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Association of contact history and family behavior with tuberculosis in children at Banyu Urip Public Health Center, Surabaya City, Indonesia: A case-control study

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ABSTRACT

Background and purpose: The Surabaya City had the highest number of pediatric tuberculosis cases in East Java Province; while, Banyu Urip Public Health Center contributed significantly to the number of pediatric tuberculosis in Surabaya. This study aims to analyze risk factors of tuberculosis among children aged 0-14 years in the working area of the Banyu Urip Public Health Center in Surabaya City.

Methods: This is a case-control study conducted in Banyu Urip Public Health Center area in 2022. All 42 children aged 0-14 years with TB were included as cases and 42 healthy children were selected as control purposively. Data collection was carried out using questionnaires which filled in by the guardian/caregiver of each child. The variables collected include children's characteristics, immunization history, contact history and knowledge, attitude, practices (KAP) toward TB of the families. The data was analyzed descriptively and continued with a C*hi-square* test.

Results: The majority of children had received BCG immunization among both cases (95.2%) and control (100%) and had no comorbidities among cases (88.1%) and control (97.6%). We found history of contact (p<0.001), poor families' knowledge (OR=3.80; 95%CI: 1.00-17.56; p=0.0026) and poor practices (OR=3.28; 95%CI: 1.22-8.92; p=0.009) were associated with a higher likelihood of TB infection among children in Surabaya.

Conclusion: Risk factors for pediatric TB were contact history with TB patients, poor family knowledge, and poor family practices. Awareness campaign to improve parental and community knowledge and practices regarding TB must be carried out using different methods that are preferred by the communities

Keywords: tuberculosis, children, contact history, family knowledge, family practices, Indonesia

INTRODUCTION

Tuberculosis (TB) is caused by *Mycobacterium Tuberculosis Bacillus* which can infect human organs including kidneys, lungs, heart, lymph glands, larynx, ears, eyes, pleura, bones, and other organs. However, the organ that is often found infected is the lung so it is called Pulmonary TB.[1] According to the Centers for Disease Control (CDC), the air is the right environmental medium for *Mycobacterium* transmission. The bacteria will spread widely in the air along with droplets that come out when tuberculosis patients talk, cough, sneeze, or spit.[2] TB can affect all ages, including children. The problem experienced when children suffer from TB is the process of diagnosing cases that is difficult because the clinical symptoms experienced by children are mostly non-specific.[3] However, pediatric TB is considered important because it is a marker or illustrates the occurrence of TB transmission in the community today.[4] Therefore, it is necessary to carry out preventive management on risk factors for the cause and transmission of TB in children.

The classification of risk factors for the emergence of TB in children consists of germs or bacteria that cause TB, individual factors, and environmental factors.[5] Risk factors associated with tuberculosis in children include age, sex, nutritional status, BCG immunization history, comorbidities history, contact history, and others. The results of research conducted by Pradani and Kundarto found that some pediatric TB patients have a history of comorbidities including HIV, *epilepsy*, *urticaria*, *pneumonia*, *heart disease*, *Colli sinistra abscess*, and others which were the aggravating circumstances.[6] In addition, an important point in a study on tuberculosis is whether there is a history of contact with tuberculosis patients.[7] There are efforts to prevent *Mycobacterium tuberculosis* infection, a study conducted by Michelsen in Greenland found that BCG immunization can significantly reduce *Mycobacterium tuberculosis* infection and tuberculosis disease among children and those in early adulthood.[8]

Meanwhile, the results of research conducted by Noviansyah in Bangunjaya Village in 2020 found that parental behavior is related to cases of pulmonary tuberculosis in children.[9] The domains of behavior include knowledge, attitudes, and actions. Family knowledge about the dangers of tuberculosis will provide stimulation for a family to take action to prevent disease transmission in the family.[10] This means that if parents behave well in TB prevention, it affects children's health, which avoids children from the risk of TB.[11]

Indonesia ranks second in the world after India as a *high-burden country* for TB.[12] In 2020, it was reported that TB cases were found to reach 351,936 people with an additional of 32,812 cases in children aged 0-14 years. Of the 34 provinces, three provinces reported having the highest number of tuberculosis cases in children aged 0-14 years and East Java province is ranked third.[13] Tuberculosis of children aged 0-14 years in East Java in 2020 reached 2,747 cases with the coverage of new cases finding reaching 23.9%, which was lower than in 2019 with the coverage of 44.6%. The low coverage of case discovery risks the non-identification of new cases, thus expanding the transmission of new TB in the surrounding environment. Areas in the East Java Province that occupied the top position of pediatric TB cases was Surabaya City.[14] Based on Surabaya City health profile data, one of the areas in Surabaya City that contributed to many cases is Sawahan District.[15] The results of a preliminary study in Sawahan District found that the highest number of pediatric tuberculosis cases in 2021 was at the Banyu Urip Public Health Center.

