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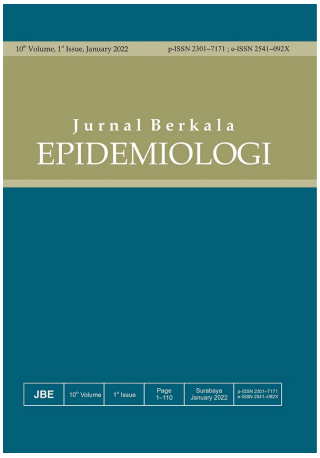

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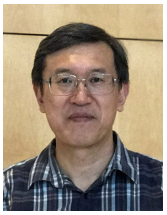

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ORIGINAL RESEARCH

NUTRITION AS A RISK FACTOR OF CHILD LEPROSY IN GRESIK DISTRICT 2019

Nutrisi Sebagai Faktor Risiko Kejadian Kusta Anak di Kabupaten Gresik Tahun 2019

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ABSTRACT

Background: Indonesia's annual increase in leprosy is a serious health problem. In east Java, child leprosy cases spread in several counties/cities, the number of new cases of child leprosy cases has been raised in Gresik District from 2015 until 2019. **Purpose:** This study analyzed characteristics, BCG vaccine status, nutritional status and home environment, the correlated risk factors to child leprosy in Gresik District. **Methods:** This study used a design population-based matched case-control design and analysis data using computer computing**.** The variables for this research were characteristics (age, sex, and education) and BCG vaccine status (BCG scar and without BCG scar), nutritional status classified as Body Mass Index (BMI)(normal and thin) and protein (albumin and Hb serum), and home environment (wall, ceiling, floor, humidity, ventilation, and density of occupancy). It was conducted in October 2019-February 2020 using a questionnaire, observation and measurements. The total sample was 36 respondents, of which the number of the case was 18, and the control was 18. Data were analyzed using the Logistic Regression method entered with a 95% CI and an OR. **Results:** Home environment had not correlated to leprosy cases of children. The completeness of BCG vaccine status correlated to children's leprosy cases (p=0.02). BMI had correlated to leprosy cases of children (p=0.01). The most influential variable was the completeness protein of albumin serum (Odds Ratio (OR) =9.10; 95%CI=1.11-41.44; p=0.01). **Conclusion:** The most dominant risk factor correlated with the incidence of leprosy is the serum albumin level.

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ABSTRAK

Latar Belakang : *Kasus kusta yang meningkat setiap tahunnya di Indonesia merupakan masalah kesehatan yang serius. Kasus kusta anak di Jawa Timur tersebar di seluruh Kabupaten/Kota, angka penemuan kusta anak di Kabupaten Gresik selalu ada sejak tahun 2015-2019.* ***Tujuan :*** *Penelitian ini untuk menganalisis karakteristik, status Imunisasi BCG, status gizi dan kondisi lingkungan fisik rumah sebagai faktor risiko yang berhubungan dengan kejadian kasus kusta anak di Kabupaten Gresik.* ***Metode :*** *Penelitian ini menggunakan desain kasus kontrol berpasangan berbasis populasi dan analisis data menggunakan komputasi komputer. Variabel dalam penelitian ini adalah karakteristik (umur, jenis kelamin, dan pendidikan), status Imunisasi BCG (ada scar dan tidak ada scar), status gizi yaitu* BMI (normal dan kurus) protein (albumin dan hemoglobin serum) *dan lingkungan fisik rumah (dinding, langit-langit, lantai, kelembaban, ventilasi, dan kepadatan hunian). Variabel terikat adalah anak penderita kusta. Dilakukan pada bulan Oktober 2019-Februari 2020 dengan menggunakan kuesioner menggunakan panduan wawancara, observasi, dan pengukuran. Jumlah sampel sebanyak 36 responden dengan jumlah kasus 18 responden dan jumlah kontrol 18 responden. Analisis data menggunakan Regresi Logistic metode enter dengan 95% CI dan OR.* ***Hasil :*** *lingkungan fisik rumah tidak berhubungan dengan kejadian kusta anak. Status Imunisasi BCG berhubungan dengan kejadian kusta (p = 0.02). BMI berhubungan dengan kejadian kusta (p = 0.01). Variabel yang paling berpengaruh adalah protein yaitu albumin serum dengan nilai p=0.01; Odds Ratio [OR], 9.10; 95% Confidence Interval [CI], 1.11-41.44.* ***Kesimpulan :*** *Faktor risiko paling dominan yang memiliki pengaruh paling besar terhadap kejadian kusta anak di Kabupaten Gresik adalah kadar albumin serum.*

