Original Article

Correlation between bacterial index and grade of disability amongst leprosy patients: A single center retrospetive study

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Abstract

Background Leprosy occurs due to primary M. leprae infection that attacks the peripheral nerves. Limited resources directly links the bacterial index (BI) with the grade of disability in leprosy patients in Indonesia, even though the problem of disability greatly affects quality of life of patients.

Methods A cross-sectional retrospective study approach was conducted. Total sampling technique was performed from medical records of patients with diagnosis of PB or MB leprosy, accompanied by grade 0, 1 or 2 disability. Correlation analysis test was performed to determine the correlation between BI and grade of disability in leprosy patients.

Results A total of 278 patients were included in this study, divided into 13 patients (4.7%) of PB leprosy and 265 patients (95.3%) of MB leprosy. Significant results were obtained in 5 out of 9 groups: (a) hand group in PB+MB leprosy (p value: 0.047); (b) foot group in PB+MB leprosy (p value: 0.002); (c) foot group in PB leprosy (p value: 0.000); (d) hand group in MB leprosy (p value: 0.021); and (e) foot group in MB leprosy (p value: 0.006).

Conclusion Positive correlations between BI and grade of disability were found in 56% of the analysis groups.

Key words
Leprosy, paucibacillary, multibacillary, bacterial index, grade of disability.

Introduction

Leprosy is a serious chronic infectious disease that is still widely found but is also often ignored. This disease occurs due to primary *Mycobacterium leprae* infection that attacks the peripheral nerves. This infection can also effects the skin, oral mucosa, upper respiratory tract, reticuloendothelial system, eyes, muscles, bones, and testes.[1] In addition to damaging the nerves that can cause physical disabilities, leprosy also has a major impact on the decline in the quality of life of the sufferer.

Important clinical aspects such as systemic clinical features, nerve involvement, leprosy reaction, as well as deformity and disability of leprosy have a very large impact on patient's quality of life.[2] Until now, there has been no research that directly links the bacterial index (BI) with the grading of disability in leprosy patients in Indonesia, even though the problem of leprosy and the resulting disability often gives

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social stigma and greatly affects the quality of life of the patients.

This retrospective study was conducted to determine the relationship between the bacterial index and the grade of disability in both paucibacillary (PB) and multibacillary (MB) leprosy patients. With this data, it is hoped that it can be used as an adequate educational material for leprosy patients, so that both clinicians and patients can together make efforts to prevent the onset of leprosy disability.

Methods

This research is an observational analytic study with a cross-sectional retrospective approach which was conducted in the Leprosy Clinic of Dr. Soetomo General Academic Hospital Surabaya. A total sampling technique was performed, obtained from medical records of patients with a diagnosis of PB or MB leprosy, accompanied by grade 0, 1 or 2 disability. This study was approved by the Ethics Committee of Dr. Soetomo General Academic Hospital Surabaya (1207/112/4/I/2022).

Descriptive analysis was performed on patient's characteristics (age, sex, type of leprosy, BI, grade of disabilities, location of disabilities, and type of disabilities). BI is described as the density of bacilli, defined as 6+ (many clumps or over 100 bacilli in an average field); 5+ (100 to 1000 bacilli in an average field); 4+ (10 to 100 in an average field); 3+ (1 to 10 in an average field); 2+ (1 to 10 bacilli in 10 fields); 1+ (1 to 10 bacilli in 100 field; and zero (no bacilli observed after searching at least 100 fields). Grade of disability in leprosy is defined by the WHO grading system: Grade 0= absence of disability (no anaesthesia) and no visible damage or deformity on eyes, hands, or feet; Grade 1; loss of protective sensibility on eyes, hands, and feet; Grade 2; presence of

deformities or visible damage to the eyes, hands or feet.

Results

A total of 278 patients were included in this study, divided into 13 patients (4.7%) of PB leprosy and 265 patients (95.3%) of MB leprosy. There were 12 patients who did not meet the inclusion criteria from all the research samples collected, namely patients diagnosed as neural and subclinical leprosy. Total male patient visits were 189 patients (68%), while female patients were 89 patients (32%), with a male and female ratio of approximately 2:1. Total patients with age <14 yrs. were 12 patients (4.3%), while age >14 yrs. were 266 patients (95.7%). The majority of patients had negative BI, as many as 130 patients (46.8%), followed by BI 2+ (21.6%) and BI 3+ (18.3%) having the second and third highest proportions respectively **(Table 1)**.

The majority of leprosy disabilities found in our study was grade 0 disability, in all locations observed (eyes, hands, and foot), as seen in **Table 2**. This study found that there were 112 patients (40.3%) who had grade 1 and 2 disabilities in various combinations of locations.

