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"Epidemiology of Leprosy during the Period from 2010 to 2022 in Mansoura, Egypt "

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ABSTRACT:

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Background: Leprosy is a chronic infection caused by acid-fast rod-shaped bacillus Mycobacterium leprae. It mostly affects the skin and peripheral nerves, triggering a variety of cellular immunological reactions that may have long-term effects, including peripheral neuropathy. WHO categorizes leprosy into two groups: paucibacillary, which has five or less skin lesions, and multibacillary, which has six or more. The disease spectrum is closely correlated with the level of cellular immunity and bacterial load.

Objectives: to estimate the annual case detection rate of leprosy in Mansoura dermatology and leprosy hospital, the proportion of lepromatous leprosy and tuberculoid leprosy cases and to assess epidemiological trends of leprosy before and after the start of COVID-19 pandemic in Egypt.

Methods: A cross sectional study included 289 patients who were diagnosed and registered as newly detected leprotic patients at leprosy clinic in Mansoura dermatology and leprosy hospital during 2010 and 2022.

Results: Annual case detection rate of leprosy in each year estimated by number of reported leprosy cases in relation to the population number in the governorate measured by the central agency for public mobilization and statistics in each year has decreased gradually from 2010 to 2022 with the highest annual case detection rate in 2010 and lowest in 2022. Annual case detection rate of leprosy has been decreased from 4.001/1 million in 2010 to 0.861 /1 million in 2022.

Conclusions: The results of this retrospective analysis of leprosy data showed a decrease in the annual case detection rate of new leprotic patients through the study period (289 patients from 2010 to 2022) in comparison with the previous old studies During COVID pandemic, there was significant decrease in average number of recorded leprotic patients/ year, as .in Egypt well as annual case detection rate (0.99 /1 million) of leprosy when compared to their average number/year and annual case detection rate (4.46 /1 million) before COVID pandemic.

Keywords: COVID, Egypt, Epidemiology, Leprosy.

Introduction

Leprosy has been known to man for centuries. Mycobacterium leprae was discovered in 1873 by a Norwegian scientist Hansen, hence the name of leprosy now as Hansen's disease. (Ghosh and Chaudhuri, 2015). Leprosy is a chronic infectious disease caused by Acid-fast, rod-shaped, gram-positive, obligatory intracellular bacillus Mycobacterium leprae which exhibits phagocyte tropism in the epidermis and Schwann cell tropism in peripheral nerves. (Britton, 2004).

Despite the identification of its primary causative agent, Mycobacterium Leprae, this disease continues to pose a public health threat on a global scale, particularly in underdeveloped and developing countries. It mostly affects the skin and peripheral nerves, resulting in a variety of cellular immunological responses that can have long-term effects, including peripheral neuropathy (Bruce, 2000). In tropical nations, leprosy is rapidly expanding, especially in under developed and developing countries. The World Health Organization (WHO) declared in 1990 that leprosy should be eradicated worldwide by the end of the 20th century. (WHO, 2022).

Early diagnosis of the lesion is essential for timely and effective treatment of the disease. This contributes to reducing the stigma associated with the condition by preventing the disease's complications, which could result in physical limitations that have a significant impact on people's social and personal lives (WHO, 2015; Arif et al., 2019). WHO simply classified leprosy into pauci-bacillary which is characterized by having five or less skin lesions and multi-bacillary that is having six or more skin lesions; disease spectrum roughly correlates with the effectiveness of cellular immunity and corresponds to bacterial load (Montoya and Modlin, 2010).

Through the past 20 years, there have been major changes in the annual case detection rate of leprosy since the introduction of multi-drug therapy as a result of the short duration of therapy and more intensive control programs (WHO 2012). Without a reliable vaccine, early detection and treatment of the illness are essential for preventing the spread of M. leprae, lowering the risk of physical impairment and deformity, and lessening the disease's financial, psychological, and physical burden (Alencar et al., 2012; Santos et al., 2015; Fonseca et al., 2017).

Egypt has achieved the WHO goal in leprosy elimination as early as 1994 at the national level. But there are still few districts, which have not achieved elimination yet in Egypt (WHO, 2019). As there are many hyper-endemic pockets present in Egypt and the risk factors controlling the spread of leprosy are still not known completely, WHO is working on those high risk groups and endemic areas (WHO, 2019).

Due to lack of sufficient research on leprosy, many unknown results and complications in patients with leprosy, delayed case detection with increasing disabilities, frequent relapses and poor awareness of leprosy which continues to be a healthcare issue in many developing nations, many features of the disease, especially its epidemiology, are unclear, and extensive research is required to better understand it. Therefore, this study was conducted to explain the recent factors controlling the epidemiology, diagnosis, and management of leprosy.

