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Socio-Economics of Childhood Pulmonary Tuberculosis with Adult Tuberculosis Household Contacts in Daerah Istimewa Yogyakarta Province

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Abstract

Background: Since the tuberculosis (TB) disease in children constitutes a global health problem that has long been neglected, this study sought to predict socioeconomic factors as public-health determinants that could protect children who were exposed to TB in their household. **Method**: A case-control study of 132 children (under 14 years old) who shared their household with adults suffering from pulmonary TB was conducted in the Province of Daerah Istimewa Yogyakarta. This study consisted of an interview and anthropometry measurement for the controls screening test, while the cases were monitored by pediatricians with a scoring system childhood TB diagnosis from the secondary hospital database. A multiple logistic regression was used to analyze the results. **Results**: A healthy housing condition, predicted by a naturally illuminated luminary bedroom prevented the incidence of the childhood TB disease (p = 0.043) even if exposed to adult TB in their environment (p = 0.775). **Conclusions**: Healthy housing factors with good sunlight protected children especially at the early stage, when there were active pulmonary TB adult household contacts. Ventilation and morning sunlight facilitated air circulation, vitality and the body's immune system towards TB protection.

Keywords: socio-economic, children, tuberculosis, household contact

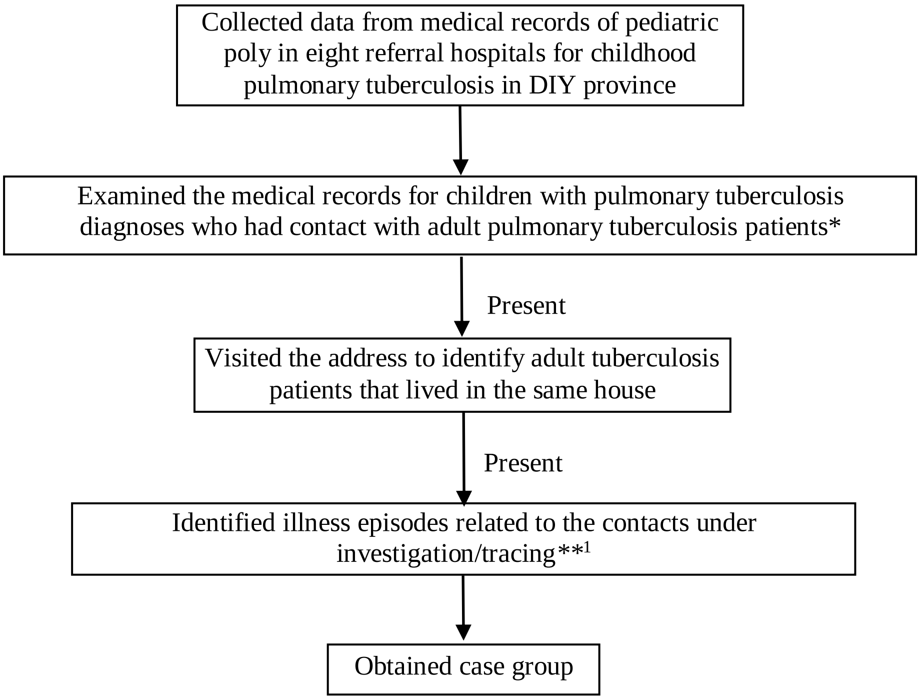
Introduction

Pulmonary TB transmission in children is impacted by contact with adult pulmonary TB. Children are not the causal subjects who transmit the disease to the population. Contact was the main source of the transmission of adult pulmonary TB to childhood pulmonary TB.[1] Adults who had positive acid-resistant Mycobacterium TB bacille (Basil Tahan Asam – BTA) were vulnerable to transmitting the disease to children, especially if contact occurred intensively in the same house.[2] In global prevention efforts, chemopropylaxis has been performed for children with a family history of TB to prevent TB infection, particularly in children who were already infected in order to reverse the development of pulmonary TB illness.[3]

Childhood pulmonary TB is often ignored and is also difficult to diagnose well.[4] It often occurrs because there was contact with an adult pulmonary TB patient. This transmission risk increases when the children live in same house as a TB patient.[1] However, not all children who have contact with a pulmonary TB adult in the same house develop TB.[4] Several factors were expected to influence this risk or to prevent children from developing pulmonary TB when in contact with an adult pulmonary TB patient who lives in the same house. This study aimed to assess the socio-economic factors that may reduce the risk of childhood pulmonary TB incidence in children who share a house with adult pulmonary TB patients.