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INTRODUCTION

Leprosy generally infected children at age less than 15 years old. This chronic infectious disease was caused by bacteria known as *Mycobacterium leprae* (*M. Leprae*). Leprosy cases are generally influenced by several risk factors such as incomplete child nutrition, BCG vaccine status, and historical contact with patients (Alotaibi et al., 2016).

Indonesia ranked third with 17.012 leprosy cases after India with 126.800 cases, and Brazil is the second with 34.894 cases has been arranged by the World Health Organization (World Health Organization, 2020).

East Java ranked first from 22 provinces with the highest leprosy cases. The number of children that were affected by leprosy persists in the endemic area in East Java the province with the highest in Indonesia. Gresik regency is considered one of the leprosy pocket areas leprosy of children were affected by leprosy in the Gresik District rate of the found of the new case has remained constant for five consecutive years from 2015 to 2019 (East Java Provincial Health Office, 2019).

The number of new cases of leprosy found in Gresik District in 2019 was used age 0-14 years old artificially seven people (7.61%) with 2 level disabilities (2.17%). The prevalence of leprosy in the Gresik District in 2019 was 0.72% per 10,000 population. Based on Venkatakrishman research, leprosy in children indicates an active transmission of leprosy through close contact with family and the environment (Venkatakrishnan, Thangaraju, Jeganathan, Sankaran, & Kannan, 2020).

M. Leprae can infect humans of all ages. Especially, it can infect children below 15 years

old who do not get essential vaccines (Santos, Penna, Costa, Natividade, & Teixeira, 2016). Children in the range of 5 to 7 years old are often infected by leprosy, but it was rarely found in infants under six months because of the passive immunity from their mother's placenta (Lee, Oh, Lee, & Finucane, 2015).

Understanding of leprosy and its risk factors should be noted. Low nutritional status is often observed in patients with low protein or backup energy within the body (Lee et al., 2015). Apart from nutritional factors, the determinants of disease spread are also determined by daily environmental conditions. The number of occupancy densities in a household can also be a factor in transmission (Barreto et al., 2017). The aim of this study was conducted to analyze risk factors related to child leprosy. It is also expected that this research could help terminate the chain transmission and accelerate the handling of child leprosy.

METHODS

The study used population-based matched case-control to analyze the relationship of characteristics, BCG vaccine status, nutrition, and home environment. The location of this study was in Gresik District from October 2019 to February 2020 with comparing group case and control. The sample was children from 3-14 years old with positively stated leprosy by the doctor. They are also stated in medical records in the Gresik Clinic District.

The case sample was children from 3 to 14 years old positively stated as leprosy from the doctor. The control sample was children from 3 to 14 years old that were not patients in the Gresik Clinic District. The value of the sample is as follows:

Lemeshow (1997)

$$n = \frac{\{Z\,1\text{-}\alpha/2\,\sqrt{[2p\,(1\text{-}P)]} + Z\,1\text{-}\beta\,\sqrt{[P1\,(1\text{-}P1) + P2\,(1\text{-}P2)\}^2}}{(P1 - P2)^2}$$

Note:
n = Minimum Sample
α = Level of significant (0.05)
β = Power (80%)
P2 = Control sample proportions
P1 = Case sample proportions

The author obtained a study sample of 18 people from the comparison of the case group, and the control group was 1:1. Then, we got the sample size is 36 people. The sampling decision was *probability sampling*. It was used to make the populations have the same chances to be chosen as samples.