PATIENTS AND METHODS

Study design, data source and study population

A cross sectional study included 289 patients diagnosed and registered as newly reported leprotic patients at leprosy clinic in Mansoura dermatology and leprosy hospital during the Period From 2010 to 2022.

Ethical considerations: The research approval of the study was obtained from the Ethics Committee of the Portsaid University Faculty of Medicine number S.no (57) DRM818_005 before starting the study. Anonymity and confidentiality of subject's data were maintained. Ethics, values, culture, and beliefs of subjects were respected.

Sampling procedure: Data was collected from the registered records of patients who were visiting the leprosy clinic in Mansoura dermatology and leprosy hospital from 2010 to 2022.

Diagnostic procedures: Based on the clinical history, physical examination, laboratory investigations, including a biopsy for histology, the diagnosis was made by a specialist. Histopathologically, leprosy can be classified into lepromatous leprosy, borderline lepromatous leprosy tuberculoid leprosy, borderline tuberculoid leprosy and Mid-border line leprosy. Histopathology of lepromatous leprosy (LL) showed an atrophied epidermis with grenz zone and dermis showing foamy macrophages (called as lepra cells) surrounding blood vessels, nerves, and adnexa structures. Lepra cells contained lepra bacilli. ZN staining demonstrated acid-fast bacilli in globi. Borderline lepromatous leprosy (BL) showed inflammatory infiltrate mostly lymphocytes few histiocytes and perineural fibrosis. Lepra bacilli were seen. Tuberculoid leprosy (TT) showed dermis consisting of granulomas composed of epithelioid cells and Langhans' giant cells. No grenz zone was noted. Lepra bacilli were few in number. Borderline tuberculoid leprosy (BT) showed epithelioid cells and many lymphocytes. ZN stain was negative for acid fast bacilli. Mid-borderline leprosy (BB) showed epithelioid cells and few lymphocytes. Histoid leprosy showed atrophy of epidermis with grenz zone. Dermis showed spindle cells arranged in whorled or storiform pattern. Acid-fast stain showed numerous bacilli (Manandhar et al. 2013). Slit skin smear (SSS) is a microbiological technique, involving Ziehl–Neelsen staining of smears from either the lesion or sites like the earlobes. Positive acid-fast bacilli (AFB) in SSS is one among the three cardinal signs of leprosy. Most clinicians rely on smear examination to diagnose and classify the disease into multibacillary (MB) or paucibacillary and in addition, SSS is also used to monitor the efficacy of treatment, to rule out relapse and drug resistance. Viable bacilli appear as uniformly red solid-stained rods having a length five times greater than the breadth with rounded, straight or pointed ends. The dead bacilli stain irregularly and appear granular or fragmented, and hence the term, broken bacilli (Banerjee et al. 2011).

Following a leprosy diagnosis, individuals were divided into two groups: paucibacillary (PB) and multibacillary (MB). Patients were labelled as having PB if they had less than 5 skin patches and/or one nerve trunk is involved. Patients who had more than six patches, more than two thickened nerves, infiltrations with or without papules or nodules, and smear positivity were categorized as having MB.

The grading of disabilities was assessed according to the WHO, as follows (El-Dawela et al. 2012):

Hands and feet: Grade 0: sensation still present, no obvious damage, nor deformity. *Grade 1*: anesthesia is present, there is neither obvious damage nor deformity. *Grade 2:* visible deformity and/or damage present.

Eyes: Grade 0: no eye problem due to leprosy or evidence of visual loss. *Grade 1:* eye problems due to leprosy, vision not severely affected. *Grade 2:* lagophthalmos, iridocyclitis, corneal opacities, and/or significant visual impairment (vision 6/60, unable to count fingers at 6 m) are all possible.

The ulcers in leprosy patients are categorized as primary and secondary ulcers.

Clinical presentations: Leprosy infection presents with numbness before the skin lesions appear. Temperature is the first sensation that is lost, followed by light touch, then pain, and finally deep pressure. A hypo-pigmented macule is often the first cutaneous lesion, and then lesions evolve into the lepromatous, tuberculoid or borderline types. As intermediate leprosy, tuberculoid leprosy, borderline leprosy, borderline lepromatous leprosy, and lepromatous leprosy.

Statistical Analysis

The results were statistically analyzed and tabulated using SPSS V.25 program (IBM Corporation, 1 Orchard Rd, Armonk, NY 10504, USA) and Microsoft Excel 2019 program (Microsoft Corporation, One Microsoft Way Redmond, WA 98052-6399, USA). Qualitative data was described as frequency and percentage (%). Quantitative data was described as mean and SD. The annual case detection rate of the disease was calculated by the measurement of all individuals affected by the disease every year in relation to the average population as documented by central agency for public mobilization and statistics. T-test was used to compare two or more qualitative variables. Mann Whitney Test (U test) was used to assess the statistical significance of the difference of a non-parametric variable between two study groups. Chi-square test was used for comparison of qualitative variables. A *P* value was considered statistically significant at a level less than 0.05.

