Analysis of Demographic, Socio-Economic and Biological Factors With the Incidence of Leprosy in Bombana Regency Southeast Sulawesi Province

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Abstract

Leprosy is an infectious disease caused by *Mycobacterium leprae*. This study aimed to know the risk factors of leprosy events in Bombana Regency in 2020. This study was an observational analytic study with case control study design. The sample of this study was all population of Bombana Regency in 2020. The case sample was the population diagnosed in the Leprosy Reporting Information System information reported by the Bombana Regency Health Office during 2017 to 2019, while the control sample was undiagnosed leprosy with *matching* based on age and gender. The total sample was 122 people (61 cases and 61 controls). Control sampling with *systematic random sampling*. Data analysed using by the STATA computer program with *odds ratio* test and multiple logistic regression. The results showed that BCG immunization (OR = 5.74, 95% CI = 1.95-16.89) and income (OR = 3.35, 95% CI = 1.34-8.38) were risk factors for occurrence leprosy, while population migration variables, education level, and humidity are not significant risk factors for leprosy. The study concluded that BCG immunization and income are risk factors for leprosy. The variable most at risk for leprosy is BCG immunization.

Keywords: *Leprosy, demographic factors, socioeconomic factors, biological factors*

Introduction

Leprosy is a chronic infectious disease caused by the bacteria *Mycobacterium leprae*[1].This disease attacks the skin, peripheral nerves, upper respiratory tract mucosa and eyes. Leprosy rarely causes death, but the poor management cases of leprosy can cause leprosy to be progressive, causing permanent damage to the skin, nerves, limbs, and eyes[2]

World Health Organization (WHO) reported the number of new leprosy patients by the end of 2018 in all regions is 208,619 cases (*case detection rate* (CDR) 2.74 per 100,000 population) and the number of patients still registered for treatment is 184,212 cases (prevalence 0.24 per 10,000 population), with a grade 2 disability rate of 1.6 per 1,000,000 population and the number of cases of children among new cases reaching 16,013 cases (0.79 per 100,000 children)[3]

Indonesia based on the number of sufferers was the third ranked in the world after India and Brazil. The prevalence of leprosy in 2019 is 0.75 per 10,000 population (target <1 per 10,000 population), the number of new leprosy cases is 6.04 per 100,000 population (target <5 per 100,000 population), level 2 disability is 3,35 per 1 million population (target <1 per 1 million population) and the proportion of leprosy in children in 2019 of 10.74% of total new cases (target <5% of total cases)[4]

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Indonesia has reached the national level of leprosy elimination (prevalence rate <1 per 10,000 population) in 2000. While at the provincial level, in 2019 there were 8 provinces that had not yet achieved leprosy elimination. Southeast Sulawesi Province in 2019 has reached the status of leprosy elimination[4].

The prevalence of leprosy cases in 2019 in Southeast Sulawesi Province was 0.93 per 10,000 population, the number of new leprosy case findings was 7.88 per 100,000 population, the level 2 disability rate was 2.22 per 1 million population and the proportion of leprosy cases in children was 2.82%[5]

Achievement of leprosy elimination in a province is not always directly proportional to the achievement in the regency/city in a province that has achieved leprosy elimination. Bombana Regency is one of the leprosy endemic districts and does not include districts that have achieved leprosy elimination in the Southeast Sulawesi Province.

Data from the Bombana Regency Health Office shows the prevalence of leprosy in 2019 of 1.03 per 10,000 population, the number of new leprosy case findings of 8.13 per 100,000 population with all multibacillary cases (MB), the proportion of leprosy cases in children by 7%, the proportion of cases level 2 disability of 7%[6]

The data above showed that leprosy is still a problem in Bombana Regency. A high proportion of *multibacillary* leprosy (MB) cases indicates a late detection in the community. In addition, the proportion of cases of leprosy in children is still above 5% which means there are hidden sources of transmission and high rates of transmission in the community[7] Allegedly there are leprosy patients who have not been detected so that the available data is still smaller than the actual number.

Bombana Regency has tried to control leprosy. However, in recent years the prevalence of leprosy is still quite high. Therefore, it should be important to know about the factors that contribute to the risk of leprosy in arranging strategies and interventions targeted at early detection and *treatment* of at-risk populations[8]. If the risk factor for leprosy is still unknown, the intervention program intervention given is not on target, so that the transmission of leprosy can continue. This study aims to determine the risk factors for leprosy in Bombana Regency in 2020.

