Original Article

The occurrence and is factors of tuberculosis in children with close contact to adult lung tuberculosis

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Abstract

Background Tuberculosis (TB) in is children different from TB in adults in terms of the difficulty in making prompt diagnosis, the more progressive course of disease and the high-risk for the occurrence of disseminated TB. Transmission of TB in children mostly originates from adults, which the biggest risk is the index case with positive sputum smear.

Objective To find out the incidence of TB in children who have close contact with adult TB patients and to determine some risk factors for the development of childhood TB.

Method This cross-sectional study was conducted between March to July 2009. We studied children aged less than 5 years old with close contact, living in the same house with adult TB patients. The diagnosis of TB was made based on National TB scoring system for children.

Results Of the 50 children, we obtained 17 (34%) positive children with TB after going through with national TB scoring system for children. There was a significant relationship between AFB positive sputum, passive smokers and residential density (overcrowding), but there was no significant relationship between age, nutritional status, gender of the contact source, and family income per month.

Conclusion Only the positive sputum smear has a significant correlation associated with the occurrence of TB in children who have close contact with adult TB patients. **[Paediatr Indones. 2010;50:232-8]**.

Keywords: *tuberculosis, close contact, transmission*

Tuberculosis (TB) is one of the re-emerging diseases. TB germ was figured out after Robert Koch successfully identified in the 19th century, and Daniel in 2006 assumed that this bacteria has killed more people compared to any other microbial pathogens.[1,2] Diagnosis of childhood tuberculosis, defined by the World Health Organization (WHO) and Center of Disease Control (CDC) as TB in children less than 15 years, are difficult because the symptoms are not typical, often associated with primary complex and the difficulty in finding TB bacteria in the sputum. The more progressive course of disease and the high risk for occurrence of disseminated disease make childhood TB be more problematic.[3] Transmission of TB bacteria in children generally derived from adults with positive smear. Most adults who suffering from active TB are infected many years before when body immunity can still protect them against the occurrence of TB illness.[2,3]

When a child is diagnosed with active TB, it means that the people close to this child, and almost always are adults, suffering from active TB and will

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likely being a source of infection for this child, and will spread it to other people around.[4] The biggest risk of contracting TB is an index case with positive sputum smear. Some risk factors such as adult smokers, malnutrition, child's age, family size, population density, poverty, female source of contacts (mother, aunt, grandmother), also play a role in transmission of TB in children.[2] The aim of this study was to find out the incidence of TB in children who have close contact with adult TB patients and to determine whether factors such as positive sputum smear, gender of the source of infection, age of the children, children nutritional status, children as passive smokers, family income, residential density (overcrowding) have influences of the transmission.

Methods

This was a cross sectional study conducted at Lung Clinic for adult TB cases and screening for children who live with the index case carried out in the Children Clinic of R.D. Kandou Hospital, Manado. The study subjects were chosen randomly. We included children aged > 3 months and < 5 years who live with adult TB patients for at least 3 months period, and the parents agreed to participate and signed an informed consent. We excluded children who had received specific treatment for TB, children with other diseases or malignancy, and children who were in any immunosuppressant agents. Adults were diagnosed as having lung TB on the basis of suggestive symptoms and signs, confirmed with either presence of tuberculosis bacilli on Ziehl-Neelsen staining of sputum (hereafter referred to as positive sputum patients) or diagnostic chest radiograph in the absence of tuberculosis bacilli in sputum specimens (referred to as negative sputum patients). The diagnosis of adult patients was established at the Lung Clinic for adult TB.

