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Measles Immunization and Vitamin A for Prevention of Pneumonia in Indonesia

Imunisasi Campak dan Vitamin A untuk Pencegahan Pneumonia di Indonesia

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Abstract

Pneumonia is the major cause of child death in Indonesia after diarrhea. Increasing coverage of measles, *pertusis*, *Streptococcus pneumoniae* (Spn) and *Haemophilus influenzae* b (Hib) immunization substantially can control pneumonia. Spn and Hib vaccines have not been included in category of mandatory immunization in Indonesia. Measles vaccine has more direct effect on prevention of pneumonia than *pertusis* vaccine. Providing immunization followed by providing vitamin A will increase the specific antibody titer among children. This study aimed to determine effects of measles vaccine and vitamin A to pneumonia incidence among toddlers. Method of study was cross sectional using 13,062 data of children drawn from 2012 Indonesia Demographic and Health Survey. Data were analyzed using poisson regression test. Analysis results showed that prevalence of pneumonia among Indonesian children was 5.4%, measles immunization coverage was 82.57%, and vitamin A supplementation coverage was 74.9%. Furthermore, providing measles immunization and vitamin A could prevent pneumonia incidence among toddlers (12 – 59 months old) up to 26.5%. Providing measles immunization then followed by providing vitamin A can be used as a preventive action in attempt to decrease pneumonia incidence.

Keywords: Toddlers, measles, pneumonia, prevention, vitamin A

Abstrak

Pneumonia merupakan penyebab kematian tertinggi pada anak di Indonesia setelah diare. Pengendalian pneumonia dapat dilakukan dengan peningkatan cakupan imunisasi campak, pertusis, *Streptococcus pneumoniae* (Spn), dan *Haemophilus influenzae* b (Hib). Vaksin Spn dan Hib belum masuk ke dalam kategori imunisasi wajib di Indonesia. Vaksin campak lebih memiliki pengaruh langsung terhadap pneumonia dibandingkan dengan vaksin pertusis. Pemberian imunisasi yang disertai pemberian vitamin A akan meningkatkan titer antibodi pada anak. Penelitian ini bertujuan untuk mengetahui pengaruh pemberian imunisasi campak dan vitamin A terhadap kejadian pneumonia. Metode penelitian adalah potong lintang dengan menggunakan 13.062 data anak yang terdapat pada data Survei Demografi dan Kesehatan Indonesia tahun 2012. Data dianalisis dengan menggunakan uji regresi poisson. Hasil analisis menunjukkan prevalensi pneumonia pada anak di Indonesia adalah 5.4%, cakupan imunisasi campak sebesar 82.6%, dan cakupan pemberian vitamin A sebesar 74.9%. Pemberian imunisasi campak disertai dengan pemberian vitamin A dapat mencegah terjadinya kejadian pneumonia pada anak usia 12 – 59 bulan sebesar 26,5%. Pemberian imunisasi campak yang disertai dengan pemberian vitamin A dapat digunakan sebagai tindakan pencegahan dalam upaya penurunan kejadian pneumonia.

Kata kunci: Anak bawah lima tahun, campak, pneumonia, pencegahan, vitamin A

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Introduction

One of efforts many countries in the world in the fight against poverty and health problems is the Millennium Development Goals (MDGs) program. There are eight goals to be achieved as one of the MDG-4 goals is to decrease two-third of child mortality. This goal can be achieved if the two major problems of infant mortality, such as pneumonia and diarrhea, can be addressed effectively.[1,2]

In 2011, there was approximately one-third of toddler death because of pneumonia worldwide.[3,4] In 2007, toddler mortality in Indonesia was 44 per 1,000 live births.[5] The figure is still relatively high compared to other countries in Southeast Asia. Mortality rate of toddler aged 1 – 4 years in Indonesia was 9 per 1,000 children in 2007. As much as 15.5% of deaths are due to pneumonia. This data ranks Indonesia at the sixth place in term of pneumonia incidence in the world and the highest in Southeast Asia.[5] There are approximately six million new cases each year with incidence of pneumonia 0.28 episode per each child.[6]

Indonesia Demographic and Health Survey (IDHS) in 2007 showed that pneumonia was the cause of 11.2% of morbidity among toddlers.[7] In 2007 and 2008, pneumonia cases showed that proportions of pneumonia among toddlers were 49.35% and 49.23% respectively. These figures showed that half of pneumonia incidence occurred among toddlers.[5]

Pneumonia is a case often associated with the incidence of measles, in which 56 – 86% of pneumonia mortality was associated with measles. Cases of severe pneumonia mortality associated with measles are two times higher than the mortality of severe pneumonia without measles. The increase of mortality is because of immunosuppressive and systemic effects of measles with bacterial super infection.[4-7] Widodo, in his study suggested that complete immunization (*pertusis* and measles) on young children could reduce the morbidity caused by pneumonia.[8]