Materials and Methods

This study was an observational analytic with case control design. The study took place in Bombana Regency, Southeast Sulawesi Province. The sample of this study was all population of Bombana Regency in 2020. The case sample was the population diagnosed in the Leprosy Reporting Information System information reported by the Bombana Regency Health Office during 2017 to 2019, while the control sample was undiagnosed leprosy with *matching* based on age and gender. The total sample was 122 people (61 cases and 61 controls). Control sampling with *systematic random sampling*. Data collected by using a questionnaire. In addition, humidity measurements using a *thermohygrometer*, lighting using a *luxmeter* and ventilation using a meter on the respondent's house. Data analysis performed was univariate with frequency distribution, bivariate with *odds ratio* (OR) and multivariate with multiple logistic regression.

Findings

Table 1 The risk of Variable of Leprosy

Variable	Case		Control		Total		p	OR 95%CI
	n	%	n	%	n	%		
Demography Factor								
Migration								

Cont... **Table 1 The risk of Variable of Leprosy**

High risk (migration)	20	32.8	12	19.7	32	26.2	0.099	1.991 0.8-5.0
Low Risk	41	67.2	49	80.3	90	73.8		
Social Economic Factor								
Income								
High Risk (<Minimum Average)	52	85.2	37	60.7	89	73.0	0.002	3.747 1.4-10.1
Low Risk (≥Minimum Average)	9	14.8	24	39.3	33	27.0		
Education								
High Risk (<Junior High School)	46	75.4	37	60.7	83	68.0	0.080	1.989 0.8-4.6
Low Risk (Senior High School/College/ University)	15	24.6	24	39.3	39	32.0		
Biological Factor								
BCG								
High Risk (never had BCG)	56	91.8	39	63.9	95	77.9	0.000	6.318 2.0-22.8
Low Risk (had BCG)	5	8.2	22	36.1	27	22.1		
Humidity								
High Risk	24	39.3	12	19.7	36	29.5	0.017	2.648 1.0-6.5
Low Risk	37	60.7	49	80.3	86	70.5		

Table 2 Multivariate Analysis Result of Leprosy

Variable	**Odds Ratio (OR)**	**Std.error**	**z**	**p>|z|**	**95% Conf. Interval**	
					LL	**UL**
Education	0.418	0.257	-1.41	0.158	0.125	1.400
Income	3.658	1.916	2.48	0.013	1.310	10.216
Migration	1.521	0.713	0.90	0.370	0.607	3.814
BCG	9.246	6.839	3.01	0.003	2.169	39.407
Humidity	1.750	0.809	1.21	0.225	0.707	4.330
Constant	0.088	0.057	-3.73	0.000	0.024	0.315

Table 1 and 2 shows that respondents who were at high risk (had migrated) had more leprosy (32.8%) compared to those without leprosy (19.7%). The *OR* results were 1.991 (95% CI = 0.809 – 5.017). This means that respondents who have migrated have a risk of leprosy 1,991 times greater than respondents who have not migrated.

Respondents with a high risk category (having income less than UMR) had more leprosy (85.2%) compared to those without leprosy (60.7%). *OR* test results obtained a value of 3.747 95% CI = 1.459-10.165). Thus, respondents with income less than UMR have a risk of suffering from leprosy 3.747 times bigger than respondents with income more than UMR.

Respondents with a high risk category that has education level below junior high school suffer more leprosy (75.4%) compared to those who do not suffer from leprosy (60.7%). The *OR* test results obtained values of 1.989 (95% CI = 0.855-4.681). This means that respondents with a low level of education (junior high school and below) are at risk of suffering from leprosy 1.989 times greater than respondents with a high level of education (high school/college).

Respondents with a high risk category (not immunized with BCG) had suffered more leprosy (91.8%) compared to those without leprosy (63.9%). *OR* test results, obtained a value of 6.318 (95% CI = 2.066-22.881. So that, the respondents who have never received BCG immunization have a risk of leprosy 6.318 times bigger than those who have received BCG immunization.