This was approved by the Ethics Committee and the parental informed consent was obtained prior to enrollment. Detailed history and clinical examinations of children were performed by the investigators. Those included history of fever and/or cough more than two weeks duration, failure to gain weight, loss of appetite, decline in weight, and symptoms of extra-pulmonary tuberculosis such as lymphadenopathy. History of

BCG vaccination was especially enquired, and scars were examined. A detailed history was also recorded regarding exposure to environmental tobacco smoke, family income and residential density. The children height and weight measurements were performed. The diagnosis of TB was made based on National TB scoring system for children, which consisted of 8 parameters which are TB contact, tuberculin skin test (TST), nutritional status, fever (2 week-period or more), coughing (3 week-period or more), enlargement of lymph nodes, bone swelling and chest x-ray. Nutritional status were classified according to Centers for Disease Control (CDC) 2000 criteria, as followed: mild malnutrition were defined as weight per height < 90% or weight per age < 80% and severe malnutrition as weight per height < 70% or weight per age < 60%. Each subject underwent tuberculin skin testing, performed by the intradermal injection of 1 tuberculin unit of purified protein derivatives (PPD-RT23) into the volar surface of the left forearm and was read 72 hours later in good light with the forearm slightly flexed. The induration was measured by the pen method and transverse induration of greater than 10 mm was defined as a positive tuberculin test. A single trained technician in the administration and interpretation of tuberculin test performed the procedure in all children. Positive TB was diagnosed if the child had score of 6 or more according to the National TB scoring system for children.

X^2 test, Spearman's rho test, Fisher's Exact test, were used to see relationship with the incidence of infection risk factors and logistic regression to see the relationship between several factors altogether. All data processed by SPSS program version 15.

Results

Out of 50 children studied, 17 children had positive TB and other 33 did not. We found that all children had no symptoms of fever and only two children had cough, consisted of one child with TB and one child without TB. Swelling of bone joint was not found in any subject. Lymph node enlargement was found in 36 children, in whom 17 children had positive TB and 19 children without TB. As for BCG immunization, it was found that all children in both groups had been immunized, marked by positive BCG scar.

Distribution of subjects according to the occurrence of TB with clinical symptoms (fever, cough, lymph nodes enlargement, bone swelling) and whether BCG scar present or not, can be seen in Table 1.

Among the 50 children studied, children aged less than 1 year old was 4 children, 2 were positive TB, and others were not. Four of 15 children aged 1-3 years were positive TB and another 11 were not. In the age group of more than 3 years to less than 5 years old, found as many as 31 children, 11 of them positively sick with TB and 20 others not. The results of statistical analysis to test Spearman rho correlation coefficient, indicates that there is no significant relationship between age and incidence of pulmonary TB in children whose closely contact with adult TB patients (P = 0.856).

Of the 50 children studied, no one suffered from severe malnutrition, children with positive pulmonary TB who were found suffering from mild malnutrition was 42.9% and children with no malnutrition was 32.6%. The results of statistical analysis by Fisher's Exact test showed that there was no significant relationship between nutritional status and incidence of pulmonary TB in children with closely contact with adult TB patients (P = 0.446).

Adult TB patients with positive sputum smear were found in as many as 17 persons, while a negative sputum smear were 33 persons. Of 17 index cases with positive sputum smear, 13 children had TB, and 4 of children did not have TB. Of 33 index cases with negative sputum smear, 4 children had TB and 29 did not have TB. The results of statistical analysis by chi

Table 1. Distribution of subjects according to clinical symptoms and presence of BCG scar

Clinical symptoms and positive BCG scar	TB occurrence	
	TB positive, n = 17	TB negative, n = 33
Fever	0	0
Cough	1	1
Lymph nodes enlargement	17	19
Bone swelling	0	0
BCG scar	17	33

Table 2. The relationship of possible risk factors affecting the occurrence of TB in children

Variable	TB (+) n = 17	TB (-) n = 33	P value
Age			
< 1 year	2	2	P = 0.856
1 – 3 year	4	11	
> 3 year - < 5 year	11	20	
Nutritional Status			
no malnutrition	14	29	P = 0.446
mild malnutrition	3	4	
Sputum smear			
positive	13	4	P < 0.001
negative	4	29	
Residential Density			
overcrowded	12	11	P = 0.012
not overcrowded	5	22	
Passive smoker			
yes	13	5	P < 0.001
no	4	28	
Gender of the index case			
Male (father, grandfather, brother, uncle)	7	14	P = 0.933
Female (mother, grandmother, aunt)	10	19	
Family income			
< Rp. 480.000	4	13	P = 0.780
Rp. 480.000 – 600.000	9	5	
Rp. 600.000 – 700.000	0	0	
> Rp. 700.000	4	15	
Total	17	33	

