the educational level of the mother was not a factor in the incidence of pneumonia.[25]

This study focused on determining the association of DPT-HB-HiB immunization, measles–rubella, nutritional status, lack of vitamin A intake, low-birth weight history, parents' education, parents' occupation, and parents' monthly income to the incidence of pneumonia in children less than five years. We did not include environmental indicators due to limited information on data and measurement tools.

Materials and Methods

Study design and setting
This was a case–control study conducted on information obtained from medical records in Community Health Centres, immunization card, and interview using questionnaire tools of children's parents, which were collaborated with the midwives' coordinator and health staff related to five Community Health Centres in five subdistricts in Makassar City.

Study participants and sampling
The population in the study was children aged 0–60 months with a total of 14,743 in the five Community Health Centres of Malimongan Baru, Ballaparang, Tamamaung, Bira, and Mamajang in Makassar City. The minimum sample size with a case–control design is calculated using the Lemeshow design and results in 60 minimum samples. Children less than five years had pneumonia by referring to World Health Organization (WHO) standard for pneumonia diagnosis with fast breathing, fever, wheezing, and coughing.[12] In five Community Health Centres from January 2021 to December 2022, 70 cases were found, which were included in this study. The inclusion criteria for the case sampling were the children less than five years who were ever diagnosed with pneumonia and residing in Makassar City, as well as obtaining consent from the parents. The control group was performed by the random sampling method and ruled out the exclusion criteria from the sampling size. The control group never suffered from pneumonia, coronavirus disease 2019 (COVID-19), or tuberculosis and did not hospitalize during data collection. The ratio between case and control is 1: 2 with a total of 210 children less than five years who were assessed for their eligibility to participate in this study.

The exclusion criteria for both cases and control sampling were the children less than five years who resided outside Makassar City, were sick at the time of the research, and did not give consent for the data collection.

The independent variables in this study are immunization status and status of vitamin A capsule intake in the last six months, while the control variables were determined as age, nutritional status, low birth weight history, parents' education, parents' occupation, parents'

monthly income, and presence of smoker inside the household to control the confounding factors.

The nutritional status of children sampled was determined using anthropometric measurements, which were carried out by collaborating with midwives' officers in each Community Health Centre. The digital weight scale is used to measure a child's weight, while for the case group, body weight is recorded before pneumonia diagnosis, and these data were available in the personal medical records of children in each Community Health Centre. The weight value is analyzed using anthropometric tables of the WHO Child Growth Standard and body mass index (BMI) for age to obtain the Z-score to determine the nutritional status of children less than five years.[13]

Basic immunization status was determined for each type of immunization. This research focuses on diphtheria pertussis etanus hepatitis B- hemophilus influenza type B and measles–rubella. Complete was identified by getting 1 dose of DPT-HB-Hib immunization each at 2, 3, and 4 months of age and 1 dose of measles–rubella immunization at 9 months of age. Vitamin A status was determined by consuming vitamin A at a dose of 100,000 IU (International Unit) for babies aged 6–11 months and by consuming vitamin A at a dose of 200,000 SI for ages 12–59 months.[6]

Data collection tools and technique

The socio-demographic was identified into three categories subject to (1) parents' occupation, (2) education level, and (3) monthly income of parents. The occupation of the children's parent (either mother or father) was categorized as (1) government or private sector employee, (2) self-employee, and (3) housewife. Parents' education was categorized as (1) high education (completed diploma or bachelor or master or doctoral) and (2) low education (completed primary school or elementary school or secondary school). The monthly income of the children's parent was categorized into two levels, and the regional minimum wage in Makassar 2021 is used as the standard to determine the level of income, (1) equal to and above UMR = IDR 3,255,403 (2) and below UMR = IDR 3,255,403.[14] The data collection during the interview and seeing the medical records and immunization card as documentation were performed using Kobo Toolbox, an Android-based tool.