Methods

Data collection differed between the case group and the control group. However, this difference was necessary to prevent selection bias. A case was defined as a clear diagnosis of positive childhood TB status impacted by an adult pulmonary TB patient in a shared house. The cases were collected from eight referred hospital databases of patients who sought treatment (passive case finding). The comparison sample of those without childhood TB living in the same house as an adult pulmonary TB was collected in the same settings as the



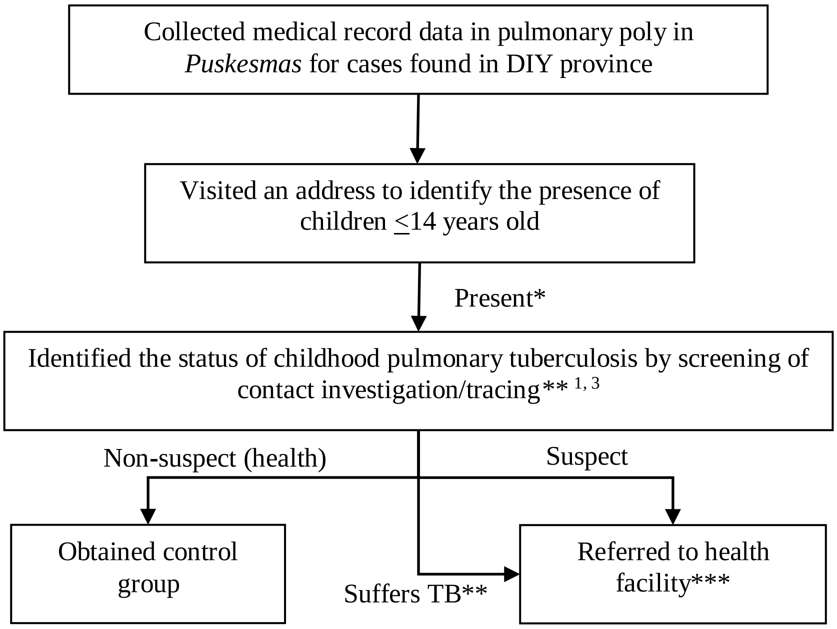
*Point 1 The parameter of childhood pulmonary tuberculosis scoring system
**Obtained information on pulmonary tuberculosis illness episodes (inclusion: ever had/have positive BTA recorded/diagnosed in a health facility)

Figure 1. Tracing of Case Group

found cases (active case finding). Figure 1 shows that childhood TB status in a hospital setting was traced to adult pulmonary TB patients who lived in shared houses. Adult TB sufferers were identified by a clearly diagnosed history by health professionals and a period of possible TB transmission.[5] Adult TB patients in this study had been recorded and treated (for children under five) or already recovered (for children 5-14 years old); these patients were traced as possible causes of childhood TB status. This is because children above 5-years old could suffer pulmonary TB after a year of primary infection from an adult pulmonary TB patient, while children under five only need a shorter time of several weeks.[3,5,6]

Since children without TB are not reported, a control from adult TB household contacts was created by screening results on adult pulmonary TB patients in health center medical records (Puskesmas) in the same population settings in which cases were found (Figure 2). In this study, housing condition was calculated (scored) from an aggregate index of house conditions according to Act of the Ministry of Health, Republic of Indonesia Num. 829/Menkes/SK/VII/1999 that was renewed by Ditjen PPM (2002). The housing of adult pulmonary TB sufferers with children was categorized into meeting health conditions and not meeting health conditions. The bedrooms, kitchens, and living rooms were assessed by separate utilization, cleanliness, existence and use of window, ventilation, and natural illumination by sunlight.

Economic status was derived from Principal Component Analysis (PCA) which was generated by index of household goods belonging.[7] This study identified and calculated twelve household goods whether exist or not in every household. PCA analysis have formed four indexes that range from the poorest to highest level of economic status. Meanwhile, education level was calculated by higher school to university degree for high education category, while below of it have identified as low education level. Density was measured by WHO definition for children density. Previous studies have specifically estimated the best housing density for children (0-14 years old), that was adopted by the WHO (1993), as 3 m^2/room.[8] We measured the housing density in the past before the adult developed by TB. It evaluated 12 months to 6 months before the adult have confirmed TB by health professionals (regarded to TB mechanisme where in children, it happens faster or less than 6 months after infection).[9,10]



*If there was more than one child, then all children were screened to see the results
**Screening results were suspect if there were one or more of 3 children meeting pulmonary tuberculosis criterion: (cough, fever, and growth failure)
***The suspected children were referred to the Public Health Center to establish a diagnose, but this was not involved in the study