Table 3. The results of logistic regression analysis

Variable	Coefficient regression	Significance (P)
Age	-0.169	0.611
Nutritional	1.077	0.419
Gender	-0.280	0.283
Sputum smear	2.128	0.034
Residential density	1.076	0.317
Income	0.215	0.707
Passive Smoker	1.654	0.123
Constanta	-3.820	0.184

square (X^2) test indicated that there was a significant relationship between pulmonary TB incidence in children whose closely contact with positive sputum smear adult TB patients (P <0.001).

About residential density, 23 children living in crowded houses and 27 children live in a house that was not crowded. Of 23 children who live in crowded houses, we found that 12 children had TB, whereas 11 children did not have TB. And from 27 children who lived in houses that were not crowded, 5 children had TB and another 22 did not. The results of statistical analysis by X^2 test showed that there was a significant association between pulmonary TB incidence in children was closely contact with adult TB patients in meeting housing (overcrowded) (P = 0.012)

Among 50 children, 18 children were in-house passive smoker, and 32 children were not. Of the 18 children who were in-house passive smoker, it was found that 13 had TB, whereas 5 children did not have TB. From 32 children who were not passive smoker, 4 children had TB and 28 did not have TB. The results of statistical analysis by X^2 test indicates that there was a very significant relationship between pulmonary TB incidence in children whose closely contact with adult TB patients in a state children as passive smokers (P <0.001).

We found that 7 children got TB from 21 male adult TB patients as index cases, while other 14 children were not. And from 29 female adult patients as an index TB cases, 10 children got TB from them and 19 others did not. The results of statistical analysis by X^2 test showed that there was no significant relationship between pulmonary TB incidence in children whose close contact with TB patients according to index case's gender (P = 0.933).

Seventeen of 50 children came from families with income less than 480,000 rupiahs per month, in which 4 children got TB, while 13 children did not. Fourteen children came from families with income of Rp. 480,000 - Rp. 600,000, of whom 9 had TB, and 5 children did not have TB. None of the children come from families with incomes between Rp. 600,000 - Rp. 700,000. A total of 19 children came from families with income more than Rp. 700.000, 4 of them had TB and another 15 did not. The result of statistical analysis with Spearman rho correlation coefficient, indicates that there was no significant relationship between family income and the incidence of TB in children who have close contact with adult TB patients (P = 0.780).

The relationships of possible risk factors affecting the occurrence of TB in children were shown in Table 2. The result of the relationship between several risk factors simultaneously on TB incidence in children who have close contact with adult TB patients showed that only positive sputum smear factor of the index case (the source contact), which has significant relation with pulmonary tuberculosis incidence in children who has close contact with adult TB patients (P <0.05), as presented in Table 3.

Discussion

Out of 50 children living at the same house with adult TB patients, we obtained 17 (34%) children had positive TB after going through with National TB scoring system for children. This result is almost the same as that obtained by Singh[5] et al in India, found out 33.8% children positive with TB.

The most common clinical symptoms is the enlarged lymph nodes. Inselman LS[6] and Setyanto Trastotenojo[7], stated that lymphadenopathy is more frequently found in children with TB compared to TB in adults. Most often affected area is anterior or posterior coli lymph nodes. Nevertheless, it is also said that this clinical symptoms is not specific for TB in children, and it can be caused by other diseases, so it should elaborate to any possible other diseases.

Coughing more than 3 week-period is included in the criteria of National TB scoring system for children. In this study, we found that coughing was only experienced by 2 children, 1 child with TB and 1 child without TB. Marais et al[8] in a study in South

Africa found that final diagnosis for children who had cough more than 2 week-period as clinical symptom, were viral infections and asthma.