Based on those backgrounds, this study aims to analyze the relationship between factors including BCG

immunization history, comorbidities, case contact history, family knowledge, family attitudes, and family practices with tuberculosis in children. The results of this study are expected to be able to improve the management of tuberculosis control and prevention in children.

METHOD

This research was a case-control study conducted at the working area of Banyu Urip Public Health Center and data was collected between March to June 2022. The population of this study was divided into two groups including the case and the control populations. The population of cases were children aged 0-14 years with TB based on medical record of Banyu Urip Public Health Center for at least 6 months before this research began. While, the control population were children aged 0-14 years without tuberculosis symptom, who lived close to children with tuberculosis, with a maximum distance of 200 meters. The samples of cases and controls were selected purposively according to the inclusion criteria. In particular, the controls were selected based on the same sex criteria as the cases. The total number of samples included was 42 for each group. The respondents of this study are guardians of children who have the right to represent children in signing informed consent such as father, mother, brother, grandfather, or grandmother

The primary data collection was conducted using a questionnaire, which have been tested for validity and reliability to produce an appropriate and accurate questionnaire as a data collection tool. Validity and reliability test were conducted at the Banyu Urip Public Health Center with a total of 41 respondents. Based on statistical tests, a significant validity value was obtained with r count >0.05. Furthermore, the test results for reliability showed the questionnaire had moderate or high reliability.

The questionnaire contained questions related to the children's characteristics, including: (1) history of BCG immunization; (2) history of comorbidities such as HIV&AIDS, diabetes mellitus, liver disorders, lung disorders, goiter, etc.; (3) history of contact with TB patients at home, including the child's parents, grandparents, siblings, or child's caretakers. Other questionnaires were used to determine the family's level of knowledge, attitudes and practices. The knowledge questionnaire contained 10 questions, the attitude questionnaire contained 10 questions using a Likert scale (strongly disagree, disagree, agree, and strongly agree). The practices questionnaire contained 7 questions regarding parental actions when children cough and sneeze, habits of opening windows, cleaning the floor of the house, drying sleeping equipment, and efforts to maintain children's nutrition.

Secondary data collection in the form of tuberculosis data for children aged 0-14 years was obtained through a recapitulation of the case reports recorded in the 2021 and 2022 tuberculosis information system (SITB) from the Banyu Urip Public Health Center in Surabaya City. Data analysis was conducted using a *Chi-square* test with a 95% confidence *ρ-value* (α=0.05). Statistical tests were conducted to determine the relationship between variables, namely independent variables (BCG immunization history, comorbidity history, case contact history, family knowledge, attitudes, and practices) with the dependent variable, tuberculosis in children aged 0-14 years. The amount of risk can be estimated using the *Odds Ratio* (OR) value. The results of data analysis are presented in the form of descriptions and tables.

This research has been approved by the Research Ethics Commission of the Faculty of Public Health,

Universitas Airlangga with number 17/EA/KEPK/2021.

RESULT

Table 1 shows the distribution of age and sex of the TB cases and controls in this study. Almost half (47.6%) of the cases were aged 6-10 years old and 4.8% were infants. The age group of control is comparable to the cases (p=0.36 based on Chi Square test). The majority (69.0%) of cases were male, and the distribution for sex was the same between cases and controls because controls were selected based on the same sex as the cases.