The variables for the study were divided into two independent, namely variable and dependent variable. Independent variables were characteristics of research subjects such as age, sex, and education classification (elementary and junior levels). BCG vaccine status cut off in this study is (scar BCG and not scar BCG). The nutritional status calculation was conducted according to Asian BMI classification is (normal and thin). The albumin cut-off in this study was (3.50-4.80 g/dL). The Hemoglobin cut-off in this study was (13.50 g/dL). A home environment with each category eligible and not eligible. The walls of the houses that qualify were made of adobe, and those that do not qualify were made of wood. Meanwhile, the ceilings of qualified houses were made of gypsum, and those that do not qualify were plywood/asbestos. The house floor that qualifies was board/ceramics, and those that do not qualify were plaster. The humidity floor qualification was 40-60%, and those who did not qualify were < 40-60%. House ventilation qualifies was (≥ 20 m^2) and those do not qualify are (≤ 20 m^2). Density dwelling that qualifies was not fulfilled condition (≥ 4 m^2), and those do not qualify were fulfilled condition (≤ 4 m^2). The dependent variable was the child of leprosy.

The data collection for this study was an interview to the respondent using a questionnaire to get the characteristics information (age, sex, and education). The manual observation guide is to get BGG vaccines status. It can be seen whether or without scar BCG from child health book, measurements BMI using statue meter and environmental conditions of the physical ventilate with using roll meter, moisture using thermo-hygrometer, and the sample of protein for serum albumin and serum Hemoglobin (Hb).

Univariate analysis was used to know the frequency distribution for each variable conducted. Then, bivariate analysis was used to know whether or not there is a relationship between the dependent and independent variables. Data analysis includes descriptive statistics (frequency and Logistic Regression test). Results were considered statistically significant if p-values were < 0.05. Statistical analysis was performed with computer computing. All ethical issues had been reviewed according to the latest version of the clearance was obtained from the RSUD Dr.

Soetomo Surabaya on 19 November 2019, number 166/KEPK/XI/2019.

RESULTS

This study was conducted in February 2020 in Gresik District. Respondents who participated in this study amounted to 36 respondents by comparison between large sample cases and control 1:1, consisting of 18 people as the group case and 18 people as the control group. Variables used to identify characteristics were age, sex, and education level in a questionnaire in Gresik District in 2019. The results of the analysis of characteristics of the subject in Gresik District in 2019 saw in Table 1.

Based on the analysis of sex, the majority were 22 males (52.80%) because the majority of the population are male, as much as 654.925 people. Based on the education level analysis, the respondents were mostly education status at the elementary level was 19 (52.80%). Education affected the level of knowledge.

Variable identified BCG vaccine status was a practical guide. The result saw in table 1. In Table 1, known that of the results of the analysis of BCG vaccine status in Gresik District 2019, both cases and control is discovered that 23 children (69.40%) without BCG scar even their BCG vaccines because the access reached to health services is limited.

Variables that were used to identify nutrients are nutritional status based on anthropometry, serum albumin levels, and the haemoglobin serum in the form of a questionnaire in Gresik District 2019. The results of the nutrients analysis are presented in table 1. Based on table 1, analysis suggests that the nutritional status based on BMI from two groups of both the cases and the control group found that children with thin categories' nutritional status were 22 children (61.10%).

Based on protein analysis, the results of serum analysis showed that most of the serum albumin were within normal limits, as many as 19 children (52.80%). Based on the serum Haemoglobin (Hb) levels analysis, most of them were normal as many as 23 children (63.90%).

Based on the analysis results, the relation between environmental condition with status and leprosy can be seen in Table 4 with six variables in accordance with their needs to research the wall of a house. The ceiling, floors, the moisture, ventilation/window of a house, and the density dwelling become the essential points in this case.

Based on the result of the analyzed physical home, the environmental conditions in Gresik District was better than the control. The cases were as follows: for the presence of the wall of a house known that most material adobe and eligible were 34 (94.40%). The existence of the ceiling mainly made of material/ gypsum, and eligible was 27 (75.00%). The floors mainly made not eligible was 19 (52.80%). Condition humidity discovered that the humidity was not eligible 31 (86.10). The condition of the ventilation/window of a house to the control group known that the ventilation/window of the house primarily does not meet the requirement (≤ 20 m^2) was 25 (69.40%). The occupancy density that most were conditions not eligible was 28 (77.80%). The criteria for the ineligible broad room is when each person has (≤ 4 m^2) space/people. The relation between physical home, the environment and leprosy can be seen in Table 1.

