Leprosy in Ethiopia: Epidemiological trends from 2000 to 2011

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Abstract:
Time-trend, a form of longitudinal ecological study design was employed to describe the epidemiological trends and changes of leprosy in Ethiopia from 2000 to 2011. Database and published accounts of the Federal Ministry of Health (Health and Health related Indicators from 2000-2011) originally collected by health institutions in the country through a routine surveillance system were used to generate the data summary. On average, 5,034 leprosy cases were recorded nationally every year. Out of these, the average number of new cases of leprosy was 4,475 (88.9%). The corresponding yearly national average prevalence and case detection rates per 10,000 were 0.7 and 0.6, respectively. Multi-bacillary cases of leprosy were the predominant 3,963 (88.7%) form of the disease. Overall childhood leprosy rate and grade-2-disability rate respectively were 7.1 and 9.3 per 100 new cases. The treatment success rate was more than 86 per 100 registered cases. A yearly average relapse rate of 4.8 per 100 total cases (242 on average per year) was recorded while a total of 188 leprosy patients (3.7 per 100 total cases) defaulted from follow-up between 2000 and 2011. There were a total of 53 deaths per year on average. The National Tuberculosis and Leprosy Control Program had been successful in its control activities and services. The overall incidence and prevalence rate of the country signifies the attainment of World Health Organization (WHO) target for leprosy elimination. However, the highest proportion of childhood leprosy and a considerable number of new cases could witness the active transmission of the disease and the existence of new infections within the country.

Keywords:
Ethiopia; Epidemiology; Leprosy; Prevalence

1. INTRODUCTION

Leprosy, a chronic inflammatory mycobacterial disease mainly involving skin and peripheral nerves and occasionally other organ systems, is not particularly age or gender specific disease. It can affect all ages and both sexes since infection can take place at any time depending upon the opportunities and levels of exposure [1]. Poor living standards and inadequate nutrition make people more susceptible to leprosy and disability [2]. The behavior of individuals also helps the transmission cycle to continue, as many people are reluctant to seek medical care even after being diagnosed because of misconceptions, stigma and superstitions [3].

Leprosy has a long history in Ethiopia. Literature indicated that leprosy had been recognized as major public health problem for more than half a century [4]. With more than 14% disability rate, more than 700 Ethiopians are
disabled every year, and around 5000 new cases of leprosy per year on average are reported despite the efforts of stakeholders [5]. The number may be far higher than this figure if active case detection and proper diagnosis are incorporated in the national tuberculosis and leprosy control program. Huge number of undetected new cases of leprosy usually remains under-reported because of misdiagnosis [6].

Sometimes, the occurrence of the disease in low frequencies and the uneven distribution within the country may influence someone to think that leprosy is about to be eliminated despite the otherwise factual truth. Unless logical review of cases of leprosy that describes the overall trend/pattern in exhaustive manner is in place, no one can be sure about the status of the disease. Thus, stable evidences over time that address the overall situation of the disease across the country need to be ascertained.

More specifically, in countries like Ethiopia where the state of leprosy research is clearly in decline [7], the need to assess the epidemiological trend of the disease leprosy in comprehensive manner seems imperative. Therefore, this study aims to examine the epidemiological trends of leprosy in Ethiopia reported between 2000 and 2011.

### 2. MATERIALS AND METHODS

#### 2.1 Background information of the study area

The study was carried out in Ethiopia, the second most populous country in Africa [8]. Ethiopia is a Federal Democratic Republic country comprised of nine national regional states and two city administrations. The national regional states and the city administrative councils are further divided into 611 Woredas (districts) and around 15,000 Kebeles (primary administrative units). An estimated 42,302 healthcare workers and more than 30,000 health extension workers were deployed to provide general health services across the country, the vast majority through the public sector in a corresponding 116 hospitals, 2,142 health centers and 14,192 health posts [9]. Since leprosy was integrated into the general health services in the country, both governmental and non-governmental health institutions including some private health facilities provided leprosy related services.

#### 2.2 Study design

Time-trend, a form of longitudinal ecological study design was applied to describe the epidemiological trends of leprosy control indicators of the country. Annual leprosy reports of the Ministry of Health from 2000-2011 including the database were reviewed prospectively.