Table 1. Distribution of age and sex of the cases and controls

Variables	Cases		Controls	
	n	%	n	%
Age (years)				
0 – 1	2	4.8	0	0.0
>1–5	12	28.6	14	33.3
6–10	19	45.2	20	47.6
>10	9	21.4	8	19.0
Sex				
Girl	13	31.0	13	31.0
Boy	29	69.0	29	69.0

From Table 2, we can see that the immunization status among controls was 100% while among cases were 95.2%. We can't calculate the OR based on the p value, there was no difference since both groups have high vaccination coverage. Children with comorbidities were five times more likely to have TB compared to those with no comorbidities, 11.9% compared to 2.4%, although it was not statistically significant (OR=5.54; 95%CI: 0.57-268.27; p=0.09), likely due to small sample size. The history of comorbidities referred to in this study are diseases that have been suffered by children such as lung disorders, heart defects, struma, epilepsy, and throat infections.

Meanwhile, the history of contact is a significant predictor of TB with 90.5% of children with contact history experienced TB compared to none (0%) of the control (p<0.001). The most common contact were parents (father and mother) as high as 61.2%, followed by grandparents at 21%.

The majority (90.5%) of the controls' family have a good level of knowledge compared to 71.5% of the cases'. The children from fair knowledge family were almost four times more likely to have TB compared to those with good level of knowledge (OR=3.80; 95%CI: 1.00-17.56; p=0.0026). For the attitude aspect, half (50%) of cases' family have negative attitude compared to 40.5% of controls'; however, this comparison was not statistically significant. Meanwhile, family practices toward TB prevention show a significant association with the odd of TB infection. The cases' family were more likely to have poor practices (59.5%) compared to the controls' (31.0%). Poor practices increased the likelihood of TB in children by more than three-folds (OR=3.28; 95%CI: 1.22-8.92; p=0.009)

Table 2. The risk of pediatric TB based on vaccination, comorbidities and contact history

Variables	Cases		Controls		OR (95%CI)	p
	n	%	n	%		
BCG Immunization						
No	2	4.8	0	0.0	-	0.152
Yes	40	95.2	42	100.0		
Comorbidities						
Yes	5	11.9	1	2.4	5.54	0.09
No	37	88.1	41	97.6	(0.57-268.27)	
Contact with TB patients (±3 months)						
Yes	38	90.5	0	0.0	-	<0.001
No	4	9.5	42	100.0		
Source of contacts						
Father	15	39.5				
Mother	9	23.7				
Grandfather	4	10.5				
Grandmother	4	10.5				
Siblings	3	7.9				
Aunty/Uncle	3	7.9				

Table 3. The risk of pediatric TB based on family knowledge, attitude and practices

Variables	Cases		Controls		OR (95%CI)	p
	n	%	n	%		
Knowledge						
Fair	12	28.6	4	9.5	3.80	0.026
Good	30	71.4	38	90.5	(1.00-17.56)	
Attitude						
Negative	21	50.0	17	40.5	1.47	0.381
Positive	21	50.0	25	59.5	(0.57 -3.82)	
Practices						
Poor	25	59.5	13	31.0	3.28	0.009
Good	17	40.5	29	69.0	(1.22-8.92)	

DISCUSSION

Children are at high risk to contract TB infection, partly due to intense contact or interaction with adults and other family or community members in everyday life.[16,17] We found the highest proportion of TB cases were within age range of 6-14 years, which is similar to previous study where children in the age range of >5-14 were the most frequent age group.[18] In some cases, TB infection among children can become more severe such as meningitis TB or miliary TB.[19] However, age may not play important role if ones have good immunity and nutritional status.[20]

Sex is also suggested to have association with TB among children. A study found that boys are 1.6 times more likely to be infected with tuberculosis compared to girls.[21] The causative factors of the higher risk are due

to emotional, psychological, and child growth and development factors. This is also related to the tendency of boys to be more active with activities inside and outside the home than girls.[22] This statement is in contrast to Crofton who stated that between boys and girls there is almost no difference with cases of childhood tuberculosis. A risk factor that affects the process of development of tuberculosis in both boys and girls is the child's weak immune system.[23]

In this study, children remain at risk of tuberculosis infection despite BCG immunization. The data from City of Surabaya Health Office shows high coverage of BCG immunization, 100.6% in 2021 and 99.9% in 2022.[24,25] Based on this research, it also shows that the majority of children in the case and control groups have received BCG immunization so that there is no difference. Similarly, a previous study in Jakarta found the history of BCG immunization was not related to tuberculosis in children because those who suffered or did not suffer from pulmonary tuberculosis had received BCG immunization.[26] Factors that may be associated with the ineffectiveness of BCG immunization in children are improper immunization time, method of administration, improper dose, and improper storage of vaccines.[27] In general, BCG immunization cannot prevent the risk of primary TB infection in children but has proven its effectiveness in preventing severe tuberculosis, such as miliary TB and meningitis TB. Therefore, BCG immunization is still one of the efforts to prevent pediatric tuberculosis carried out by the government.[28,29]