This report was written in the Gresik district in 2019. For the cases in this research, children who were in 3-14 years old have been diagnosed by doctors based on medical data in hospitals, and the control group is the research of 3-14 years old that is not patient leprosy. School-age children tend to be greater interaction with others and the environment. Besides, they often interact with families, and neighbors also interact with school friends and teachers, which was sometimes they did not come from the village/the local area. It means the exposure to the bacteria *M.leprae* is higher. Based on the analysis results, the relation between the status of BCG vaccines status and leprosy can be seen in Table 1.

The analysis of correlations with the statistical regression logistics method was used to obtain the p-value for each nutritional status variable BMI and protein (albumin, and Hemoglobin (Hb). Based on the analysis of the relationship between nutritional status and leprosy, children can be seen in table 1.

Based on the nutritional status, BMI, it was obtained ($p = 0.06$), p-value <0.05 ($p<\alpha$), indicating that there was a relationship between the nutritional status of people in the year 2019 in Gresik District. It got the score of OR value or worth 7.86 it means children with nutritional status 7.86 lean times more risky afflicted with leprosy children than children with normal nutritional status.

The levels of serum albumin obtained was 0.00 or a value of ($p < \alpha$), indicating that there is a connection between levels of serum albumin in the leprosy children in Gresik District in 2019. It was

got the value OR worth 9.10 means children who have the level of albumin not normal (< 2,10- 3,40 g/dL) had 9.10 times more risk factors with leprosy child compared children who have normal levels of albumin (3,50- 4,80 g/dL).

P-value of levels of Hemoglobin (Hb) serum was 0.02 or value of ($p < \alpha$), indicating that there was a correlation between levels of Hemoglobin (Hb) serum in the leprosy children in Gresik district 2019. It was obtained OR value of 7.86, which means that children with abnormal Hemogloin (Hb) are 8 times riskier afflicted with leprosy than children is about Hemoglobin (Hb) normal.

P-value of environment for each variable of the walls of the house obtained the value of p value as much as 0.99. It indicated that there was no connection between the existence of the walls of the house with an occurrence of leprosy children in Gresik District in 2019. The presence of the ceiling obtained the value of p as much as ($p = 0.70$). It showed that there was no connection between the presence of the ceiling walls with the occurrence of leprosy children in Gresik District in 2019. The existence of the floor of a house obtained a value of ($p = 0.10$), indicating that there was no connection between the floors of a house with leprosy children in Gresik District in 2019. The humidity obtained value of ($p = 0.15$) indicated no connection between the leprosy children and the humidity in Gresik District in 2019. Ventilation obtained value of ($p = 0.28$) indicated no contact between/ventilation window of a house and the leprosy children in the Gresik District in 2019. The occupancy density obtained a value of ($p = 1.00$), indicating no connection between the occupancy and the leprosy children in Gresik District in 2019.

The selection of the most frequent factors from bivariate analysis determines the relationship between the dependent and independent variables. All the variables in this study can help them join bivariate analysis was a variable with the value of (p-value < 0.05) and variable whose enters by taking into account the proportion of cases and the substance of research was hypothesized. Based on table 1, the variable that has leverage with the high leprosy is the greatest children from the point of view of the value of OR the highest . The greater the value of a variable OR independent, the more variable large impact they may have on the high number of diphtheria children. In this study, it was discovered that ordinary serum levels are the most dominant factors that deal with leprosy in children in the Gresik District 2019.

DISCUSSION

Leprosy most often occurs in children aged 5-14 years old because they interact more with their family, neighbors, school friends, and teachers outside their villages/ residences. This matter is in line with Noordende et al. (2019) that school-age children increase the risk of being afflicted with leprosy because they are the most vulnerable and might spread the disease (Patmawati & Setiani, 2015). Another study argues that a strong indicator of the active source of child leprosy transmission can be seen from children under 15 years of age who contract leprosy in the environment (Barreto et al., 2017).

Boys are riskier in suffering from child leprosy than girls are because boys spend outdoor activities more often than girls do. Outdoor activities have a higher potential as a factor in transmitting leprosy. This research shows that boys have a higher risk of suffering leprosy than girls with 2:1 as transmitting ratio (Saha, Mandal, & Dutta, 2015).

The level of education is one factor that has a role in transmitting child leprosy. The level of education will affect the way of thinking, especially in understanding information. In another way, the education level cannot be separated from the learning process. Education also reported a similar finding that education is a processed form of efforts to understand the knowledge that can improve our health. Hence, it is expected that children can apply their knowledge from earned information into everyday life, especially regarding the prevention of child leprosy disease (Noordende et al., 2019).

