
FACTORS ASSOCIATED WITH BCG SCAR OF PEDIATRIC TUBERCULOSIS PATIENTS AT PISANGAN AND EAST CIPUTAT COMMUNITY HEALTH CENTERS**Farsida^{1*}, Ayu Farah Syifa¹, Azka Zifa Tanama¹**¹Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta*Correspondence email: farsida@umj.ac.id

ABSTRACT

Tuberculosis (TB) is one of the most common cause of death happened in children. Prevention of TB through Bacille Calmette–Guérin (BCG) vaccination is an action to produce immunity against TB disease. After vaccination, a scar forms from the boil, which indicates a successful vaccination. This research aims to determine the factors that can be associated with BCG Scar in pediatric TB patients. A cross-sectional design was conducted at the Pisangan and East Ciputat Community Health Centers in January-September 2020. Data collection using medical records and telephone interviews on 35 samples was taken using the probability sampling technique, simple random sampling. With inclusion criteria for pediatric TB patients (0-18 years) and exclusion criteria that do not include telephone numbers and addresses. Bivariate analysis was used with the chi-square test. The results showed a significant relationship between contact history and BCG scars in pediatric TB patients. Age, gender, nutritional status, exclusive breastfeeding, immunization, mother's education, parent's occupation, family income, and smoking history were not significantly related to BCG scar. Contact history related to BCG scar. Parents should be giving more attention to and protect their children from the people around them to cut off the chance of contact with TB sufferers even though the child has been vaccinated.

Keywords: Child TB; Contact History; Scar BCG

INTRODUCTION

Tuberculosis (TB) is one of infectious disease that has becoming the leading to ill health, TB also becoming one of the top 10 disease that causes of death globally, moreover TB got ranked above HIV/AIDS as the cause of death from a single infectious agent. The bacillus *Mycobacterium tuberculosis* is the caused that made TB happened, this bacillys spreads everytime a person with TB expels bacteria to the air especially when they cough. Globally in 2019, estimated 10.0 million people in range of 8.9-11.0 had TB. This number has declined quite slowly in the recent years. In 2019 accounted 12% of children (aged <15 years) developed TB. Indonesia occupies the second position with the highest TB cases globally, with 543,874 cases in 2019.¹ In the same year in Banten province, there were 3,123 TB cases in children 0-14 years old.²

The Bacille Calmette–Guérin (BCG) vaccine is one of the common intervention to control and preven TB infection for children. This vaccination can give protection in children from severe forms of TB. A scar will form after the BCG vaccination, which indicates a successful BCG vaccination. If a boil doesn't form, it doesn't mean that the BCG vaccine didn't work or that protection didn't form, so there's no need to repeat it even if a boil or scar doesn't form.³

Children who were vaccinated with BCG and had scars overall had better survival than children vaccinated with BCG and had no scars.⁴ One of the essential marker to show a proper functioning immune system is scar BCG. Inexpensive and direct initiatives such as early BCG vaccination, BCG scar tissue monitoring, and revaccination of scar-negative children can directly impact child survival worldwide.⁵

Children who have scars are said to have fewer skin infections and sepsis, and this is because BCG is a type of non-specific immune stimulator. It is confirmed by a recent research that BCG produces a Th1 immune response at birth. It is also associated with mortality, which is 45-55% lower during the first year and a half of life than those without scars.⁶

There is a relationship between the incidence of TB infection and the BCG vaccine scar formation. In Rosandali's study, people who did not have BCG scars were more common in TB patients.⁷ BCG scar readings have been used as an indicator of vaccine status and are becoming standard practice for assessing the protective effect of BCG in retrospective studies. A BCG scar has been an indication of protection against TB. However, more than fifty percent of the research population with BCG scars were infected with TB.⁵ Based on this, researchers are interested in knowing the factors associated with BCG Scar in pediatric TB patients.

MATERIAL AND METHODS

This study used a descriptive type of research using a cross-sectional design. This research was conducted at the Pisangan and East Ciputat Health Centers from January to September 2020. The sample was selected using a probability sampling technique of simple random sampling with a total of 35 samples. The number of samples is calculated by the Slovin formula:⁸

$$n = \frac{N}{1 + Nd^2}$$

Inclusion criteria in this study were pediatric TB patients (aged 0-18 years) and willing to participate in the study. The exclusion criteria are respondents who do not include telephone numbers and addresses. The research instrument used a questionnaire to obtain data on age, gender, TB contact history, nutritional status, immunization status, history of exclusive breastfeeding, BCG vaccination scars, economic status, mother's education, parent's occupation, smoking history in parents taken via phone.