Vaccination programs recommended by Global Action Plant for Pneumonia conducted by the United Nations Children's Emergency Fund (UNICEF) have interventions for the prevention of morbidity and mortality due to pneumonia that include measles, *pertusis*, Spn and Hib. Hib vaccine can significantly reduce the incidence of severe pneumonia by 6% (RR = 0.94, 95%CI 0.89 - 0.99), reduced by 18% (0.82, 0,67-1.02) pneumonia with radiological confirmation.[3,9] Based on several studies of vaccines (vaccine probe), it is estimated that pneumococcal conjugate vaccine can prevent morbidity and mortality by 20 – 35% of pneumococcal pneumonia cases.[10]

Pneumonia is a serious complication of measles, and the most common cause of mortality associated with measles worldwide. Thus, reducing risk factor and management of measles incidence among children through vaccination will help control occurrence of pneumonia associated with measles.[11] In this study, the control is defined on preventive measures on the incidence of pneumonia among toddler. The study results will be a benchmark in estimating the effectiveness of measles immunization in reducing the risk of pneumonia incidence as a preventative measure in Indonesia. Therefore, this can significantly contribute in improving the understanding of decision makers to prevent the occurrence of pneumonia. The aim of data analysis was to determine effects of measles immunization and vitamin A that decreased prevalence of pneumonia among toddlers in Indonesia in 2012.

Method

This study used secondary data as drawn from 2012 IDHS, conducted by Indonesia's Central Statistics Agency (BPS) in collaboration with the National Population and Family Planning Board (BKKBN); Ministry of Health and ICF International. The survey was designed to collect data of fertility, family planning as well as maternal and child health. IDHS was commissioned by Indonesian government. The ICF International provided technical assistance through MEASUREDHS project, a program funded by the United States Agency for International Development (USAID). Data drawn from IDHS used in the study were prevalence of pneumonia, measles immunization and vitamin A.[12]

Prior to the start of the fieldwork of IDHS, the questionnaires were pretested in Riau Province and East Nusa Tenggara Province to make sure that the questions were clear and could be understood by the respondents. Different sample coverage of women from ever-married women aged 15 – 49 years to all women aged 15 – 49 years was importantly provided in the pretest. In addition, there were new questions and changes in question format from those in the standards of IDHS questionnaires. Persons who participated at the main survey were trained for interviewers. The training took place for 12 days in May 2012 at nine training centers. All of participants were trained using the household and individual questionnaires. Fieldwork took place from May 7 to July 31, 2012.[12]

2012 IDHS is designed with sample calculations that can be used to estimate data for the national, rural and urban, and provincial level. IDHS interviewed as many as 47,533 women aged 15 – 49 years, but only as many as 45,607 women had completed the interviews with results of the response rate or the achievement of number of interviews to 96%. Results of interviews of women aged 15 – 49 years identified number of 18,021 toddlers aged 0 – 5 years.[12] The missing data and "do not know" were ex-

cluded from analysis. The data sample used in this analysis was 13,062 toddlers aged 12 – 59 months.

Cross-sectional studies with dichotomous outcomes often use logistic regression. Result of logistic regression data was as a score of odds ratio (OR). If in the very rare cases, OR score would be closed to the value of risk ratio (RR)/prevalent ratio (PR). In the study with not rare case, the OR would move away from PR.[13] This study used PR to describe the results. The regression poisson test was suitable for this analysis. The use of poisson regression robust at sufficient sample would show better results for estimating PR than the log-binomial method.[14] Analysis of the cross-sectional and Mathel Haenszel was deemed unsuitable in the analysis of a complex sample.

Results

Overview of measles immunization could be obtained through the answers from maternal and child health record book availability of the measles immunization status acquired by the child. Generally, measles vaccine to children is provided at the age of 9 months or thereafter. Pneumonia is characterized by cough with difficult or rapid breathing and chest in-drawing at the last two weeks.

Table 1 showed that prevalence of pneumonia among Indonesian children was 5.4%. The highest prevalence of pneumonia was in Central Sulawesi (12.4%), meanwhile the lowest was Papua Province. The achievement of measles immunization on toddlers in Indonesia in 2012 was amounted to 82.6%. The highest achievement of measles immunization was in the Special Region of Yogyakarta, while the province with the lowest immunization coverage was in Papua Province. Result of Vitamin A proportion in Indonesia showed 74.9%, meanwhile the highest achievement was in the Special Region of Yogyakarta (89.8%) and the lowest achievement was in Papua Province (45.9%).

Table 1 . Distribution of Proportion of Pneumonia, Measles Vaccine and Vitamin A

Variable	Category	Proportion (%)	95% CI
Pneumonia	No	94.6	94.0-95.2
	Yes	5.4	4.8-5.9
Measles vaccine	No	17.4	16.2-18.7
	Yes	82.6	81.3-83.8
Vitamin A	No	25.1	23.7 - 26.5
	Yes	74.9	73.5 - 76.3

Based on results of Table 2, PR was under 1 (PR < 1), which means that children who got measles vaccine were protected from pneumonia. This result also showed PR of measles vaccine among toddlers who did not get vitamin A and measles vaccine among toddlers who got vitamin A. It found that toddlers who got measles vaccine and vitamin A were more protected then toddlers who did not get vitamin A.