Figure 2. Tracing of Control Group

Table 1. Socio-economic Status of Childhood TB with Adult TB Household Contacts

	Cases (n=66)		Controls (n=66)		Total (n=132)	
	N	**%**	**N**	**%**	**n**	**%**
Economic status						
Poor	15	22.7	11	16.7	26	19.7
Middle	23	34.8	30	45.5	53	40.2
Middle upper	16	24.2	10	15.2	26	19.7
High	12	18.2	15	22.7	27	20.5
Education level of adult TB						
Low	37	56.1	39	59.1	76	57.6
High	29	43.9	27	40.9	56	42.4
Occupation type of adult TB						
motherhood/un-worker	9	13.6	14	21.2	23	17.4
Unemployed worker	44	66.7	44	66.7	88	66.7
Employee	13	19.7	8	12.1	21	15.9
Housing condition						
Unmet condition	33	50	28	46.4	61	46.2
Met condition	33	50	38	57.6	71	53.8
Natural illumination of bedroom (sunlight)						
Poor	33	50	18	27.3	51	38.6
Sufficient	33	50	48	72.7	81	61.4
Housing density						
Crowded	7	10.6	19	28.8	26	19.7
Un-crowded	59	89.4	47	71.2	106	80.3

Table 2. Multivariate Analysis of Childhood TB with Adult TB Household Contacts

Category	Bivariable analysis			Multivariable analysis		
	***Crude* OR**	**95% CI**	***p***	***Adjusted* OR**	**95% CI**	***p***
Socioeconomic status						
Low	*Referral*	*Referral*	**0.568**	*Referral*	*Referral*	**0.267**
Mid	1.648	0.639-4.250	0.302	0.618	0.113-3.360	0.577
High	1.000	0.333-3.005	1.000	0.349	0.050-2.433	0.288
Highest	1.705	0.575-5.055	0.336	2.545	0.359-18.024	0.350
Bed room illumination						
Not sufficient	*Referral*	*Referral*	**0.008**	*Referral*	*Referral*	**0.043***
Sufficient	2.667	1.291-5.508		5.530	1.057-28.921	
Housing density						
Dense	*Referral*	*Referral*	**0.011**	*Referral*	*Referral*	**0.775**
Not dense	0.293	0.114-0.757		0.754	0.109-5.226	

The enter method of multiple logistic regression was used to predict the protective factors of childhood TB status for children living in the same house as an adult TB sufferer. This method involved entering all variables that passed a screening test ($p < 0.25$ and substantial). Variables were excluded one by one starting from the greatest p value to the smallest p value until reaching the desired significance ($p < 0.05$). Changes in the Odd Ratio (OR) that were not allowed (higher than 10% in each predictor variables) were also considered.[11]

Possible confounders were identified in order to maintain comparability between the case and control group. Confounding was treated as an independent variable, as it influenced related factors. Information bias, such as non-differential misclassification, was controlled by using a valid and reliable data collecting tool that was modified from a previous study questionnaire.[5,10,12-14] Informed consent from the respondent was obtained in written form. Ethic approval of the study was obtained from the Expert Commission on Research and Research Ethics, Faculty of Public Health, Universitas Indonesia (87/H2.F10/ PPM.00.02/2014).

Results

Table 1 shows that socioeconomic status distribution, while Table 2 presents multivariate analysis of this study.In this study, Nearest Neighbor Analysis was performed with CrimeStat III with 132 coordinate points. The results show that the cases' patterns were clustered, with statistic test values of Z = -12.4961 and $p = 0.0001$. Urban setting in developing countries are more likely to be composed of insufficient land for a huge population, which gives rise to unresolvable problems related to communicable diseases, particularly Tuberculosis (TB). The NNI showed a concentrated cluttering pattern (0.43147). The location of the concentrated groups was the Yogyakarta City area. This study concluded that TB transmission is not always related only to housing density, but also to the local environment and the transmission of TB.

Discussion

Socio-economic reasons have been explored to evaluate the impact of TB in developing countries[4,15-17], especially in Indonesia.[18,19] This study confirmed that the economic status and housing density are the indirect variables which can predict childhood TB, when the children live in adult TB-inflicted households (Table 2). However, this research revealed that a well-illuminated bedroom status can significantly reduce the transmission risk of childhood TB, as a predictor variable.

Housing condition. Persistent correlations between poor housing conditions and poor health levels have already been reported by cross-sectional studies which recommended the betterment of housing conditions as well as improved health conditions.[20] However, the complex correlations removed the condition that confounding variables, such as economic status, could be considered strong enough to be justified. In other words, the increase in healthy housing conditions was also not a certain cause of increasing the degree of health. The correlation patterns that were obtained by controlling the other variables answer the question that housing condition consists of three components: physical, sanitation, and behavioral components. Good housing condition is a protective factor to prevent active pulmonary TB transmission. Housing health protects children from not only communicable diseases, such as pulmonary TB, but also from injury. It also aids their development, nutrition status, and mental health.[21,22]

In general, this study found that housing conditions are unable to protect children who live in the same house with an infected adult, from pulmonary TB transmission. However, it may be possible to describe it by the available composite variable. Bed room illumination explained that housing condition of childhood TB status who live in same house with adult pulmonary TB suffer (OR = 2.667 Oradj = 5.530) (Table 2). Bedroom is always main room that existed in each house. It had longest proportion for activities both when take a rest (sleep) (about 8 hours per day) and sedentary activities. Average 90% of people spend their time indoor, wherein 50-70% in house and 30% in bed room. At least 1/3 of time was spend in this room.[22] In children especially infant, underfive and preschool children, spend more time (>12 hours per day) for activities; such as playing, having creation, and take rest[23] whether was alone or accompanied by adult.

