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Original Article

Risk factors for positive tuberculin tests in children

Purnomo Sidhi,[1] Dwi Wastoro Dadiyanto,[1] Suhartono[2]

Abstract

Background Tuberculosis (TB) is a chronic infectious disease and a public health problem. The World Health Organization (WHO) declared TB to be a global emergency because of currently increasing rates of disease and drug resistance. Two million people die annually because of TB. Children are one of the highest groups at risk for TB infection. An effort to define risk factors is needed for effective intervention.

Objective To identify risk factors for positive tuberculin tests in children.

Methods This case control study was done in elementary school children aged 8–12 years in areas served by three community health centers in Semarang. Twenty-nine subjects were Mantoux positive and 29 others served as controls. Consecutive sampling was used for all negative Mantoux test results. Pulmonary TB was diagnosed using the TB scoring system, including the Mantoux test. Statistical bivariate and multivariate analyses were performed.

Results History of household TB contact as a risk factor for positive tuberculin test in children resulted in an OR of 3.76 (95% CI 1.059 to 13.342), P=0.040. History of illness at the time of testing resulted in an OR of 10.23 (95% CI 1.138 to 91.930), P=0.038. The probability of positive tuberculin testing was 90.7% if both these variables were positive.

Conclusion History of household TB contact and the history of illness at the time of testing were risk factors for positive tuberculin tests in children. **[Paediatr Indones. 2011;51:311-5]**.

Keywords: *tuberculosis contact, tuberculin test, children*

Pulmonary tuberculosis, also known as tuberculosis (TB), is a chronic infectious disease caused by *Mycobacterium tuberculosis*. These bacteria have caused more disease in recent decades, and have been classified as a re-emerging disease.[1] The World Health Organization (WHO) estimates that 1.3 million new cases of TB have arisen in children worldwide and 450,000 children younger than 15 years die annually.[2] In developing countries, the risk of TB infections in children is 2-5% and TB causes 8-20% mortality in children.[3] WHO stated that Indonesia is one of the 22 high-burden countries with this disease.[4,5]

Tuberculin skin test (TST) is a useful diagnostic test for TB, with sensitivity and specificity of ≥ 90%. Based on tuberculin skin test results, we can formulate a tuberculin index as a guide to understand the extent of TB infections to measure the prevalence of tuberculosis infection and ARTI (Annual Risk of Tuberculosis Infection) in children.[6,7] An Indonesian survey in 2004 showed that positive acid fast bacteria (AFB) prevalence was 104/100,000, while positive AFB incidence was 96/100,000 with several regional variations.[6] Children with tuberculosis might show a positive tuberculin skin test with or without apparent clinical, radiographic, or laboratory

From the Department of Child Health, Medical School, Diponegoro University/Kariadi Hospital, Semarang, Indonesia.[1] From the Faculty of Public Health, Diponegoro University, Semarang, Indonesia.[2]

Reprint requests to: Purnomo Sidhi, Department of Child Health, Medical School, Diponegoro University/Kariadi Hospital, Jl. Dr. Soetomo No. 18, Semarang, Indonesia. E-mail: *purnomo_sidhi@ymail.com*

manifestations.[1,8,9] A definitive diagnosis can be established by finding *Mycobacterium tuberculosis* in microbiological assessments.[9]

In Semarang, there was no tuberculin index available, in children. Tuberculin skin test screening on elementary school children in Semarang in 2007 showed that 74 (16.6%) of 444 children had positive tuberculin skin tests. This 2007 study was a collaboration project between the Indonesian Ministry of Health, the WHO and the Provincial Health Office of Central Java.[10,11] The aim of this study was to determine risk factors for positive tuberculin tests in children.

Methods

We used the 2007 Semarang studies[10,11] for our analysis. This data formed the basis for us to review the history of tuberculosis contact as a risk factor for positive tuberculin skin tests in children. In the 2007 studies, 444 elementary school students (grades III-VI) had their first tuberculin test placed. Of these 444, 370 children tested negative and 74 tested positive for tuberculin skin test. Data was also gathered in 2009, when 191 children (grades V-VI), underwent a second tuberculin test with 161 testing negative and 30 testing positive. From these cases we performed an observational study. The number of cases and controls were established using a 1:1 ratio, as we calculated the minimum sample size required to be 29 in each group. Twenty-nine children testing tuberculin positive were taken as the case group and 29 children as the control group, for a total of 58 subjects. We assumed a positive tuberculin test to be a diagnosis of TB in children. Univariate, bivariate and multivariate analyses using double logistic regression, $\alpha = 0.05$ and a 95% confidence interval were performed on the data. Risk assessment was estimated using odds ratio (OR) with a computerized program.

Results

Twenty-nine children with positive tuberculin tests formed the case group, while 29 children testing negative formed the control group, for a total of 58 subjects. Of the 58 subjects, 31% had a history of household TB contact.