Potential impact measurement can be done by calculating in Population Attributable Fraction (AFP) and Prevented Fraction in Population (PFP). When the exposure is a protective factor or OR < 1 then used PFP. PFP is used to calculate the prevalence of potential that can already be prevented as a result of their exposure/intervention in the population.

According to results of Table 3, PFP of measles immunization was 24.8%. This means that there was 24.8% incidence of pneumonia in the population that had been prevented by the presence of measles immunization. PFP value can be increased if toddlers get measles vaccine and vitamin A. PFP value under these conditions was 26.5%.

Discussion

Based on analysis, the prevalence of pneumonia among toddlers in Indonesia amounted to 5.4%. This prevalence was still within the range of values reported by 2012 IDHS, in which the prevalence among children was 5.1%. Prevalence of pneumonia in Indonesia in 2012 was lower than the prevalence in 2007 that reached 11.2%.[5] This study showed the prevalence of pneumonia among children who did not get measles immunization was 7.4%, meanwhile there were 4.9% children with pneumonia who got measles immunization. Prevalence of pneumonia among children who got measles immunization was lower than prevalence of children who did not.

Measles immunization can prevent morbidity and mortality of pneumonia because measles is a major complication of pneumonia that causes almost a quarter of deaths due to pneumonia. Measles infection can suppress the immune system in toddlers and often causes them lose weight, shrinking production of vitamin A in the

Table 2. Effects of Measles Vaccine among Toddlers

Variables	Category	PR	95% CI	p Value
Measles vaccine	No	1		0.022*
	Yes	0.7	0.57-1.96	
Measles vaccine * Vitamin A	Measles vaccine among toddlers not getting vitamin A	0.8	0.4-1.2	0.07**
	Measles vaccine among toddlers getting vitamin A	0.6	0.3-0.8	

* p value regression poisson test
**p value for Homogenity of prevalent ratio

Table 3. Calculation of Prevented Fraction in Population of Measles Immunization against Pneumonia

Variables	PR	Pe (%)	PFe (%)	PFP%
Measles vaccine	0.7	82.6	30	24.8
Measles vaccine by not getting vitamin A	0.8	16.4	20	3.3
Measles vaccine by getting vitamin A	0.6	66.2	40	26.5

body as well as toddlers will be more susceptible to pneumonia.[15]

The prevalence of pneumonia was higher among toddlers who received vitamin A (5.6%) than who did not (4.7%). Giving vitamin A is in aim to enhance immunity against infectious diseases. However, in this study, it turned out to be different as pneumonia incidence was higher in the group of toddlers who received vitamin A than who did not. Similar result was found by Riza,[16] stating that infants who did not receive vitamin A had 1.164 times risk higher than the infants who received vitamin A.

Toddlers in countryside have lower immunization coverage and lower access to health care than toddlers in urban areas. Economic and educational characteristics are also found lower in rural areas. From the air pollution sources inside homes, in village, fuel that produces residual pollution is generally used for cooking.[17] This is cause of pneumonia among children in rural areas. Anwar,[18] in his study concluded that social factors, demographic, economic and physical environmental conditions of the home jointly contribute to the incidence of pneumonia among toddlers in Indonesia.

The effect of measles immunization against pneumonia based on economic status can be seen that children who got measles immunization and belong to middle income family were more protected from pneumonia than children who got measles immunization and belong to lower income families. According to another study, Machmud,[19] found the relation between poverty in families with pneumonia among children.

PR of pneumonia among toddlers who got measles immunization against pneumonia was 0.7 times lower than who did not. Toddlers who had been immunized were more resistant to pneumonia. The effect of measles immunization on children who received vitamin A was proven to have a better effect to prevent from pneumonia, which means that children who got measles immunization and vitamin A were more protected from pneumonia than children who got measles immunization without vitamin A. Providing vitamin A to children who never had pneumonia, in a certain period of time, the children would not suffer from severe pneumonia and it can prevent mortality. Otherwise, when suffering from pneumonia, vitamin A no longer reduces morbidity due to pneumonia.[20]

In general, the highest of PFP was found among toddlers who got measles immunization and vitamin A with the number of PFP was 26.5%. This means that toddlers who got measles immunization and vitamin A were protected from pneumonia by 26.5%. Therefore, providing measles immunization and vitamin A periodically for toddlers in a mass scale can increase endurance and protection for Indonesian children, so they can grow up and develop in good condition.[21]

Conclusion

The achievement of measles immunization in Indonesia in 2012 was 82.6%. This coverage is still lower than the target set by the Global Action Plan for the Prevention and Control of Pneumonia (GAPP). One of the targets set by the GAPP is coverage by 90% for any relevant immunization (with coverage by 80% in each region). Toddlers who get measles immunization plus vitamin A will be more effective in preventing pneumonia. PFP on toddlers who get measles immunization and vitamin A is 26.5%, which shows a significant value in prevention of pneumonia among children. It states that measles immunization and vitamin A are as effective as Spn and Hib.

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