#### 2.3 Study population and sample size

All leprosy patients in Ethiopia who registered for treatment and reported between the year 2000 and 2011 on health and health related indicators of the Federal Ministry of Health (FMoH) were included in the study. Since a more or less similar and complete set of data was available and accessible for the year 2000-2011, a 12-year trend analysis was chosen.
2.4 Study variables

All leprosy control indicator variables for which the National Tuberculosis and Leprosy Control Program collects data periodically were taken as independent variables of the study. New cases of leprosy, relapse, defaulters, childhood leprosy (0-14 years), sex and disability grades (grade 1, grade 2 and grade unknown) were among the independent variables from case finding reports whereas total number of registered patients (prevalence) along with evaluated, treatment completed, died and defaulted cases of leprosy were from treatment outcome reports. Time trends of the above mentioned independent variables were considered as dependent variables of the study. The disease leprosy is classified as pauci-bacillary (PB) or multi-bacillary (MB) mostly on the basis of clinical manifestations for the purpose of treatment. A leprosy case with more than five skin lesions or at least two enlarged peripheral nerves or positive slit skin smears (if examined) is called multi-bacillary case whereas a leprosy case with no more than five skin lesions, no more than one enlarged peripheral nerve and no positive slit skin smears (if examined) is called pauci-bacillary case [4].

2.5 Data source

Data on variables of interest were collected from 2000 to 2011 health and health related indicator reports and database of the FMoH. Health institutions across the country routinely collect the data using a standardized Health Management Information System (HMIS) reporting format. The FMoH summarizes the whole report received from the different levels of the health system and publishes the information as health and health related indicators of the country on a yearly basis.

2.6 Data management

Summary sheets were prepared on Microsoft Excel for each variable of interest following their corresponding yearly values. Then, the data was cleaned and thoroughly crosschecked for its consistency and completeness. When discrepancy was identified between the values of the database and health and health related indicators, only the value of the variable at that specific year was excluded from the analysis. Incomplete records were completely omitted from the analysis. For reasons of their insignificant importance of this particular type of study, some variables were purposely overlooked from the analysis. The data analysis was done using Microsoft Excel. Rates, proportions, percentages, mean, tables and graphs were used to depict the trend characteristics of the disease leprosy. Chi-squared test for linear trend was used to verify the statistical significance of the trend, and a P value < 0.05 was taken as a cut off point for the association at 95% confidence interval. Finally, a trend line equation that best fits the nature of the trend was fixed and future predictions were made accordingly.

2.7 Ethical clearance

Federal Ministry of Health of Ethiopia was asked for verbal consent. Reports of health and health related indicators are also available online.
3. RESULTS

3.1 Prevalence rate

The registered prevalence rate had decreased slightly from 0.74 to 0.55 per 10,000 population, and this reduction was found to be statistically significant (P < 0.001). The fall in registered prevalence, however, seemed to have occurred gradually in different stages; a slight increment in the beginning followed by a marked reduction in the middle and a relatively stable prevalence rate in the end.

Figure 1. Trends of prevalence and prevalence rate of leprosy in Ethiopia from 2000 to 2011.

3.2 Case detection rate

A total of 53,700 new cases of leprosy (4,475 new cases per year on average) were detected throughout the review period. The average rate of new cases detected per 10,000 population was 0.61, and the range varied from 0.51 to 0.75 per 10,000 population. The rate of new cases detected annually continued to decline significantly from 0.67 per 10,000 in 2000 to 0.51 per 10,000 in 2011 (P < 0.001).

3.3 Childhood leprosy

The average number of leprosy cases of children detected annually was 301. This resulted in the average proportion of childhood leprosy of the nation to be 6.3% of the total registered leprosy cases and 7.1% of the newly detected cases. The rate of child cases among newly detected cases did not show any progressive decreasing trend, and such reduction of child cases from 8 per 100 in 2006 to 7.1 per 100 in 2011 was not statistically significant (P > 0.05).

3.4 New Multi-bacillary (MB) and Pauci-bacillary (PB) cases

The percentage of MB cases among newly detected leprosy cases increased significantly from 82.1% in 2000 to 91.2% in 2011 (P < 0.001). The trend of PB cases on the other hand revealed noticeable reductions of PB cases from
17.9% in 2000 to 8.8% in 2011. The overall ratio of new MB cases to new PB cases also indicated that new MB cases were 7.7 times higher than new PB cases on average per year.

3.5 Registered MB and PB cases

Out of the total registered leprosy cases in Ethiopia, the majority of leprosy cases were MB. The average number of MB cases per year was about 4,479 (89%). The overall ratio of registered MB to PB cases on the other hand indicated that MB cases were eightfold of PB cases. The ratio even showed an increasing trend from 4.6:1 in 2000 to 10.4:1 in 2011 and this increasing trend was statistically significant (P < 0.001).
The majority of leprosy cases had completed their treatment. On average, a total of 4,263 (86.8%) leprosy cases per year were treated successfully between the year 2006 and 2010. Trend of treatment completion rate also indicated that the rate had increased significantly from 84.2 in 2006 to 88.2 per 100 evaluated cases in 2010 (P < 0.001).