Health matters mentioned that vaccine distribution is one way to prevent infectious disease. It is one of the priorities from the Health Ministry as a solid form and government commitment to the government to achieve (MDGs) significantly to reduce the child mortality rate. Vaccine distribution is expected as a vital effort to health precautions in the community. The vaccine distribution program is frugal and shows remarkable results in preventing infectious diseases (Mayangsari, Zulkarnain, & Setyaningrum, 2016).

Table 1.
Distribution characteristics of research subjects with the incident children leprosy in Gresik District 2019

Variable	Case		Control		Total		*p*	OR (95%CI)
	n	%	n	%	n	%		
Age (Year)								
> 3 - ≤ 5	8	44.40	9	50.00	17	47.2		1.35
> 5 - ≤ 12	6	33.30	5	27.80	11	30.6	0.93	0.29–6.18
> 12 - ≤ 14	4	22.20	4	22.20	8	22.2		
Sex								
Male	10	55.60	12	66.70	22	61.10	0.49	0.63
Female	8	44.40	6	33.30	14	38.90		0.16–2.41
Education Status								
Elementary Level	10	55.60	9	50.00	19	52.80	0.74	1.25
Junior Level	8	44.40	9	50.00	17	47.20		0.34–4.64
BCG Vaccine Status								
BCG scar	3	16.70	10	55.60	13	30.60		6.25
Without BCG scar	15	83.30	8	44.40	23	69.40	0.02	1.33–29.43
BMI								
Normal	3	16.67	11	61.11	14	38.90		7.86
Thin	15	83.33	7	38.89	22	61.10	0.01	1.65–37.40
Albumin								
Normal	5	27.80	14	77.80	19	52.80		9.10
Not Normal	13	72.20	4	22.20	17	47.20	0.01	1.11–41.44
Hemoglobin (Hb)								
Normal	8	22.2	15	41.7	23	63.90		6.25
Not Normal	10	27.8	3	8.3	13	36.10	0.02	1.33-29.43
Wall house								
Eligible	16	88.90	18	100.00	34	94.40		-
Not Eligible	2	11.10	0	0.00	2	5.60	0.15	0.19–1.00
Existence of the ceiling								
Eligible	14	77.80	13	72.20	27	75.00	0.70	0.74
Not Eligible	4	22.20	5	27.80	9	25.00		0.16–3.38
Existence of the floor in house								
Eligible	6	33.30	11	61.10	17	47.20	0.10	0.32
Not Eligible	12	66.70	7	38.90	19	52.80		0.08–1.24
Humidity								
Eligible	1	5.60	4	22.20	5	13.90	0.15	0.21
Not Eligible	17	94.40	14	77.80	31	86.10		0.02–2.51
Ventilation /Window of the house								
Eligible	7	38.90	4	22.20	11	30.60	0.28	0.45
Not Eligible	11	61.10	14	77.80	25	69.40		0.10–1.93
The density of occupancy								
Eligible	4	22.20	4	22.20	8	22.20	1.00	1.00
Not Eligible	14	77.80	14	77.80	28	77.80		0.21–4.81
Total	234	100.00	234	100.00	468	100.00		

Data from Gresik District Health Office in 2019 shows that the vaccine coverage to complement child BCG vaccine status is 90.74%. Some research done in Indonesia, especially in East Java, found that a child-leprosy-transmitting factor can be seen from imperfect coverage of the BCG vaccine program. It was in line with research Romero-Montoya, Beltran-Alzate, & Cardona-Castro (2017), which said that the coverage for BCG vaccine needed to be increased to reduce transmitting child leprosy. This research was also supported by some research done in Colombia in 2017. Without BCG vaccine status, history would affect the transmission of child leprosy with higher risk than the one with BCG vaccine and scar BCG status (Richardus et al., 2019).

The results showed that 22 children with nutritional status were classified as thin. It shows that children have a nutritional status in the underweight category seen from the food intake that is less than the nutritional adequacy rate assessed from the food recall. There is a disruption in protein-energy intake in malnutrition conditions that significantly impairs immunity. It is in line with Wagenaar et al. (2015), who thought that child malnutrition was caused by a lack of energy, protein, and vitamins. Lack of intake causes immunity depletion, so the risk of catching diseases is higher. Another study was in line that adequate food intake was the key to forming Th1 immunity in leprosy reactions. Therefore, underweight children cannot enhance immunological responses hampered so the leprosy reaction will easily enter the body (Lobo, Aithal, & Raj, 2019).