Bedrooms, especially those for children, did not only influence the transmission of pulmonary TB but also the physical and even psychological state of the children.[23] Moreover, the usage of the bedroom based on age showed that this was different for children under five compared to 5-year-olds and older children. Infants between 0 and 18 months were still depending on their parents, especially on their mother, in the post delivery period. Whereas 2-5-year-olds engaged in very active activities but still remained close to their parents. The provision of the room starting with used furniture, scale and measure, color and style, and illumination, impacts the health of the child/infant. Natural illumination for the infant was very important had to be provided with consideration to the eye and skin sensitivity of the infant. Illumination should avoid direct exposure to sunlight and should reduce the intensity thereof.[24] However, this study was not conducted in order to look at subgroups of different age. Thus, further research is necessary in this direction.

Sunlight contains ultraviolet (UV) radiations capable of stimulating vitamin D. Vitamin D works in the body by increasing the immunity to pulmonary TB, accelerating primary anti-TB drug (first line anti-TB drug – OAT) treatment and slowing the reactivation of the Mycobacterium tuberculosis (MTB) in the secondary infection. In fact, sunlight can reduce the transmission of TB in a household environment.[25] Indirectly sunlight exposure also eliminated MTB.

Historically, before anti-TB drugs were introduced, the treatment of pulmonary TB was performed by sunlight therapy named heliotherapy. Pulmonary TB sufferers were placed in sanatoriums after considering their nutrition status. The results of therapy after more than 6 months were obtained for up to 50% of pulmonary TB sufferer who did not show clinical symptoms before their first TB stage.[26,27]

Housing density. The results of statistical analysis on population density showed a $p < 0.005$ with OR < 1. This means that a low density level helped prevent childhood TB in children with adult TB household contacts. Conversely, children who lived in crowded houses were more vulnerable to infection by communicable diseases such as pulmonary TB. This can also cause psychological stress among children who are influenced by aggressivity that results in the physical abuse of weaker children.[5]

As natural of TB disease in children, it have been confirmed from previous studies that childhood TB can not transmitted their TB infection to another either for the other child (siblings, etc) or adult.[4,9] This is because children with TB can not cough, so they are not transmitted the MTB bacil by air-borne, and its diagnosis should be confirmed by scoring system.[28,29] In this study, childhood TB should not the response but it is the effect of housing density in particularly to let them exposed by the adult TB patients. However, this study can not present the exposure level or length of stay between adult TB patients with their household children. This factors is essential for further research to recommend

However, further analysis was performed in order to assess housing density probability. The population environment cannot be ignored in housing factors as social determinants of health. These characteristics had already been implemented in investigations of public health epidemiology, especially for correlations with communicable diseases.[6] This factor was grouped into three sub-sections: area characteristic, internal condition, and type of housing. Area characteristics influenced the health in many ways[30], such as spatial analysis.

Group clustering in the study population aimed to reveal whether adult pulmonary TB sufferers who shared a house with child TB patients had clustered or random distribution patterns. This was revealed using the nearest neighbor index (NNI). This index showed the degree of spatial distribution based on the distance between minimum coordinates or minimum distances between coordinates of the closest cases. Smaller or near null NNIs indicated either small distances between point coordinates or a clustered distribution pattern. NNI = 1 indicated a random distribution pattern and an NNI greater than 1 indicated a uniform distribution pattern.[6]

Conclusions

Socioeconomic status, especially high economic status, indirectly promoted children's health. However, it was not only population density in the house that needed to be considered, as the residences' environments also played important roles in protecting children from pulmonary TB disease when they lived in the same house as an adult pulmonary TB patient. Housing condition, especially bedroom illumination, was a protective factor that could be influenced by intervention. Sunlight and ventilation prevented children from developing pulmonary TB, as these promote children's immune systems and vitality. Other reversible or easily-intervented factors for certain population settings need to be understood. Also, continuity in active case finding (e.g., contact tracing) is very important, particularly with respect to TB resistance, which is a danger not only for adults but also for children, who are not only vulnerable but also in greater danger of mortality.

Conflict of Interest Statement

None declared.

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