The trend of leprosy patients defaulted over the time span of the study period among the total number of registered cases of leprosy showed a statistically significant reduction from 4.0 per 100 in 2000 to 1.5 per 100 cases in 2011 (P
However, the reduction did not occur in a steady manner rather in two stages (decreasing and increasing trend). The average annual number of patients defaulted in 12-year period of time was 188.

On average, a total of 242 relapse cases per year with an overall relapse rate of 4.8 per 100 were reported. The rate of relapse for the whole study period showed a statistically significant increasing trend from 2.4 in 2001 to 7.4 in 2010 (P < 0.001).
3.9 Disability due to leprosy

Of the yearly average 1,434 leprosy patients, 157 (10.9%) were having unknown deformity, 885 (61.7%) were having grade-1 deformity and 392 (27.3%) were having grade-2 deformity. The national rate of disability of people with grade-1 and grade-2 disability among new leprosy cases for whom disability assessment was carried out between 2006 and 2011 was 30.2 per 100. The reported disability rates (grade-1 plus grade-2) of the country varied from 23.2 per 100 to 34.8 per 100. Grade-1 disability rate alone was 20.9 per 100 new cases of leprosy.

3.10 Grade-2 disability

A total of 2,349 people with grade-2 disability level had been verified among those who undertook a disability assessment. And, the overall reduction of grade-2 disability rate from 11.2 to 9.8 within six-year period of time was statistically significant (P < 0.001).
3.11 Death related to leprosy

The average number of leprosy cases died per year was about 45.4. The national death rate decreased continuously from 11.7 per 1,000 in 2006 to 6.4 per 1,000 in 2009. However, the overall reduction of death rate over time did not show a statistically significant difference (P > 0.05).

3.12 Prediction of leprosy control indicators

Results of predictions based on the complete set of data reported between 2000 and 2011 indicated that the prevalence rate of leprosy across the country would decrease by 0.2222 per year ($R^2 = 0.65$). This reduction is much
faster than the case detection rate as the case detection rate would decrease by 0.0203 per year ($R^2 = 0.71$). The rate of leprosy cases that complete their prescribed treatment successfully would increase by 1.0306 per year ($R^2 = 0.86$). Examination of the future trend of the defaulting rate of leprosy cases would show further reduction by 0.2155 per year ($R^2 = 0.52$) whereas the crude relapse rate would increase by 0.3658 per year ($R^2 = 0.67$). Crude disability rate (grade 1 and 2) on the other hand would decrease by 1.6939 per year ($R^2 = 0.70$).

4. DISCUSSION

It is believed that Ethiopia had achieved the elimination goal of leprosy (less than 1 case for every 10,000 population) in 1999 [10]. The findings of this study also confirmed that the country had successfully achieved the goal of elimination since 2000. However, the true prevalence rate of leprosy in Ethiopia may exceed the current average rate of the disease (0.7 per 10,000 population) if most reliable techniques of assessment other than the registered prevalence of leprosy cases currently on treatment are used. Study findings from Bangladesh [11] Indonesia [12, 13] and India [14] also showed that leprosy prevalence determined by door-to-door surveys was 2.5 to 9 times higher than the registered prevalence.

Ethiopia with both prevalence and case detection rates below 0.7 per 10,000 population since 2000 could now be considered as a leprosy low-endemic country. According to the WHO definition, leprosy is no longer a public health problem in Ethiopia. However, the decreasing trends of new case detection and prevalence rate of leprosy may dramatically impact leprosy prevention and control programs in the country. It may help leprosy control activities continue to receive little attention and low priority, and open an opportunity even for the disease to rebound and become a public health threat once again. On the other hand, the opportunity of this observed decreasing trend to be an artificial is not negligible as study findings from Bangladesh demonstrated a fake diminishing pattern [15], and this fake diminishing pattern may hinder the process of case detection as well.

The highest proportion of childhood leprosy also revealed that leprosy was a real problem of people aged less than 15 years in the country. However, the proportion was found to be relatively low as compared to the proportion in India [16], Sri Lanka [17] and Yemen [18]. Compared to other countries like China [19] and Argentina [18], it was relatively high. The proportion was found to be similar to the proportion of child cases in Vietnam [20]. The overall proportion of childhood leprosy in Ethiopia generally indicated the existence of a high level of transmission within the country [21], and actual current conditions like the food crisis, climate change, political turmoil and lack of technical means of interrupting transmission reliably may further intensify the possibility of leprosy transmission [22].