The analysis was conducted using Stata version 14 software (Stata Corp., College Station, TX, USA). First, data were generated using region and residence as stratification variables. A normalized weight was then generated. Data were declared to be complex survey data. A complex sample binary logistic regression model was conducted to assess the association between the

Table 1: Distribution frequency table for cases and controls of risk factor for pneumonia in children less than five years in Makassar

Characteristic	Pneumonia (*n*=70) *n* (%)	Control (*n*=140) *n* (%)
Sex		
Boy	34 (48,6)	61 (43,6)
Girl	36 (51,4)	79 (56,4)
Age category		
≤12 months	30 (42,9)	49 (35,0)
13–24 months	17 (24,3)	38 (27,1)
>24–36 months	14 (20,0)	33 (23,6)
≥37–60 months	9 (12,8)	20 (14,3)

suspected risk factors and the outcome. A *P* value = 0.005 was obtained to select variables for the multivariable analysis.[27] The OR with a 95% confidence interval (CI) was reported, and all variables that were found significant at a *P* value of 0,05 were considered risk factors for the case group.[15]

Ethical consideration

The research approval was granted by the research ethics department of the Faculty of Public Health, University of Hasanuddin Makassar. After delivering a brief explanation to the respondent as sampling, the principles of research ethics were applied by giving respect to the parents and children who ever had pneumonia and the control respondent and keeping the confidentiality of the respondents. Approval is obtained by signing the consent for the interview and data collection by reviewing the medical records and immunization card. After the research ends, the data are stored as research documentation.

Results

The results of research activities consist of three (3) data analysis sections for univariate, bivariate, and multivariate. The data of respondent were grouped based on pneumonia (case) and control.

Table 1 displays that the proportion between the case group (pneumonia) and the control group has the same ratio of 1: 2. The female sex category is the highest proportion according to the sex of children less in the group cases (51.4%, *n* = 36), whereas the age group ≤12 months is the highest proportion for the age group category either in the cases group (42.9%, *n* = 30) or in the control group (35%).

Table 2 displays that there is no association between parent's education level with the incidence of pneumonia in children less than five years in Makassar City (*P* = 0.163, where *P* > 0.05), whereas the parents' occupation of children less than five years has an association with the

Table 2: Analysis of the relationship of control variables on the incidence of pneumonia in children less than five years in Makassar

Risk factors	Pneumonia (*n*=70) n (%)	Control (*n*=140) n (%)	Crude OR (95% CI)	*P*
Parents' educational level				
Low	61 (87,1)	111 (79,3)	1.770 (0.753-4.525)	0,163
High	9 (12,9)	29 (20,7)		
Parents' occupation				
Government or private sector employee	5 (7,1)	24 (17,1)	2.689 (0.941-9.422)	0,047
Housewives	33 (47,2)	101 (72,2)		
Self-employee	32 (45,7)	15 (10,7)		
Parents' monthly income				
< Minimum regional wage	59 (84,3)	101 (72,1)	2.625 (1.213-6.053)	0.008*
≥ Minimum regional wage	11 (15,7)	39 (27,9)		
Presence of smoker in the household				
Yes	51 (72,9)	81 (57,9)	1,955 (1,008-3,876)	0,034**
No	19 (27,1)	59 (42,1)		
Age category				
≤12 months	30 (42,9)	49 (35,0)	0.717 (0.384-1.351)	0,268
13–24 months	17 (24,3)	38 (27,1)		
>24–36 months	14 (20,0)	33 (23,6)		
≥37–60 months	9 (12,8)	20 (14,3)		
Low birth weight				
Yes	8 (11,4)	22 (15,7)	0,692 (0,251-1.734)	0,403
Normal	62 (88,6)	118 (84,3)		
Nutrition status				
Malnutrition	25 (35,7)	15 (10,7)	4,629 (2,115-10,282)	0,001**
Normal	45 (64,3)	125 (89,3)		

*) Significant level *P*<0,005 means an association with the dependent variable. **) Significant level *P*<0,005 means an association with the dependent variable and is included in the multivariate analysis

incidence of pneumonia ($P = 0.047$), in line with the result analysis parents' monthly income, which also has an association with the incidence of pneumonia in children less than five years in Makassar City ($P = 0.008$).

The analysis result found that there was no association between the age category with the incidence of pneumonia ($P = 0.628$), and the low birthweight (LBW) shows no association ($P = 0.403$). The analysis result of LBW shows that the lower limit (LL) and upper limit (UL) values (95% CI, 0.251–1.734) include a value of 1 so the crude OR (COR) value obtained is not statistically significant. We found no association between a history of LBW with the incidence of pneumonia (COR = 0,629; $P = 0,403$), and this variable has resulted in the lower limit and upper limit values (95% CI, 0.0723–0.5612), which include a value of 1 so the COR value obtained is not statistically significant.