Respondents in the risk category (humidity of the respondent's house did not meet the requirements) had suffered more leprosy (39.3%) compared to those who did not have leprosy (19.7%). *OR* test results obtained 2,648 (95% CI = 1.096-6.573). So that, respondents who have a house humidity that does not qualify have a risk of suffering from leprosy 2.648 times greater than respondents who have a house humidity meet the requirements.

Based on LL dan UL value, we took conclusion that the risk factor for leprosy were income, BCG immunization, and humidity.

Table 3 Multivariate Analysis Result of Leprosy

Variable	Odds Ratio	Std.error	z	p>|z|	95% Conf. Interval	
					LL	UL
Income	3.355	1.567	2.59	0.010	1.343	8.383
BCG	5.749	3.161	3.18	0.001	1.956	16.891
Constant	0.099	0.061	-3.72	0.000	0.029	0.335

Table 3 shows that the results of statistical tests conducted by multiple logistic regression obtained variables that are risk factors for leprosy are BCG immunization and income ($p < 0.05$) (table 4). While the population migration variable, education level and humidity are not significant risk factors for leprosy ($p > 0.05$) (table 4). The variable most at risk for leprosy is BCG immunization (OR = 5.74)

Discussion

This study concludes that immunization is the most influential risk factor for leprosy in Bombana Regency. Although it is known as a vaccine against tuberculosis, BCG is also able to protect against leprosy, especially if it is given to leprosy household contacts[9]. This study is in line with research which states that BCG immunization status has a significant influence on new leprosy cases[10]. Other research also shows that the dominant risk factor for leprosy in Lamongan Regency is BCG immunization[11].WHO reports that BCG immunization is effective in preventing leprosy[12]. Other studies have found that BCG immunization in people without leprosy signs and symptoms is very important because it has an additional protective effect[13]

The protective effect of BCG immunization on uninfected people ranges from 10-80%[14]. The combination of drugs (chemoprophylaxis) and BCG immunization can eliminate *Mycobacterium leprae* in the host (by increasing TNF-α and IL12 levels, activating macrophages), and can reduce the risk of recurrence in patients who have finished treatment[14]

The results of this study show that income is a risk factor for leprosy in Bombana Regency. The results of this study are in line with research conducted by Monteiro et al in Brazil found that the incidence of leprosy was higher in poor groups who did not receive income support programs[15]. Other studies conducted by Grantz et al. in India found evidence of a relationship between poverty and the number of new leprosy cases at the regency level[16]. Oktaria et al. found that someone with unstable income was five times more at risk for leprosy[17]. Per capita income is closely related to food consumption expenditure. Lack of food consumption can cause inadequate nutrition. *Mycobacterium leprae* is an intracellular microorganism, therefore cell-mediated immune responses are very important in the defense of human hosts. Inadequate nutrition is associated with decreased immunity[18] It was also reported that many leprosy patients were diagnosed early in areas with good health services. Socioeconomic differences not only affect the access, but also the quality and utilization of health services[19]

Humidity measurements are considered to meet health requirements if the measurement results show a value of 40%-60%[20]. The results of this study indicate that humidity is a risk factor for leprosy in Bombana Regency. *M.leprae* bacteria live in dry nasal secretions at 36.7 ºC with 77.6% humidity. In addition, *M.leprae* can live outside the host and can last 7-9 days with 70.9% humidity. *Systematic review* conducted by de Souza VALOIS, CAMPOS, and IGNOTTI found that factors such as temperature and humidity can influence the dynamics of *M. leprae*[21]. A cohort study conducted by Lavania et al. found that positive PCR results were found for *M. leprae* in the highest nasal cavity during the rainy season when humidity was high[22]. Transmission of *M. leprae* is more frequent in humid conditions when nasal secretions are more numerous. The incidence of leprosy is usually high in hot and humid tropical and subtropical regions[23]. Conditions of humidity that do not meet the requirements can result in the survival of the *Mycobacterium leprae* bacteria in the air and increase the likelihood of transmission to families who are in a shared room.

Conclusions

This study concludes that BCG income and immunization are risk factors for leprosy. Meanwhile, population migration, education level and humidity are not significant risk factors for leprosy. The most risk factor for leprosy is BCG immunization. It is hoped that the government will make interventions in at-risk populations and can build cross-sectoral commitments to support lepers who are physically and economically incapacitated, for health workers to improve education on leprosy and the importance of complete basic immunization in the community, for the community is expected to ensure their children has received complete basic immunization.

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