Rahajoe et al[2] mentions that the most important risk factors for TB infection is exposure to infectious adults. While development from TB infection to TB illness, one of contributing risk factors is children age. In infants younger than 1 year who's infected with TB, 43% will become ill, while children aged 1-5 years, 24% will develop into TB illness. In this study, the results of statistical tests showed no significant relationship between the children age with pulmonary TB occurrence in children who had close contact with adult TB patients. Naning R[9] and Triningsih W[10] also found no significant association between children age with incidence of TB infection.

Malnutrition does have two roles in TB disease, on one hand, TB infection may result in a state of malnutrition, and on the other hand, a state of malnutrition causes immunological status alteration of affected children that facilitate the occurrence of TB infection. This study indicated that there was no significant relationship between nutritional status and occurrence of pulmonary TB in children who had close contact with adult TB patients (P = 0.446). Triningsih W[10] found no significant relationship between nutritional status with TB incidence in children.

This study showed that there was a significant relationship between pulmonary TB incidence in children who had close contact with adult TB patients with positive sputum smear (P <0.001). Singh et al[5] stated that out of 95 children who had close contact with adult TB patients with positive sputum smear, 65 children were infected with TB and 30 children were not infected with TB, and it was also statistically significant.

Residential density requirements for the whole house are usually expressed in m^2/person. Minimum capacity per person relatively depending on the quality of building and available facilities. As for the modest house, the extent of building is 10 m^2/person.[12,13] This study showed that there were significant relationships between pulmonary TB incidence in children who had close contact with adult TB patients and the density population in a house (overcrowded) (P = 0.012). Nurhidayah I et al[11] found out that the incidence of TB in children with overcrowded house residents were 66.67% compared to control

children which were 9.72%, and revealed statistically significant.

Exposure to cigarette smoke, associated with various respiratory disorders. Cigarette smoke contains some particles that can be inhaled as polycyclic hydrocarbons, carbon monoxide, nicotine, nitrogen oxides, and acrolein which can cause damage to the epithelial, lower clearance mucocylliar and phagocyte activities and suppress bactericide effects of macrophages alveoli.[13]

In this study we found a significant relationship between pulmonary TB occurrence in children who had close contact with adult TB patients and children as in-house passive smokers (P <0.001).

The gender of adult TB patients said to have an influence on TB transmission to children, female adult TB patients have greater risk for transmitting the disease to children at home, with the consideration, that the children are usually more closely with female adult TB patients (mother, grandmother, aunt) compared to men (father, grandfather, uncle).[14] However, in this study we did not find any relationship between pulmonary TB occurrence in children who had close contact with TB patients adults and the gender of adult TB patients (P = 0.933).

The income of a family is also said to be one factor that contribute to the incidence of TB in children.[2] However, after statistically tested, we were found that there was no significant relationship between monthly family income and pulmonary TB occurrence in children who had close contact with adult TB patients.

To find the relationship between several risk factors simultaneously with pulmonary TB incidence in children who had close contact with adult TB patients, we carried out logistic regression analysis. The results of this analysis showed that only positive sputum smear factor of the index case (the source contact), which had significant relation with pulmonary tuberculosis occurrence in children who had close contact with adult TB patients (P <0.05).

The limitations of this study were that this study was a cross-sectional design that could not evaluate the course of the disease, which affects the incidence of TB in children in the whole picture, also gold standard in TB diagnosis is by finding the bacteria in the sputum smear /patients gastric lavage, but we faced the difficulty to obtain a representative sputum in

children, whereas procedure for the gastric lavage was considered to be invasive. Other limitation include, the determination of socio-economic status in this study was not accompanied by a home visit, to make sure about the state of the patient houses.

Despite of those limitations mentioned above, in this study we could find that there was a high prevalence of infection among children in household contact with adult cases of tuberculosis. And also, there was a significant relationship between sputum positive AFB, passive smokers and residential density (overcrowding) and there was no significant relationship between age of the children, nutritional status, gender of the contact sources, and monthly family income. Altogether, only the positive sputum smear had a significant correlation associated with the occurrence of TB in children who had close contact with adult TB patients

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