We found children with history of comorbidities were at higher risk to have TB. A previous study also found similar finding that the presence of high-risk comorbidities causes a person to be more susceptible to contracting tuberculosis.[30] The presence of comorbidities can also affects the treatment outcome of TB patients.[31] Therefore, it is necessary to examine the comorbidities among tuberculosis patients for a better treatment outcomes.[32]

Intense contact with TB patients is putting children at higher risk for TB infection. Interaction for more than 8 hours with pulmonary tuberculosis patients will increase the risk of transmission. The intense interaction can activate *Mycobacterium tuberculosis* bacteria and accelerate bacteria into the body.[33] A study in Semarang shows that children who have had active contact with tuberculosis patients are at much higher risk of contracting tuberculosis compared to those without a contact history.[34] Children who have a history of contact with BTA+ cases may have reduced risk of TB disease by transmission prevention practices such as do not sleeping in the same room with children, not eating from the same plate or feeding children, using masks and regularly taking anti-tuberculosis drugs.[35] The potential for infection due to contact with tuberculosis patients can also be minimized by maintaining distance and position when interacting with them.[36]

Public knowledge, attitude and practices especially of families, about tuberculosis play essential roles in the process of controlling and preventing disease transmission. This is because a well-informed society will make well-behaved decisions in preventing the transmission of tuberculosis.[37,38] Previous study shows families with less knowledge was at risk of having TB by almost eight-folds.[39] In our study, we found better level of knowledge among the family of controls group compared to those of cases group although the association was not statistically significant, probably due to small sample size. Therefore, it is necessary to improve knowledge of the communities and families regarding TB transmission, prevention and therapy.

Better knowledge usually leads to positive attitude and behavior. Attitudes play an important role and greatly influence people's behavior. In this study we found no significant difference on the attitude of families

of cases and controls, although higher proportion of positive attitude was shown by the control's families. This signifies the importance to transfer knowledge into better attitude by providing positive role models and continuous reminder and supports from surrounding including health workers.

We found poor family practices toward TB prevention increased the likelihood of TB by more than three times. Another study found the same finding that people with poor behavior were 3.5 times more likely to get pulmonary TB than people who take good preventive measures.[40] Community practices that is still lacking in preventing tuberculosis transmission is one of the sources of transmission itself, causing difficulty in breaking the chain of tuberculosis disease.[41] Therefore, efforts to help the community to take measures to prevent tuberculosis transmission properly must always be increased by providing education to the public about how, what, and the impact of tuberculosis.[42] One form of the first step of education to the community is to provide examples of preventive measures for tuberculosis transmission such as covering the mouth when coughing and using masks properly and correctly.[43]

The limitation of this research is that the measurement of the level of knowledge, attitudes and practices of parents may be quite superficial and there is potential recall or social desirability bias due to self-reported responses. In the future questions should be able to explore deeper and practices can be complemented with observation. This study explored few numbers of predictors, then, future researchers should also explore more predictors including socio-demographic and economic factors, social practices and others.

CONCLUSION

We found contact history with tuberculosis patients, low family knowledge, and poor family practices were associated with higher odds of TB infection among children age 0-14 years old. Therefore, the Surabaya City Health Office has to improve current TB program focusing on improving knowledge, attitude and practices among the community to prevent TB infection and transmission. Contact tracing and screening of the close contact of TB patients must be improved, including among children. Assessment of comorbidities are also important to measure the risk of TB and treatment outcomes. Future studies should accommodate broader factors to improve our understanding on pediatric TB.

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AUTHOR CONTRIBUTION

The authors' contribution to this study is evenly divided. AFA and LS were tasked with creating the

conceptual framework of the research and compiling questionnaires. AFA conducted data collection and analysis and wrote the research results in scientific articles. LS contributed to directing and correcting scientific articles.

CONFLICT OF INTEREST

The researcher stated that there was no conflict of interest in this study.

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