The characteristics of the subjects are shown in **Table 1.**

Bivariate analysis showed OR 3.90 (95% CI 1.16 to 13.08), P = 0.040 for a history of household TB contact and OR 10.67 (95% CI 1.24 to 91.98), P = 0.038 for history of illness at the time of testing. These results indicated that these variables were risk factors for positive tuberculin skin test. The overall results of the bivariate analysis are shown in **Table 2**.

The two risk factors for positive tuberculin skin test were further analyzed by a multivariate method. **(Table 3)**

The multivariate analysis showed that history of household TB contact and history of illness at the time of testing were risk factors of TB infection in children OR 3.759 (95% CI 1.059 to 13.342) and 10.230 (95% CI 1.138 to 91.930), respectively. If the history of adult household TB contact was positive, then a history of child's illness at the time of testing increased 10-fold the likelihood of positive tuberculin skin test (probability = 90.7%), compared to children with no illness during testing.

Discussion

Tuberculosis contact was defined as living in a house where an adult was given anti-TB therapy or similar kinds of therapy for the previous 2 years.[12] Tuberculosis is often found in people of lower socioeconomic background and areas with high incidence of malnutrition, and high morbidity. BCG vaccinations were done as a preventative effort for TB to boost the role of macrophages in increasing protective immunity.[13]

The current study showed similar results to previous research by Musadad in the Tangerang regency. Musadad showed that there was an estimated risk (OR) of 3.9 in developing TB if there was more than 1 person in the same house with TB.[15]

A study in Sleman also showed similar results to our study, in that a history of TB contact was regarded as a risk for TB incidence. In Sleman, 6 children (14%) with TB had a history of household TB contact, with the risk of TB incidence higher in children < 3 years old (OR 1.689, 95% CI 0.684 to 4.172).[15]

A study on risk factors for TB infections in Gambia showed that the prevalence of positive

Table 1. Characteristic of the subject

Variable	Research Subject				Quantity	
	Case		Control			
	n	%	n	%	n	%
History of contact						
0 = No	16	27,6	24	41,4	40	69
1 = Yes	13	22,4	5	8,6	18	31
Age						
0 = 10 – 12 yrs	15	25,9	18	31	33	56,9
1 = 8 – 10 yrs	14	24,1	11	19	25	43,1
Nutritional status						
0 = Good	14	24,1	23	37,9	36	62,1
1 = Over-nourished	11	19	2	3,4	13	22,4
2 = Obesity	2	5,2	2	3,4	5	8,6
3 = Malnourished	2	3,4	2	3,2	4	6,9
BCG immunization status						
0 = Yes	23	39,7	24	41,4	47	81
1 = No	6	10,3	5	8,6	11	19
Densely populated residence						
0 = No	15	25,9	25	43,1	40	69
1 = Yes	14	24,1	4	6,9	18	31
Flooring						
0 = good	28	48,3	29	50	57	98,3
1 = not good	1	1,7	0	0	1	1,7
Ventilations						
0 = Yes	15	25,9	27	46,6	42	72,4
1 = No	14	24,1	2	3,4	16	27,6
Income						
0 = UMK ≥ 939.756	24	41,4	22	37,9	46	79,3
1 = UMK < 939.756	5	8,6	7	12,1	12	20,7
Parent's education (mother)						
0 = High, ≥ High School	15	25,9	12	20,7	27	46,6
1 = Low, < High School	14	24,1	17	29,3	31	53,4
Child's history of illness						
0 = No	21	36,2	28	48,3	49	84,5
1 = Yes	8	13,8	1	1,7	9	15,5

Table 2. Bivariate analysis summary

Independent Variables	OR	95 % CI		P
		Lower limit	Upper limit	
History of household TB contact	3.90	1.163	13.078	0.040
Age	0.655	0.230	1.863	0.596
Nutritional status	1.0	0.131	7.624	1.0
BCG immunization status	1.252	0.335	4.675	1.0
Densely populated home	0.570	0.20	1.623	0.428
Flooring at home	2.036	1.563	2.651	0.313
Ventilation at home	0.944	0.318	2.807	1.00
Parents' income	0.655	0.181	2.367	0.746
Mother's education	0.758	0.270	2.129	0.793
Child ill at time of testing	10.667	1.237	91.98	0.038

Table 3. Multivariate analysis results

Variables	B	P-value	OR	95 % CI	
				Lower limit	Upper limit
History of household TB contact	1.324	0.040	3.76	1.059	13.34
History of illness at time of testing	2.325	0.038	10.2	1.138	91.93

tuberculin skin tests between boys and girls was not different until adolescence, after which it was higher in boys. This finding may be caused by differences in social roles and activities that increase environmental exposure or the nature of susceptibility in those children, or even predisposing factors for late hypersensitivity response.[6]

Contact with an adult with TB was observed to be a major risk factor, with closer contact leading to higher risk. Therefore, contact with family members who had TB at home is an important factor in TB infections of other family members, especially the closest ones. Other risk factors were the number of people living in the same house (density of residence), length of stay in the same house with a TB patient, history of TB and staying in the same bedroom with a TB patient at night, especially sleeping on the same bed.[6]