The results showed that albumin levels are not normal were indicated that the abnormal albumin rate was higher in the case group than in the control group. It is due to insufficient food intake, so a decrease in serum albumin levels indicates protein deficiency in the body and is a sign of malnutrition. One factor that can cause changes in the concentration levels of albumin in the body is malnutrition. The level measurement of albumin serum is often used to indicate the nutritional status and health level so that can be used to detect any malnutrition in the body (Soedjana, Bowo, Putri, & Davita, 2020). Thus result was in line with research by Oliveira, Sousa, Araujo, Aarão, & Quaresma (2017) that in some patients with type Mb leprosy was more experienced in patients who have abnormal serum albumin levels. This condition is exacerbated by malnutrition due to insufficient intake of calories and protein so that it has a strong relationship as a factor of death, namely tuberculosis, lung, severe anemia, leprosy, and weight loss among HIV-infected people.

Examination in Hemoglobin level (Hb) serum is also often done as one of the tests that can indicate any anemia condition and malnutrition, resulting in reduced nutrition status (Marks, 2016). The results showed that abnormal Hemoglobin (Hb) serum levels were higher in the case group than in the control group, indicated that malnutrition occurred in children because food intake was not fulfilled. The study by Amalia, Tabri, Vitayani, & Petellongi (2017) argued that Hemoglobin (Hb) serum levels were found in the high-risk group in leprosy patients compared to hemoglobin levels in the control group. Leprosy patients of children with food intake that is less than the nutritional adequacy rate compared to the control group who have higher hemoglobin levels with good food intake. Nutrition plays a role in the formation of red blood cells (erythropoiesis), which is needed for the erythropoiesis process to prevent infectious diseases.

The results of the study on the condition of the home environment can be seen that most of them in Gresik still do not fulfil the qualifications. Based on the research results on the air sanitation condition, it can be seen that they are in the poor category. It does not meet the qualifications so that the environmental results are not related to the incidence of leprosy in children. This is due to the absence of a physical environment in both the case and control groups due to relatively homogeneous socio-economic conditions. They are in a low condition where this research has been carried out. People with low socioeconomic status usually have low nutritional status and low health knowledge. Therefore, the environmental health and health conditions are also poor (Venkatakrishnan et al., 2020).

The final connection result was that higher OR was variable with higher influence in child leprosy occurrence. That variable was serum albumin level (Cederholm et al., 2015). This discussion was under the research by Thalacker-Mercer, Johnson, Yarasheski, Carnell, & Campbell (2007), who argued that serum albumin level examination could be used as markers for assessing nutritional status. The advantage of this examination as a means for diagnosis of malnutrition is that this examination is very affordable.

Another study argues that the decrease in serum albumin levels conducted in children with malnutrition caused by lack of food intake and kwashiorkor condition has slower protein damage in the body. Serum albumin level examination is not a good indication of malnutrition, especially for patients with chronic disease (Bawazir, 2020).

CONCLUSION

BCG vaccines status and nutritional status (BMI and protein) are related to the incidence of leprosy in children in Gresik. The most dominant risk factor that has a greater influence on the incidence of leprosy is the serum albumin level. The albumin levels was not normal. It is due to insufficient food intake so that a decrease in serum albumin levels is an indication of protein deficiency in the body and is a sign of

malnutrition. One factor that can cause changes in the concentration levels of albumin serum in the body is malnutrition.

The following study can change from a case-control research method to a cohort research method to increase the causality aspect for the subsequent research. We are looking forward to other in-depth studies that used observation between nutritional status with serum albumin level to child leprosy occurrence can be done with intervention to improve nutritional quality.

CONFLICT OF INTEREST

None.

AUTHOR CONTRIBUTION

IF: writing and original draft preparation. FR: reviewing and editing. CR: draft preparation, conceptualization, methodology, and validation data. KH: methodology and draft preparation. BU: methodology, validation data, and software. TM: data curation, validation data, and software. AS: validation and investigation.

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