Original Research Article

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Risk factors associated with childhood tuberculosis: a case control study in endemic tuberculosis area

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ABSTRACT

Background: Tuberculosis (TB) in childreen is still considered as important public health problems in various countries, including Indonesia. Risk factors related to childhood tuberculosis is crucial to identify in order to conduct prevention effort effectively. The purpose of this research is to determine the effect of environmental health in house, contact history and nutritional status toward childhood tuberculosis.

Methods: This research is an analytical observational study using case-control design, with 35 samples of the case and 35 samples of the control. Several variables such as house environment, contact history and nutritional status were obtained by questionnaire and observation in house of respondents. Data analysis was conducted using Logistic Regression test to determine correlation between independent and dependent variables.

Results: This research highlighted that contact history and nutritional status were correlated with childhood tuberculosis. While house environment variables such as lighting level, floor type, house occupancy density were not related to the incidence of tuberculosis in children.

Conclusions: Contact history and nutritional status were the factors which determined childhood tuberculosis in Banyumas. It is important for parents to maintain good nutritional status of their children and to avoid them from contact with tuberculosis patients.

Keywords: Childhood, Tuberculosis, Environment, Contact, Nutrition

INTRODUCTION

Tuberculosis (TB) is one of major health problem globally, particularly in low and middle income countries. This disease is one of the top 10 causes of death worldwide, which caused social and economic burden. In 2016, 10.4 million people diagnosed with TB, and 1.7 million died from this deadliest disease. Indonesia has a high prevalence of tuberculosis (TB) and one of the 22 countries with the highest TB burdens in the world. In Indonesia, there were an estimated 1 017 378 new active TB cases in 2015, including multidrug-resistant TB.² Etiologic agent of TB is members of the species *Mycobacterium tuberculosis* complex (MTBC), which includes: *Mycobacterium*

tuberculosis (Mtb).³ TB is primarily a pulmonary disease but could also affecting bone, the central nervous system, and other organ systems. TB transmission is spread through coughs or sneezes *M. tuberculosis* bacilli from TB patients that become aerosolized droplets of less than 5 μm diameter.⁴ TB control faces several challenges such as case discovery particularly childhood TB, Multi Drug Resistance (MDR)-TB, and co-epidemic of TB/HIV.⁵

Childhood TB is under-reported due to challenges in diagnostic, since usually it is smear-negative. The majority of TB cases in children less than 12 years of age are smear-negative, and smears are seldom carried out in endemic countries. In 2016, it is estimated about 1 million children affected with TB and 250 000 children

died of TB (including children with HIV associated TB). Sign and symptoms of childhood TB according to WHO are chronic cough, defined as an unremitting cough that has been present and has not improved for more than 21 days with or without wheezing; fever, defined as a body temperature >38°C for 14 days, when other common causes, including pneumonia, have been excluded; objectively documented weight loss or failure to thrive; feelings of sickness or weakness, lethargy, and/or reduced playfulness; and night sweats. Children have an increased risk for developing severe disease within weeks to months of infection, they are high priorities when identified as contacts to infectious patients.

Information about risk factors of childhood TB in Indonesia is still limited. Historically, TB in childreen have been neglected by clinicians, policy makers and academics due to the perception that children are rarely infectious and consequently only contribute little role to disease transmission.⁸ Based on Indonesia's Health Profile in 2016, it was reported that in proportion 2015 and 2016 were 8.59% and 9.04%, respectively of all tuberculosis cases (Ministry of Health RI, 2017). Previous studies reported the incidence of TB in children occurs related to several factors such as exposure to adult TB patients, intimate contact with a TB, housing condition such as household crowding, and ventilation.⁹ Understanding in risk factors of childhood TB occurence is crucial to conduct effective strategy of control and prevention. In this study, we conduct case contol study to find out variables which influences the childhood TB in Banyumas Regency, Central Java, Indonesia. Several variables such as home lighting, house humidity, house ventilation, house floor type, house occupancy density, contact history, length of contact, contact intensity, nutritional status were included in this study. Information from this study will give valuable input to TB in childreen control strategy.

METHODS

Study design

This study is observational with case control design. Population of case are all the childhood tuberculosis case in Banyumas Regency from January to February 2018 with inclusion criteria: age ≤14 years old and no renovation during the last 6 months in the house of samples. Population of control are all neighbour of childreen tuberculosis case in Banyumas Regency, with inclusion criteria ≤14 tahun and did not have symptoms of tuberculosis and never diagnosed with TB. This study using 35 samples of case group and 35 samples of control group based on Lameshow (1997). Samples selection for case group was done by consecutive sampling.

Data collection

Data about contact history, duration and intensity were obtained by structured questionnaire, while house

environment and nutritional status were obtained by observation. Several equipments were used such as Luxmeter for measuring house lighting, and hygrometer for measuring humidity.

Data analysis

Univariate analysis was carried out to describe each of variables, while bivariate analysis using chi square with a significance level α =0.05 to find out the association between variables to the childhood TB. Furthermore, multivariate analysis with logistic regression was conducted to find out the most influential variable which related to childhood TB. The odds ratio (OR) was calculated to estimate value of the risk.

RESULTS

Characteristic of samples

75 respondents from case and control group were included in this study. Characteristic of respondents can be seen in Table 1.

Table 1: Characteristic of samples.

Samples characteristic	Case		Con	Control	
	N	%	N	%	
Sex					
Male	17	48.6	18	51.4	
Female	18	51.4	17	48.6	
Age groups (in years)					
<5	13	37.1	16	45.7	
≥5	22	62.9	19	54.3	
BCG imunization status					
No	7	20.0	9	25.7	
Yes	28	80.0	26	74.3	
Total	35	100.0	35	100.0	

Based on Table 1, percentage of male and female betwen case and control group was almost the same. Most of the samples in both the case and control groups had been immunized by BCG.