Table 1. Demographic characteristics of the subjects

Characteristics	*Total cases (n=278)*
	n (%)
Sex	
Male	189 (68)
Female	89 (32)
Age	
<14 yrs	12 (4.3)
>14 yrs	266 (95.7)
Type of leprosy	
PB	13 (4.7)
MB	265 (95.3)
Bacterial index	
0	130 (46.8)
1+	21 (7.6)
2+	60 (21.6)
3+	51 (18.4)
4+	16 (5.6)

Table 2. Grading of subject's disabilities

Characteristics	Total cases (n=278) n (%)
Eye	
0	268 (96.4)
1	6 (2.2)
2	4 (1.4)
Hand	
0	201 (72.3)
1	46 (16.5)
2	31 (11.2)
Foot	
0	203 (73)
1	49 (17.6)
2	26 (9.4)

Table 3 Locations and types of disabilities.

Characteristics	n (%)
Location of disabilities	
Eye only	2 (1.8)
Hand only	35 (31.3)
Foot only	29 (25.9)
Eye + hand	0 (0)
Eye + foot	4 (3.5)
Hand + foot	38 (34)
Eye + hand + foot	4 (3.5)
Types of disabilities	
Hypoesthesia/anesthesia	76 (51)
Decreased vision	6 (4)
Hand ulcer	2 (1.3)
Wrist drop	3 (2)
Claw hand	24 (16.1)
Mutilation	4 (2.7)
Foot drop	7 (4.7)
Claw toes	1 (0.7)
Foot ulcer	22 (14.8)
Lagopthalmus	4 (2.7)

Table 3 shows that the highest proportion is found in patients who experience a combination of hand and foot disability locations (34%). The most common type of disability found was hypoesthesia/ anaesthesia, which is a grade 1 disability, as many as 76 cases (51%). Second and third most common types of disability found were claw hand (16.1%) and foot ulcer (14.8%). Claw toes was the least common type of disability, which only amounted to 1 case (0.7%).

Analysis in this study divided the study sample into 9 major groups, based on the type of leprosy (PB+MB, PB, and MB) and the location of the disability (eyes, hands, and feet). Significant results were obtained in 5 out of 9 groups: (a) hand group in PB+MB leprosy (p value: 0.047); (b) foot group in PB+MB leprosy (p value: 0.002); (c) foot group in PB leprosy (p value: 0.000); (d) hand group in MB leprosy (p value: 0.021); and (e) foot group in MB leprosy (p value: 0.006). **Table 4** summarizes all the results of the comparative test analysis between the BI and grade of disability in leprosy patients.

Figure 1 shows a schematic graph of the comparison between BI and grade of disability, regardless of the type of leprosy, which shows significant results hand and foot locations. **Figure 2** shows a comparison in PB type leprosy, while **Figure 3** in MB type leprosy. In the PB group, the eye location group could not be analyzed because there were no patients having grade 1 nor 2 disability.

Discussion

At the turn of this millennium, we were able to complete the final step in the race to eradicate leprosy across the majority of the world, including Indonesia. As a result, the essence of leprosy problem is evolving from providing antileprosy therapy to dealing with the repercussions of leprosy.

Table 4 Comparison of BI and grade of disability in leprosy patients.

	Type of leprosy					
	PB + MB		PB		MB	
	p value	r	p value	r	p value	r
Eye	0.242	-0.070	-	-	0.211	-0.077
Hand	0.047	0.119	0.451	0.231	0.021	0.141
Foot	0.002	0.187	0.000	0.880	0.006	0.168

*Spearman correlation test, significant if the p value <0.05
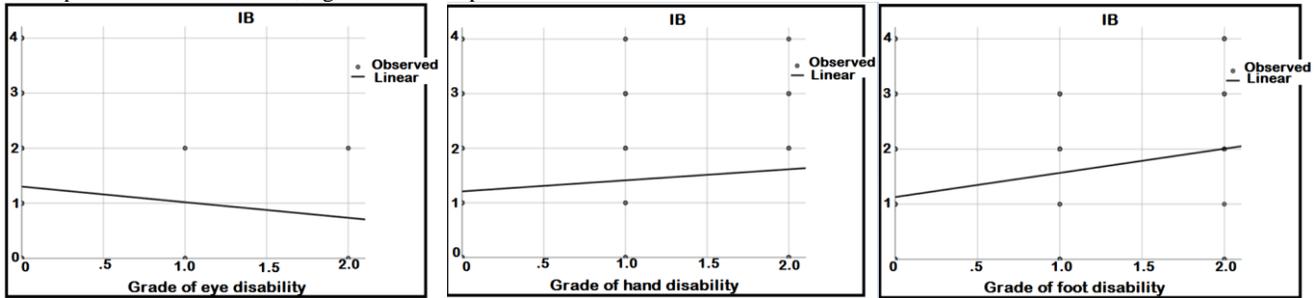

Figure 1 Comparison of BI and grade of disability in PB+MB group.
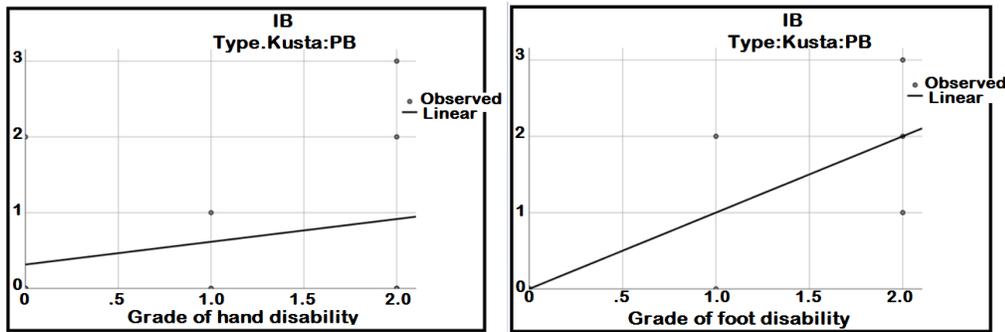