RESULTS

A flowchart of the study population is shown in Figure 1. 289 patients with leprosy were attended to leprosy clinic in Mansoura dermatology and leprosy hospital during the period between 2010 and 2022. No patients were excluded from the study, thus 289 patients files were included in the study and statistically analyzed.

Regarding the sex of cases, there was increase in reported males (200) 69% in comparison to reported females (89) 31%. Regarding the age of cases, there were 2 pediatric patients of 12 and 13 years old. All other patients were above 14 years old with the oldest of 81 years, with the median age of 48 years. Regarding the occupation of reported newly discovered leprotic patients, there was no certain occupation associated with higher incidence of leprosy infection, (Table 1).

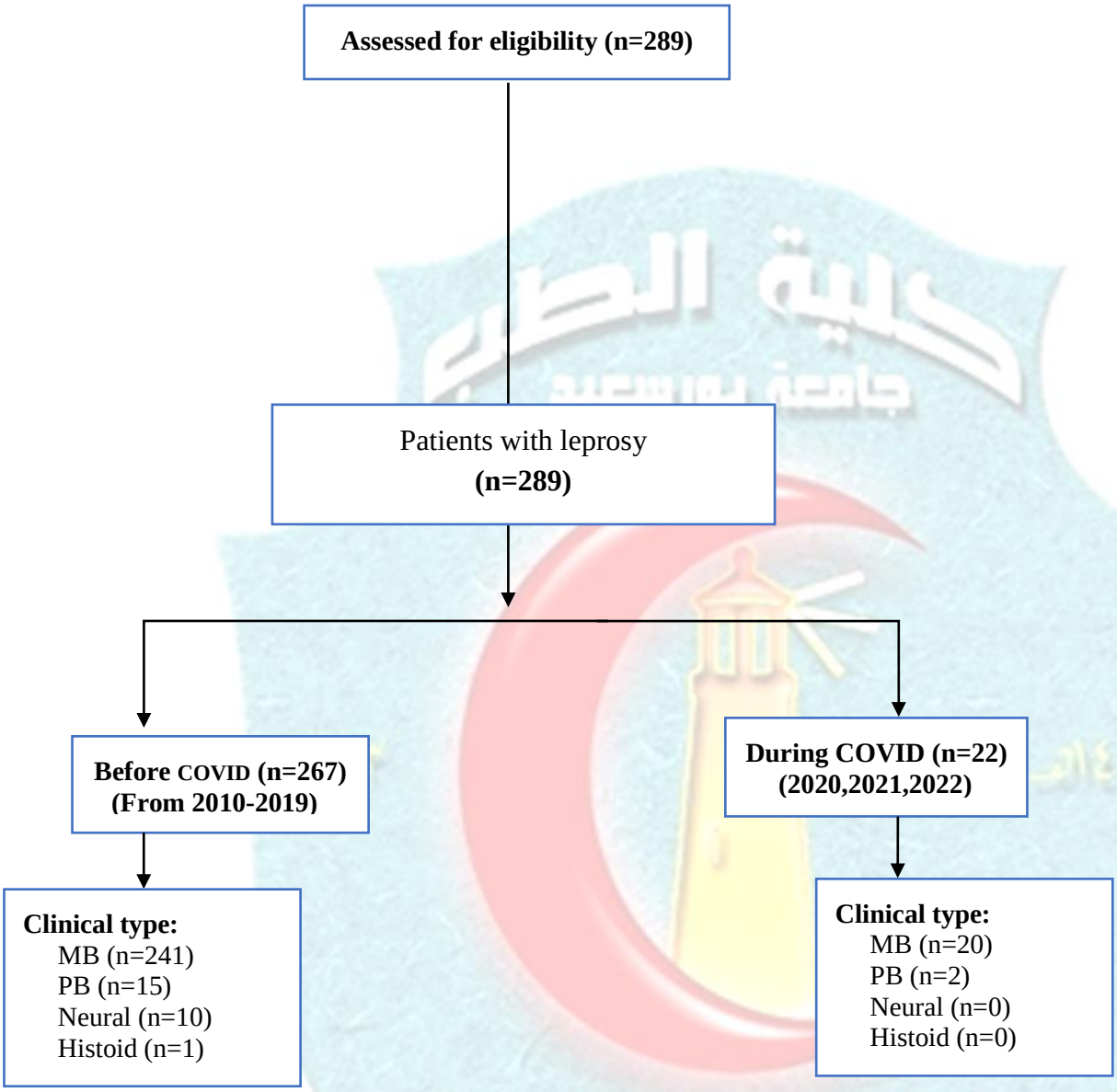

Fig 1. Flowchart of the studied patients with leprosy.