Assessment of nutritional status based on weight indicators for age (weight/age). The secondary data used are medical records of pediatric patients with TB who have been vaccinated against BCG. The data were with univariate and bivariate analysis with a chi-square test, which was processed using SPSS 21.0 program.

RESULT

This study was conducted on 35 respondents of children aged 0-18 years with a diagnosis of TB who were treated with OAT at the Pisangan and East Ciputat Health Centers. The results showed that the characteristics of respondents based on age, children aged > 6-18 years were more (60.0%) compared to those aged six years, 62.9% were male and 37.1% female. The data also showed as many as 48.6% of respondents had normal nutritional status, 28.6% were undernourished, 5.7% were malnourished and overweight, and 11.4% were obese. Respondents with a history of exclusive breastfeeding for six months were 82.9%, most of the respondents had received complete immunization as many as 82.9%, respondents had a history of household contact as much as 34.3%, 22.9% not at home and unknown contacts 42.9%. Respondents with positive BCG scars were more (80.0%) than negative BCG scars (Table 1).

Characteristics of parents obtained that as many as 62.9% have higher education, mothers who do not work as much as 77.1% more than mothers who work, fathers who work as laborers 42.9% more than work as employees 20.0% and self-employed 37.1%, family income 62.9% have income \geq minimum wage (UMP). Also, parents have a history of smoking is higher than those not smoking as much as 62.9% (Table 1).

Table 1. Child and Parental Characteristics (n=35)

Variable	N	%
Child Characteristics		
Age		
≤ 6 years	14	40.0
> 6-18 years	21	60.0
Sex		
Boys	22	62.9
Girls	13	37.1
Nutrition Status		
Several underweight	2	5.7
Underweight	10	28.6
Normal	17	48.6
Overweight	2	5.7
Obesity	4	11.4
Exclusive Breastfeeding History		
< 6 months	6	17.1
≥ 6 months	29	82.9
Immunization Status		
Incomplete	6	17.1
Complete	29	82.9
Contact History		
Household	12	34.3
Not at home	8	22.9
Unknown	15	42.9
Scar BCG		
Negative	7	20.0
Positive	28	80.0
Parental Characteristics		
Mother's Education		
Low	13	37.1
High	22	62.9
Mother's Occupation		
Employee	8	22.9
Housewife	27	77.1
Father's Occupation		
Laborer	15	42.9
Employee	7	20.0
Entrepreneur	13	37.1
Family Income		
< Minimum wage (UMP)	13	37.1
≥ Minimum wage (UMP)	22	62.9
Smoking history		
Yes	22	62.9
No	13	37.1

Based on the results of bivariate analysis (Table 2), children aged six years with negative BCG scars (42.9%) and positive BCG scars (39.3%) were fewer than children aged > 6-18 years. The analysis results showed no significant relationship between

the age of the child and the BCG scar (p-value 0.594). Girls had more negative BCG scars (57.1%) than boys (42.9%), but boys had more positive BCG scars (67.9%) than girls (32, 1%). The results of the chi-square analysis showed that there was no significant relationship between sex and BCG scars (p-value 0.214). Children with underweight have more negative BCG scars (57.1%) than children with normal nutrition (42.9%). Normal status has more positive BCG scars (71.4%) than children with underweight (28.6%). The results of the chi-square analysis showed that there was no significant relationship between nutritional status and BCG scars (p-value 0.163).

Children with a history of exclusive breastfeeding had a higher negative BCG scar (85.7%) than non-exclusive (14.3%), as well as a positive BCG scar in children with a history of exclusive breastfeeding, which was higher (82.1%) than non-exclusive (17.9%). The results of the chi-square analysis showed that there was no significant relationship between a history of exclusive breastfeeding and BCG scars (p-value 0.656). Children with complete immunization had negative BCG scars as many as seven people (100.0%), while children with incomplete immunizations did not have negative BCG scars. Children who were fully immunized had more positive BCG scars (78.6%) than children who were not fully immunized (21.4%). The results of the chi-square analysis showed that there was no significant relationship between immunization status and BCG scar (p-value 0.232). Respondents with a history of household contact as 42.9% and 57.1% did not have a negative BCG scar. Respondents with positive BCG scars who account for household contact are 32.1%, 14.3% are not at home, and 53.6% are unknown contacts. The results of the chi-square analysis showed that there was a significant relationship between contact history and BCG scars (p-value 0.015). Based on the characteristics of parents, mothers with higher education have more children with negative BCG scars (57.1%) than mothers with low education (42.9%).