Figure 2 Comparison of BI and grade of disability in PB group.
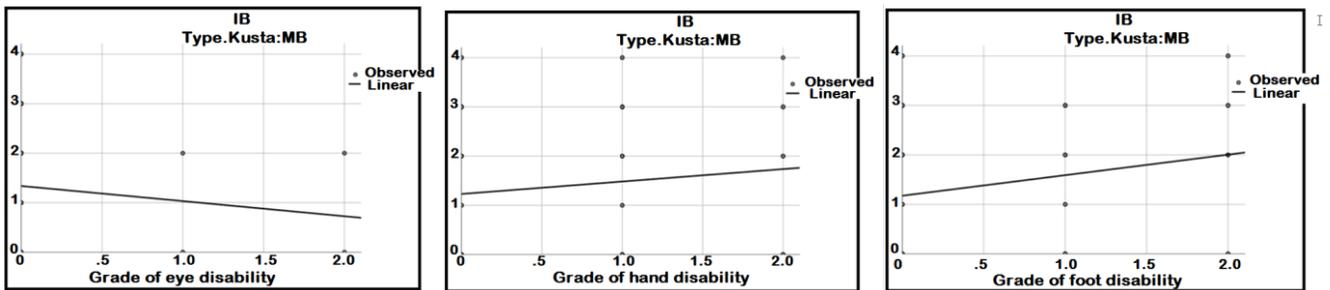

Figure 3 Comparison of BI and grade of disability in MB group.

The presence of disabilities in leprosy implies that there are certain gaps in leprosy control. According to the findings of the current study, the proportion of new leprosy patients with disabilities is fairly high, 40.2% of patients having grade 1 and 2 disability.

Our study samples were dominated by the age of >14 yrs. 266 patients compared to 12 patients with age of <14 yrs. This is in line with the pathogenesis of leprosy, where leprosy is said to require a long incubation time which can take up to 5 to tens of years until clinical manifestations appear.[3] Due to the long incubation period, more patients presenting with symptoms and seeking treatment are adults. Majority of patients were dominated by patients with a negative BI. This contradicted the fact that 83% of patients were MB leprosy, which should have a higher BI. The main factor of this discrepancy is because the Slit Skin Smear (SSS) test is very subjective and depends on the level of expertise of each examiner to find *M. leprae*. Although SSS has the advantage of being a fast and inexpensive diagnostic tool, in fact the accuracy of SSS in diagnosing leprosy is very low (sensitivity of 10-50%).[4] However, SSS is still used as one of the cardinal signs in the diagnosis of leprosy

until now.

Significant results in >50% (5 out of 9 analysis groups) in the recent study provide hope and pioneering information about the positive relationship between BI and grade of disability. These results are expected to be useful information to be integrated in the future into existing clinical guidelines, to improve services, especially as a primitive and preventive effort for leprosy and prevention of disability, so as to improve the quality of life of patients with leprosy.

The results that were not significant in this study, and even could not be analyzed (eye group in PB leprosy), could be a research bias, due to the very small number of samples in these groups, which is the main weakness of this study. For this reason, further research using more evenly distributed samples and cohort research method is expected to provide more valid results. In addition, the integrated collaboration between the Dermatology and Ophthalmology Departments is expected to increase the detection rate of leprosy defects in the eye. Increased TGF-β occurs in all types of leprosy and the incidence is increasing from tuberculoid to lepromatous leprosy. The increase in TGF-β causes a decrease in the production of TNF-α, IFN-ɤ, and iNOS which leads to an increase in the multiplication of *M. leprae* bacteria. In MB leprosy, secondary demyelination occurs due to signaling from the tyrosine kinase receptor (ErbB2), causing axonal atrophy triggered by MAPK deregulation and hypophosphorylation of nerve fiber proteins.[5]

Our study results are in line with the cross-sectional study conducted by Mowla *et al*. in Bangladesh,[6] which found that the proportion of grade 2 disability was higher in MB type leprosy. They found that a BI >3+ was one of the risk factors for the occurrence of grade 2 disability.[6] A multicenter cross-sectional study by Gunawan *et al*.[7] also found that of the children with leprosy, 50.76% had a negative BI and grade 0 disability was the highest (74.24%) among them, followed by grade 2 disability (15.15%), and grade 1 disability (10.61%). From their study, we can get a similar picture to what was found in the recent study.

Conclusion

Positive correlations between BI and grade of disability was found in 56% of the analysis groups. Results of recent study can provide new and pioneering insights for clinicians in preventing disabilities in leprosy.

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