Children less than five years with malnutritional status are 4.6 times at risk for pneumonia infection compared with those with good nutritional status (COR = 4.629) ($P = 0.000$). The results of the analysis also show that the LL and UL values (95% CI, 2.115–10.282) do not include a value of 1 so the risk value or COR value obtained is statistically significant.

The last finding is that the presence of family members who smoke in the house has a COR of 1.955 ($P = 0.034$), and this means that smoking behavior household has an association with the incidence of pneumonia with a 1.9 times higher risk of pneumonia infection compared with those who do not have. The results of the analysis show that the LL and UL values (95% CI, 1.008–3.876) include a value of 1 so the risk value or COR value obtained is not statistically significant.

Table 3 displays that the children less than five years who had incomplete DPT-HB-Hib immunization had a *P* value < 0.005, which means that incomplete DPT-HB-Hib was the risk factor and associated with the incidence of pneumonia in toddlers in Makassar City. The overall incomplete DPT-HB-Hib at three doses had an association with the incidence of pneumonia in children less than five years ($P = 0.000$) and had the highest COR (COR = 10, 295), whereas the results of the analysis show that the LL and UL values (95% CI, 4.262–26,480) do not include a value of 1 so the COR value obtained is statistically significant. Measles–rubella immunization had a correlation with the incidence of pneumonia in children less than five years (COR = 3,775; $P = 0,001$). The results of the analysis show that the LL and UL values (95% CI, 1,754–8,174) do not include a

value of 1 so that the COR value obtained is statistically significant.

This study also found that there was a relationship between children less than five years who did not get vitamin A in the last six months with the incidence of pneumonia (OR = 0,251; *P* = 0,001). The result of the analysis shows that the LL and UL values (95% CI, 0,064–0,882) do not include a value of 1 so the COR value obtained is statistically significant.

Multivariate analysis is used to determine the adjusted risk values of adjusted OR (AOR) value. The adjusted OR value is the risk value where the effects of other variables are controlled or controlled by the other variables.[26] The type of analysis used to determine the adjusted OR value is logistic regression analysis. The results of the logistic regression analysis are displayed in Table 4.

After logistic regression analysis was performed on the independent variable and the control variable on the dependent variable (pneumonia), it was found that incomplete DPT-HB-Hib immunization had a value (AOR = 9.680; *P* = 0.001), which was a risk factor and associated with the incidence of pneumonia in children less than five years. This result means that children less than five years with incomplete DPT-HB-Hib immunization were 9.68 times more at risk of getting pneumonia than those with a complete dose of DPT-HB-Hib. The other factor that consistently has a significant effect on the overall regression analysis is malnutrition status.

The adjusted OR value is the risk value where the effects of other variables are controlled or controlled, while the crude risk value or so-called unadjusted or COR does not consider the effect of other factors or variables.[26] The results of the multivariate analysis showed that there were differences or changes in the risk value or COR value with AOR. The nutritional status variable was the only variable that experienced an increase in the OR value after the analysis process, contrary to the other variables that experienced a decline in the risk value after undergoing the analysis process.

The results of the Logistic regression analysis of the independent variable status on DPT-HB-Hib immunization and the control variable nutritional status on the dependent variable (pneumonia) show that DPT-HB-Hib immunization incomplete doses and the malnutrition condition in children less than five years were the most influential factors in the incidence of pneumonia in children less than five years. However, the analysis result found that the LL and UL values (95% CI) of the DPT-HB-Hib immunization incomplete dose and malnutrition indicate a statistically significant difference with *P* < 0.05.