The trend of treatment completion rate of the country indicated that the rate of leprosy patients who completed their treatment successfully had increased notably. This indicates that activities directed at reaching the highest possible proportion of patients to complete their treatment successfully and timely were in a good momentum. The possibility of attaining the target set for treatment completion rate, at least 90% [4], was promising. In addition, the overall treatment success rate of Ethiopia’s compared to other countries like Cebu, Philippines [23] and Nepal [24] showed that Ethiopias treatment success rate was relatively better. Treatment result of MB cases with a proportion of 90.4% also helped Ethiopia to be categorized among the few African countries to have achieved the WHO targets [4]. Nevertheless, the nation failed to achieve a 100% success rate despite a long history of treating cases freely. Socio-cultural beliefs [25] and stigma [26], literacy level of patients and side effects of the treatment itself [27, 28] may be among the potential reasons for such failure. The highest magnitude of grade-2 disability that limits access to health institutions, and the eclipsing of leprosy control activities by other public health problems may have impacted treatment success rates as well.

Similarly, the number of leprosy patients defaulting over the time span of the study period against the total number
of registered cases of leprosy showed a statistically significant reduction. The reduction may be attributed to the effectiveness of the drug and shortened duration of the treatment from two to one year. It may also be contributed by the good patient and health professional communication and interaction as patients are more motivated to take the whole prescribed course of treatment properly if they understand their disease and its treatment well [24]. However, the existing rate of defaulters, mostly linked to adverse drug reactions [27–30] social stigma, the physical inability of patients, socioeconomic condition [24, 31] and level of knowledge [24] may have serious implications on the leprosy control program of the country as it can set the stage for the emergence of drug resistance and treatment failure [23, 32]. Thus, the overall rate of defaulters which seemed to decrease across the country shall be given due emphasis so that its value will be kept to the bottommost.

The overall relapse rate of the country on the other hand showed a significant increasing trend. Multi-bacillary cases were more susceptible to relapse than pauci-bacillary cases. The existence of more relapse cases may reflect imperfections on the management of leprosy patients during Multidrug Therapy (MDT) treatment [33]. Socioeconomic conditions like literacy, income, living standards and occupation may also have a significant role to play for the high relapse rates [1]. Similarly, findings of other studies noted high relapse rates among leprosy patients treated with two years MDT treatment regimen [34–36].

The findings of the present study also illustrated the existence of a considerable proportion of patients who were diagnosed at an advanced stage of the disease. More specifically, the proportion of patients with grade-2 disability (9.3 per 100) remained high, indicating a significant delay in the diagnosis and treatment [37, 38]. However, this disability rate of diagnosis was lower than the average grade-2 disability rate of leprosy in WPRO 15.5%, China 25.4% [39], and Bangladesh over 15% [40]; but found to be higher than the average disability rate of India (1.8%) [41]. In the meantime, the disability grade of 10.9% of new cases of leprosy was unknown nationally. This can indicate a significant proportion of leprosy patients had received inappropriate health care services. However, in a country like Ethiopia where programs are integrated and staffs have little training, time or inclination to test for and record physical impairments in new cases of leprosy, the finding of this study regarding the value of unknown disability was not beyond the expected.

Eventually, the likelihood of Ethiopia to achieve substantive reductions in corresponding leprosy control indicators except treatment success rate was not appreciable. For example, the country would not be able to achieve disability reduction target [4] in the near future. A substantial number of people would continue to live with impairments in the country unless special disability prevention interventions like early case finding strategies [42] are in place. Nevertheless, lagging behind the target is not a special circumstance for Ethiopia as countries with advanced economic development like China, Brazil and India were not supposed to achieve the disability reduction target too [43].

**LIMITATION:** Because of lack of data on a denominator of some variables, the analysis of some study variables did not include the whole study period.

### 5. CONCLUSION

The findings of this study indicated that leprosy was under control in Ethiopia. The National Tuberculosis and Leprosy Control Program in the country had been successful in its control activities and services. However, this reduction in endemicity of leprosy to an acceptable level should not deceive planners and decision makers while allocating resources and making other efforts. Rather, they have to further strengthen leprosy control activities and programs until the disease is eliminated from the pockets of each administrative regions of the country. At least the highest proportion of childhood leprosy and a considerable number of new cases could witness the level of transmission of the disease and the existence of new infections within the country. The Federal Ministry of Health needs to evaluate the treatment regimen as the overall relapse rate increases parallely to the treatment success rate.
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References