House environments and tuberculosis in childhood

Bivariate analysis was carried out to analyse house environments, contact history and nutritional status with TB infection in children. The results of bivariate analysis showed in Table 2.

Contact history and nutrinutional status with tuberculosis in childhood

We analyse correlation between contact history and nutrituutional status with bivariate analysis. Detail of results can be seen in Table 3.

Table 2: Bivariate analysis of house environments with child tuberculosis in Banyumas regency.

Variables	Case		Control		Davolaro
	N	%	N	%	P value
Lighting level					
Adequate	23	65.7	13	37.1	0.031
Inadequate	12	34.3	22	62.9	0.031
House humidity level					
Unqualified	34	97.1	33	94.3	0.614
Qualified	1	2.9	2	5.7	0.014
House ventilation					
Unqualified	27	77.1	24	68.6	0.591
Qualified	8	22.9	11	31.4	0.391
Type of house floor					
Unqualified	1	2.9	0	0	1.000
Qualified	34	97.1	35	100	1.000
House occupancy density					
Unqualified	14	40	14	40	1.000
Qualified	21	60	21	60	1.000

Table 3: Bivariate analysis of contact history with childhood tuberculosis in banyumas regency.

		Case	Control		Duoles
	N	%	N	%	P value
Contact history					
Yes	32	91.4	13	37.1	0.000
No	13	8.6	22	62.9	
Contact duration					
>6 months	23	65.7	3	8.6	0.000
≤6 months	12	34.3	32	91.4	
Contact intensity					
≥8 hours/day	15	42.9	1	2.9	0.000
<8 hours/day	20	57.1	34	97.1	
Nutrititional status					
Poor	24	68,6	5	14,3	0,000
Good	11	31,4	30	85,7	

Table 4: Multivariate analysis of logistic regression test.

Variabel	В	Wald	Sig.	Exp (B)	95% CI
Contact history	2.309	7.792	0.005	10.069	1.990-50.956
Contact intensity	2.212	3.617	0.057	9.136	0.934-89.315
Nutrititional status	2.432	10.427	0.001	11.380	2.601-49.797

Influential variables to childhood tuberculosis

Multivariate analysis was done by logistic regression with backward method. Variables which have p value <0.25 in bivariate analysis were included to multivariate analysis (Table 4).

The results of multivariate analysis showed that nutritional status is a factor that influences the incidence of child tuberculosis in Banyumas district with a multivariate OR value of 11.380 which means that children with poor nutritional status risk 11.380 times to

suffer from tuberculosis compared with children with good nutritional status. In addition, contact history showed OR value of 10.069 which means that children with a contact history of adult tuberculosis patients are at 10.069 times the risk of tuberculosis compared with children who have no contact history with tuberculosis patients adult.

DISCUSSION

Information about risk factors of tuberculosis which associated in children is limited to a certain extent. Children tend to be more easily infected by house-hold

contact with infected adults. Generally, children in age group 0–4 years are the most vulnerable to TB infection due to vulnerability of their immune systems. ¹³ Based on the result of this study, contact history and nutritional status were the factors which determined childhood tuberculosis in Banyumas.

Children are very susceptible to transmission of tuberculosis bacteria from adults with positive smear patients who spread bacteria through sputum sparks. The closest source of transmission for children is their parents, people who live at home, and people who often visit or interact directly with children. Based on the results of the study, it is known that most of the contact history occurred in the case group where the most proportion was 24.3% of contacts with grandparents who lived at home as much as 22.9% and 22.9% of the neighbors. Proximity and continuous contact are the main causes of tuberculosis transmission, particularly those who live at home with adult tuberculosis sufferers have a higher risk than ordinary people.¹⁴ Household contacts of adult TB patients with childreen will increase the risk of infection.. In this study, contact intensity also found be related to childhood TB occurence. 42, 9% of case group had contact intensity ≥8 hours, while in control group only 2,9%. This results supports several previous studies in adult TB who stated that more intense exposures are related to higher risk of TB infection. 14,15

Our study showed in multivariate analysis that nutritional status is a factor that influences the incidence of child tuberculosis. It was found that children in the case group had poor nutritional status as much as 68.6% while in the control group only 14.3%. Protein-energy malnutrition and micronutrient deficiencies increase the susceptibility of infection particularly in childreen. TB infection also creates immune system depression and an inflammatory state that worsens nutritional status. This results in accordance with previous research in TB adults which conducted in the same area of study which found that only nutritional status which correlated with TB infection in Banyumas Regency.¹⁶ It is difficult to determice whether malnutrition led to TB or vice versa since malnutrition and Tuberculosis are two problems which interact each other. A cohort study which follow health people over time after determining nutrition status at baseline could reveal this association.

In this study, several house environment variables such as lighting level, floor type, house occupancy density were not related to the incidence of tuberculosis in children. This is possibly because housing condition between case and control had no significant diffrence. Several previous study stated that housing condition had association with TB infection. ^{17,18}.

However in this study, we proved that contact history and nutritional status were more related to TB infection in children. An increased density of droplet nuclei in the air from TB adults around the house leads to an increased risk of infection in children. Results of this study confirmed the importance of TB adult case investigation and detection of cases in children. Implementation of The Stop TB Strategy of the World Health Organization for household contact investigations of active screening of TB disease among contacts of smear-positive TB cases must be carried out. In addition, improving nutrition in children also important to prevent the occurrence of TB disease.

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