Discussion

This observational study used a case–control design, and we observed and analyzed the related factors for the incidence of pneumonia in Makassar City. The prevalence of pneumonia in Makassar City in 2020 was 3.9% of a total of 5,671 children less than five years who experience respiratory disease, and in 2021, the

Table 3: Results of risk analysis for pneumonia in children less than five years in Makassar

Risk factors	Pneumonia (*n*=70) n (%)	Control (*n*=140) n (%)	(Crude OR) (95% CI)	*P*
DPT-HB-Hib				
Incomplete	29 (41,1)	9 (23,9)	10,295	0,001*
Complete	41 (58,6)	131 (76,1)	(4.262-26,480)	
Measles–rubella				
Incomplete	24 (34,3)	17 (12,1)	3,775	0,001*
Complete	46 (65,7)	123 (87,9)	(1,754-8,174)	
Consumption of vitamin A				
Absence	9 (12,9)	5 (3,6)	0,251	0,011*
Received	61 (87,1)	135 (96,4)	(0,064-0,882)	

*) Significant level *P*<0,005 means a correlation with the dependent variable and is included in the multivariate analysis

Table 4: Logistic regression analysis results of risk factors for pneumonia in children less than five years in Makassar

Exposure variable	Crude OR	*P*	95% CI	Adjusted OR	*P*	95% CI
Incomplete dose of DPT-HB-Hib	10,29	0,001	4,262-26,480	9,680	**0,001**	3.472-26.987
Incomplete dose of measles–rubella	3,775	0,001	1,754-8,174	1,153	0,770	0,444-2,994
Malnutrition	4,629	0,001	2,115-10,282	5,486	**0,001**	2,471-12,178
Lack of consumption of vitamin A capsule	0,251	0,110	0,064-0,881	0,774	0,720	0,191-3,131
Presence of smoker in the household	1,955	0,034	1,008-3,875	1,260	0,528	0,614-2,584

The boldface indicates a statistically significant difference with *P*<0.05

prevalence rate will decrease to 2.4%. The bivariate analysis found that DPT-HB-Hib immunization incomplete dose, the measles (MR) immunization incomplete doses, and malnutrition status, history of absence getting vitamin A in the last six months, and the presence of smoker in the household were significantly associated with the incidence of pneumonia in children less than five years. The other originating factors of parents' socio-demographic characteristics such as parents' occupation and parents' monthly income were significantly associated with the incidence of pneumonia in children less than five years in Makassar City. The immunization with DPT-HB-Hib incomplete doses has the highest COR of 10,29, which means that the risk is 10,29 times higher for those who did not have incomplete DPT-HB-Hib doses, and this result is consistent with the previous research[7] where the infants who received the first dose of DPT-HB-Hib had postimmunization antibody titers for pertussis and diphtheria immunogenicity obtained at 2 months of age. Antibody persistence for diphtheria, tetanus, hepatitis B, and Hib in children was found after complete basic immunization with DPT-HB-Hib at 3 months, 5 months, and 11 to 12 months.[16] The rate of pertussis vaccine response was 82.5% at anti-pertussis concentrations ≥ 40 (1/dL) with a significance value of $P = 0.038$.[17]

The logistic regression analysis showed that incomplete DPT-HB-Hib doses were the biggest risk factor for the incidence of pneumonia in children less than five years, and second place was followed by the malnutrition variable. The statistical analysis results in this study were consistent with the previous study where the DPT-HB-Hib vaccine has good effectiveness after receiving immunization up to the third dose and combo dose. Infants who received the first dose of DPT-HB-Hib had postimmunization antibody titers for pertussis and diphtheria immunogenicity ($P = 0.000$) and Hib immunogenicity ($P = 0.030$), which means the infant's immunogenicity level against immunization, the first dose of DPT-HB-Hib obtained at 2 months of age.[7] The level of immunogenicity against pertussis in infants who received the second and third doses of DPT-HB-Hib immunization is associated with the second and third doses of DPT-HB-Hib immunization after the age of 7 months. A similar range for all infants who showed response rates, particularly among preterm infants for all antigens, was 80–99% for both DTaP-IPV-Hib-Hep B and control vaccines.[16]