Table 2. Factors associated with Scar BCG

Variable	Scar BCG (-)		Scar BCG (+)		p-value	OR	CI 95%
	N	%	N	%			
Age					0.594	1.159	0.216-6.207
≤ 6 years	3	42.9	11	39.3			
> 6-18 years	4	57.1	17	60.7			
Sex					0.214	0.400	0.065-1.933
Boys	3	42.9	19	67.9			
Girls	4	57.1	9	32.1			
Nutrition Status					0.163	3.333	0.605-18.371
Underweight	4	57.1	8	28.6			
Normal	3	42.9	20	71.4			
Exclusive Breastfeeding History					0.656	0.767	0.075-7.860
< 6 months	1	14.3	5	17.9			
≥ 6 months	6	85.7	23	82.1			
Immunization Status					0.232		
Incomplete	0	0.0	6	21.4			
Complete	7	100.0	22	78.6			
Contact History					0.015*		
Household	3	42.9	9	32.1			
Not at home	4	57.1	4	14.3			
Unknown	0	0.0	15	53.6			
Mother's Education					0.525	1.35	0.250-7.278
Low	3	42.9	10	35.7			
High	4	57.1	18	64.3			
Mother's Occupation					0.516	1.467	0.226-9.534
Employee	2	28.6	6	21.4			
Housewife	5	71.4	22	78.6			
Father's Occupation					0.219		
Laborer	5	71.4	10	35.7			
Employee	1	14.3	6	21.4			
Entrepreneur	1	14.3	12	42.9			
Family Income					0.475	0.618	0.102-3.765
< UMP	2	28.6	11	39.3			
≥ UMP	5	71.4	17	60.7			
Smoking history					0.475	1.618	0.266-9.852
Yes	5	71.4	17	60.7			
No	2	28.6	11	39.3			

More children with mothers with higher education (64.3%) than children with low maternal education (35.7%) with positive BCG scars. The results of the chi-square analysis showed that there was no significant relationship between maternal education and BCG scar (p-value 0.525). Mothers who do not work have more children with negative BCG scars (71.4%) than working mothers (28.6%). Likewise, the positive BCG scar of the children with mothers who do not come to work is higher (78.6%) than children with mothers who work (35.7%). The results of the chi-square analysis showed that there was no significant relationship between the mother's occupation and BCG scar (p-value 0.516).

Fathers who work as laborers have more children with negative BCG scars (71.4%) than fathers who work as employees and entrepreneurs. Meanwhile, fathers who work as entrepreneurs have children with positive scars (42.9%) more than those who work as laborers and employees. The results of the chi-square analysis showed that there was no significant relationship between the father's occupation and BCG scar (p-value 0.219). Families with income ≥UMP have more children with negative BCG scars (71.4%) than income <UMP (28.6%). Likewise, positive BCG scars for families with income ≥UMP more (60.7%) than income <UMP (39.3%). Parents who have a history of

smoking have children with more negative BCG scars (71.4%) than parents who do not have a history of smoking (28.6%). Likewise, the positive BCG scars of parents who had a

history of smoking were higher (60.7%) than parents who had no history of smoking (39.3%) (Table 2).

DISCUSSION

Child Characteristic

In this study, the age of respondents with the highest incidence of TB was respondents aged six years and over. In contrast to the research by Brajadenta et al. (2018), from 160 children diagnosed with TB, 83 children were aged 0-5 years, while 77 other children were aged 5-14 years.⁹ In Indonesia, TB is one of the most common causes of mortality and morbidity in children. Children are very susceptible to TB infection. Children aged five years have a greater risk of developing TB infection because of their cellular immunity in their age is not fully developed (immature).¹⁰

A cellular adaptive immune response provided by the ability of *Mycobacterium tuberculosis* to survive intracellularly. It is played by specific T cells in order to defend against TB. B cells, T Follicular B helpers, T regulators, restriction CD1, CD8+, CD4+, Th1, Th2, and Th17 are giving response to Bacillus of Calmette and Guerin (BCG) immunization as the adaptive immune response.¹¹ Current childhood TB infection represents a future source of TB disease.¹²