A child's history of illness at the time of testing was also a risk factor for positive tuberculin skin testing in children. A child who was sick at the time of testing could increase the chance of a positive response. However, suppression of the immune system for any reason could cause the body to give no reaction to the tuberculin test even if TB infection had already ensued.[1,6] Several conditions may cause anergy, such as malnutrition, malignancy, long-term steroid use, chemotherapy, measles, pertussis, varicella, influenza, severe TB, and vaccination with a live attenuated virus. In the above list, influenza is considered to be an infection by the influenza virus (not including the common cold, usually caused by rhinovirus).[1,6]

Bivariate analysis showed a risk size estimation of 10.667 (95% CI 1.237 to 91.98 and P = 0.038). Thus, a child's history of illness at the time of testing was a risk factor for positive tuberculin skin tests in children.

Multivariate analysis showed 90.7% probability of pulmonary TB infection in children (tuberculin skin test positive) after taking into consideration the variables of history of household TB contact and child's history of illness at the time of testing. Therefore, efforts to reduce the risk of tuberculosis infection in children should be made by mothers and/or other family members to minimize the risk of adult TB patient contact. Residential density may also be a predisposing factor increasing the chance of contact with adult TB patients. To reduce family members' susceptibility to risk of TB infection for low-income families, we need to consider improving children's nutritional status by choosing reasonably priced but nutritious foods.

BCG immunization for children could reduce the risk of pulmonary TB infections. As such, the *Lima Imunisasi Lengkap* immunization program needs to be adhered to. Good hygiene and healthy lifestyle (e.g., PHBS program) can further help improve children's and overall family health.

In conclusion, history of household TB contact and a child's history of illness at the time of testing contributed to positive tuberculin skin tests in children.

References

1. Rahajoe NN, Basir D, Makmuri MS, Kartasasmita CB. Pedoman nasional tuberculosis anak. 2nd ed. Jakarta: Respirology Division Indonesian Pediatric Society; 2007. p. 3-34
2. World Health Organization. Global tuberculosis control. Surveillance, planning, financing. 2002 [cited 2006 Oct 18]. Available from: *http://www.who.int/ gtb/publications/globrep*
3. Kabra SK, Lodha, Seth V. Some current concepts on childhood tuberculosis. Indian J Med Res. 2004;120:387-97.
4. Munoz FM, Starke JR. Tuberculosis (*Mycobacterium tuberculosis*). In: Behrman RE, Kliegman RM, Jenson HB, editors. Nelson textbook of pediatrics. 17th ed. Philadelphia: Saunders; 2004. p. 958-72.
5. Kebijakan nasional kolaborasi TB-HIV di Indonesia. In: Kolaborasi Subdit TB dengan Subdit AIDS & PMS Ditjen PP & PL. Salatiga: Ministry of Health of Indonesia; 2008. p. 7-23.
6. Kartasasmita BC, Basir D. Epidemiologi tuberculosis. In: Rahajoe NN, Supriyatno B, Setyanto DB, editors. Buku ajar respirologi anak. 1st ed. Jakarta: Indonesian Pediatric Society; 2008. p. 162-8.
7. Pertemuan sosialisasi survei tuberculin. Semarang: Provincial Health Office of Central Java; 2007. p. 5-18.
8. American Thoracic Society, Center for Disease Control and Prevention. Diagnostic standards and classification of tuberculosis in adults and children. Am J Respir Crit Care Med. 2000;161:1376-95.
9. Amdekar YK. Consensus statement of IAP working group: status report on diagnosis of childhood tuberculosis. Indian Pediatr. 2004;41:146-55.

10. Laporan pertemuan sosialisasi survei tuberkulin. Semarang: Provincial Health Office of Central Java; 2007. p. 3-17.
11. Loprang F. Sosialisasi survei tuberkulin di Indonesia. Semarang: World Health Organization; 2007. p. 1-25.
12. Vijayasekaran D, Kumar RA, Gowrishankar NC, Nedunchelian K, Sethuraman S. Mantoux and contact positivity in tuberculosis. Indian J Pediatr. 2006;73:989-93.
13. Hypersensitivity and chronic inflammation. 2006 [cited 2005 Dec 23]. Available from: *http://www.immuno.pdth.com._ac.uk/~immuno/part1/lec13/lec13_ 97.html*
14. Oemijati S, Samsudin, Assin MS, Tamaela LA, Nasar SS. Penerapan etika penelitian kedokteran. In: Sastroasmoro S, Ismael S, editors. Dasar-dasar metodologi penelitian klinis. 2nd ed. Jakarta: Indonesian Pediatric Society Publishing House; 2002. p. 288-93.
15. Musadad A. Penelitian hubungan faktor lingkungan rumah dengan kejadian TB paru di lingkungan rumah tangga. CDK. 2003. p.63.