The DPT-HB-Hib immunization coverage rate for children under five years, especially at infant age in 2019 to 2021 in Makassar City, is 70.9%.[5] This coverage rate is still below the target coverage rate for DPT-HB-Hib immunization, which is supposed to reach 100%. The coverage rate for basic immunization coverage in children less than five years in 42 Community Health Centres in Makassar decreased by 11.3% during the COVID-19 pandemic.[29] An effort was realized to reduce the prevalence of pneumonia, and the Provincial Health Office in Sulawesi has declared the provision of pneumococcal-13 (PCV-13) immunization in all Community Health Centres in Makassar City for infants as an additional basic immunization to the immunization, which was previously given (DPT-HB-Hib) since October 2022. PCV-13 immunization is given to infants aged 2 months for the first dose, 4 months for the second dose, and 12 months for the third dose. PCV-13 immunization has the benefit of reducing morbidity and mortality due to invasive pneumococcal disease by vaccinating all children who meet the criteria set by the Centres for Disease Control and Prevention.[21,22] During measles–rubella immunization, South Sulawesi Province coverage rate reached 95% through the month of the National Childhood Immunization Program.[23,24] Pneumonia infection is less common in children who have received measles immunization from 0 days up to 90 days postimmunization with a vaccine protective effect (rate ratio = 0.75).[30] This is consistent with the 85% increment of antibody concentrations found in toddlers who have been given measles immunization at a dose of 9 months of age and respond to an increase in antibody concentrations of 90%–95% when vaccinated at ages 12 months to 18 months.[18]

This study also found that nutritional status had a risk of 4,8 times more likely to be infected with pneumonia with a significance value of $P = 0.001$ compared with children less than five years with good nutritional status. The incidence of pneumonia infections worsens along with malnutrition status, which often occurs in infants, and these findings confirm the existence of synergistic causes between malnutrition and infection in terms of infections of the respiratory tract.[31] For malnourished and vitamin A-deficient children less than five years, the mortality rate can reach 25%.[18] Children less than five years who have never taken vitamin A supplements have 2.85 times higher risk of being infected with pneumonia compared with those who have taken vitamin A supplements.[32] Deficiency of vitamin A, a history of no exclusive breastfeeding, and malnutrition status are predictors of the cause of pneumonia in children less than five years.[19] Vitamin A is an essential nutrient and cannot be synthesized by the human body; therefore, vitamin A intake must come from food sources. Vitamin A is an anti-infecti`ve vitamin because it functions to regulate the human immune system.[20]

This study also found that the parents' occupation and monthly income were associated with the incidence of pneumonia in children less than five years. The result

corresponds to a study that found reinforcing factors, and enabling factors such as occupation were associated with the mothers' performance in terms of complementary feeding to their children,[33] which found that low-income levels have a relationship with the incidence of pneumonia in children less than five years (OR = 2.2; P = 0.47), and low socioeconomic level increased the risk of the incidence of pneumonia in children. Socioeconomic indicators were related to the incidence of pneumonia.[9] Exposure to secondhand smoke and contact or living with people who smoke inside the household significantly increases the proportion of pneumonia (P = 0,034), and this result is consistent with previous research, which found that exposure to wood smoke, cigarette smoke, and contact or living with someone who had a cough significantly increased the proportion of pneumonia.[28] Despite of the findings in this study showed no relationship between parents' educational level with pneumonia in children less than five which opposite to the previous study that found there was a relationship between education level and pneumonia in children less than five years (P = 0.01).[9] The parents' role (both father and mother) in providing balanced nutrition that is suitable for the age of the child and encouraging healthy eating habits is very necessary to be applied in each family to prevent complications of diseases such as pneumonia.[25]

Limitation and recommendation

During the implementation of this study, several limitations were found that affected the research. Firstly, the incomplete case data during data collection has led to a reduction in the number of case samples from the previously planned. Secondly, when collecting data on the control group, the researcher had limitations in matching the same proportions for the age group of respondents under five years with a ratio of 1: 2 between the case and control groups, and this was due to the obtained consent given by the respondents to be interviewed during the implementation.

Conclusion

DPT-HB-Hib immunization incomplete doses and malnutrition condition were the highest risk factors for pneumonia incidents in children less than five years. Makassar City Health Office through the Community Health Centre is expected to be able to increase the coverage rate for DPT-HB-Hib immunization for all doses to cover a minimum of 95% according to the standard minimum immunization coverage rate. To obtain the research expansion on the analysis of the determinant's factors for increasing coverage of the DPT-HB-Hib immunization for infants as an effort to control pneumonia infection and its complications in children less than five years will be valuable for the next study.

Conflicts of interest
There are no conflicts of interest.

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