There are more TB patients in boys than girls. This study is in line with previous research, which stated that the gender of children with TB was more common in boys than girls.^{13,14} This is different from the research conducted by Permatasari and Trijati (2014), which stated that the sex research results in TB in children were mostly female.¹⁵ Based on the Indonesian Health Profile, the number of TB cases in Indonesia in 2019 was 543,874 cases. Compared with women, the number of TB cases in men is 1.4 times higher in all provinces.² Men are more susceptible to TB than women because men have higher mobility and activity than women, so they are more likely to be exposed.¹⁵ This is associated with psychological factors, emotions, and growth

and development. There is a tendency to be more active than girls than boys. The risk of exposure to tuberculosis germs is greater in boys who play a lot or do activities outside the home, making it difficult to control.¹⁶ TB cases in men have a risk of 1,311 times compared to women if it is associated with smoking habits in men. In almost all developing countries, smoking prevalence is more than 50% in men compared to women.¹⁷ People who smoke can lower the body's immunity to be more susceptible to TB.¹⁸

The majority of respondents have normal nutrition, followed by underweight, then obesity, after that several underweight and overweight have the same value. This study is in line with Windy Rakhmawati et al. (2011), which stated that from 74 respondents, 58 children experienced good nutritional status.¹⁹ This is different from the research by Putra & Amelia (2013), which stated that the majority of respondents with TB were children with poor nutritional status.²⁰ The condition of children with poor nutritional status makes it easier for children to be exposed to infectious diseases, including TB disease. Bodyweight is one of the parameters that give an idea of body mass. Body mass affects the changes, such as when exposed to infection. Nutritional status is closely related to individual problems because it is a predisposing factor that can exacerbate infectious diseases. When malnutrition can affect a person's immune system, a decrease in the body's immune system makes it easier for children to get infectious diseases, including TB disease.¹⁵

The results showed that most respondents were given exclusive breastfeeding for six months. According to Permatasari and Trijati's (2014) research, TB respondents who were not given exclusive breastfeeding were more than those who gave exclusive breastfeeding. Breast milk functions to increase the body's immunity,

fight germs that enter and can reduce serious illnesses. Infants who are not exclusively breastfed have a 9.19 times risk of TB disease than those who are solely breastfed.¹⁵

This description shows that a higher percentage of children have a history of contact, with 34.3% being household contacts. Children that has history of contact with adults has the main risk factor for children to get TB.¹⁰ Usually, children can become infected with TB after being exposed to adults who have pulmonary TB with a smear (+) result. This study indicates that the percentage of children with a history of TB contacts is smaller when viewed in Nurwitasari's study, which concluded that 87.5% of 24 children.²¹ However, the number of children with a history of contact is quite large, and the results are almost the same as other previous studies, namely the study of Putra and Amelia, which said that there were 30 out of 50 children (60%) who had a history of TB contact.²⁰ In contrast to the Noviarisa study, which showed that only a few children had a history of contact, about 43.9% of the 198 children.²²

In this study, there were more positive scars than negative scars, in contrast to the research of Rosandali et al. (2016). They found that children with TB had more negative scars than positive scars, and there was a significant relationship between the incidence of tuberculosis infection and the BCG vaccine scar formation.⁷ Scar formation after BCG vaccination indicates successful vaccination.²³ After BCG vaccination, children who have scars have better survival overall than children who do not have scars after vaccination.⁴ The effectiveness of BCG vaccination varies between 0-80%.²⁴ The evidence for the protective ability of BCG against childhood TB disease is not very consistent. Still, the results are quite good, ranging from 60-80%, both in developing and developed countries, for pulmonary TB and extrapulmonary TB, although higher levels of protection are found low in the tropics.¹⁰ Several factors affect the scar not forming, such as incorrect injection method/technique, lack of injection dose, poor vaccine

condition/quality, immunity and sensitivity of the child's skin, and the reaction of the child's immune system.²⁵

Parent Characteristic

Most of the patient's parents' last education was higher education, including senior high school and graduate degrees. According to Permatasari and Trijati's (2014) research, more respondents with higher education than those with low education stated no relationship between parental education and children's TB.¹⁵ In contrast to Putri et al. (2015), respondents with low education were more than those with higher education, which confidence a relationship between parental education and children's TB. Low education can affect the level of understanding of child care, such as care, feeding, and guidance to children, which impacts declining health.²⁶ The higher the education of parents, the easier it is to give an understanding of information to maintain the health of children. As in the case of TB, namely by monitoring nutritional intake, BCG vaccination, preventing contact with adult TB sufferers, and paying attention to and maintaining the home environment.⁹

It can be seen from the table of characteristics of parents by occupation that more mothers have the status of IRT. There are similar results from two previous studies, namely the research of Fauza and Riani, which said that more mothers did not have a job or were housewives (63.6%) compared to working mothers.^{27,28}

One of the risk factors that influence the incidence of TB in children is the parents' work status, especially if the child's mother is busy with her work. According to previous research, this is generally because working mothers have little time to spend with their children, so there will be less attention to children's health. In addition, if parents entrust their children to someone else, they will not realize that the person caring for their child has pulmonary TB.¹⁵ In this study, during the interview, several respondents said that the respondents did not know who their

children were in contact with when they were working.

Fathers of TB patients with children have more labor jobs, followed by self-employed and employee jobs. According to Putri et al. (2015), more respondents work than respondents who do not work. Parents' occupations are related to family income. Parents who do not work or whose income is not large can result in the child's nutritional status being less so that they are vulnerable to various diseases, one of which is TB. If the income of a large family is sufficient to meet the nutritional needs of children and children's nutrition can be guaranteed.²⁶

Family income obtained a higher percentage of respondents who earn > UMP. Economic factors are closely related to housing conditions, overcrowding, sanitation, and poor environment increasing TB transmission.²⁹ Lack of family income is also closely related to lack of nutritional intake, which can later lead to weak immunity. In addition, poor economic conditions can lead to a lack of education about TB disease and a lack of access to health services acceptable to patients. A study says that 78.8% (156 respondents) have low socioeconomic status. However, according to research by Permatasari & Trijati (2014), there is no significant relationship between economic status and the incidence of pulmonary TB in children under five.¹⁵

According to research by Samuel (2016), one of the important role in healing and general well-being from TB germ infection is nutrition. However, someone with a low economic status will suffer from high levels of malnutrition due to inadequate nutrition, which in addition to being a risk factor for developing TB disease, can also affect the outcome of TB treatment.³⁰

From this description, parents of children with TB patients with a history of smoking were more than those without a history of smoking. This study is in line with Puspitasari et al. (2015), which stated a history of smoking in parents of TB children in as many as 46 respondents, while there was no history of smoking in parents of TB

children in as many as 40 respondents. Children with smoking parents are said to be passive smokers. Secondhand smoke has a relationship with the development of TB disease. The effect can reduce lung function. Substances contained in cigarettes can impact immunity and body defense mechanisms.³¹

Factors associated with Scar BCG

Based on the results obtained from this study, children with negative scars in children with a history of non-home contact were more than household contacts, and there were no negative scars in children with unknown contacts. Children with positive scars were found in all children with unknown contact history and more than children with household and non-home contacts. There is a significant relationship between the history of contact with BCG scars. This shows the lack of vigilance of parents in controlling or caring for children so that they are exposed to TB sufferers. The parents assume that the scar formed due to the BCG vaccine indicates that the child will be immune to the infection.

In this study, age, gender, nutritional status, history of exclusive breastfeeding, immunization status, mother's occupation, father's occupation, family income, mother's education, and smoking history were not significantly related to BCG scars. A study found that the median scar size in the UK population is bigger than the scar size of BCG vaccination in the Malawian population that appeared three months after.³² In the study of Dhanawade et al., BCG scar formation was not significantly associated with age or gender. The age at which the vaccine was administered is also not always a determining factor in scar occurrence.³³ The results of this study are in line with previous studies, which stated that gender and nutritional status of children were not associated with BCG scars.³⁴ In the study of Amaruddin et al. (2019), it was shown that there was a significant relationship between socioeconomic status and the nutritional status of infants at birth with BCG scars after controlling for leptin levels.³⁵ BCG scars are a sign of better survival among children in

countries with high child mortality. BCG vaccination could affect the response to several major infections, one of that also includes malaria.³⁶

The limitation of this research is the data collection process using a questionnaire, so there is still the possibility that the respondents did not answer correctly. And the COVID-19 pandemic has prevented researchers from meeting with direct visits to patients' homes, so primary data was taken by telephone.

CONCLUSION

Contact history related to BCG scar in children. It is recommended for parents to pay more attention to and protect their children from the people around them to cut off the possibility of contact with TB patients even though the child has been vaccinated. Medical personnel should supervise/control the quality of the vaccine and the method/technique of injection. And see the scar marks as a successful BCG vaccination.

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