Table 1: Comparison of age and sex of recorded leprotic patients between periods before and during COVID pandemic. Data expressed as mean, standard deviation, number and percentage.

	Before Covid (2010-2019)	After Covid (2020-2022)	P-value
Age group (mean±SD)	49.4±14	47.5±13.6	0.616
Sex (N. and %)			
Males	182 (68.2%)	18 (81.8%)	
females	85(31.8%)	4 (18.2%)	0.182
Occupation	**Number**	**%**	
Student	8	2.8%	
Governmental employee	18	6.2%	
Private sector employee	2	0.7%	
Others	261	90.3%	

Data are expressed as number and percentage.

Table 1 shows that during COVID pandemic (2020-2022), there were no significant differences' regarding age and sex in comparison to the period before COVID pandemic (2010-2019) with non-significant P values.

The annual case detection rate of leprosy in each year which was estimated by number of reported leprosy cases in relation to the population number in the governorate measured by the central agency for public mobilization and statistics in each year has decreased gradually from 2010 to 2022 with the highest annual case detection rate in 2010 and lowest in 2022. Annual case detection rate of leprosy has been decreased from 4.001/1 million in 2010 to 0.861 /1 million in 2022, (Figure 2).

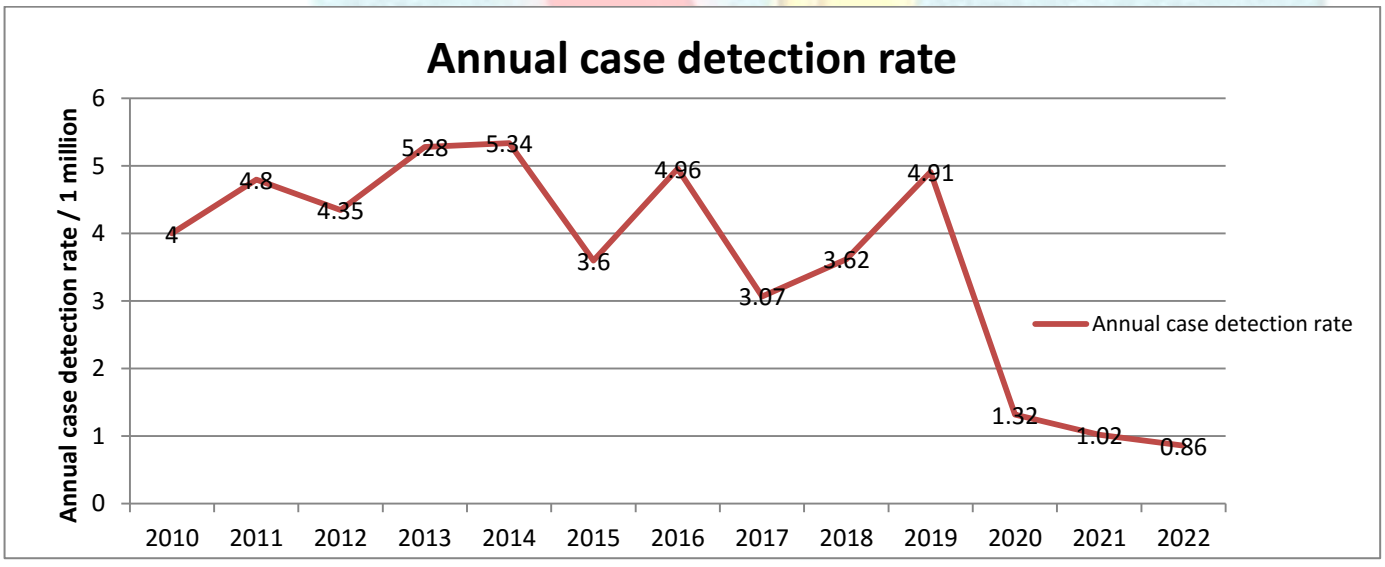

Figure 2: Annual case detection rate of leprosy through the study duration 2010-2022.

Regarding, during COVID pandemic, there was significant decrease in average number of recorded leprotic patients /year (7.3±1.5), as well as annual case detection rate (0.99 /1 million) of leprosy when

compared to their average number (26.7±4.8) and annual case detection rate (4.46 /1 million) before COVID pandemic. Moreover, regarding total number of new leprotic case detection reported in Dakahlia before and during COVID pandemic, there was significant decrease in number of recorded leprotic patients during the years of COVID pandemic in Egypt; 2020, 2021, 2022 about 22 patients (7.6%) in comparison to new case detection rate before COVID pandemic from 2010 to 2019 about 267 patients (92.4%), (Table 2).

Table 2: Comparison between average annual case detection rate before and during COVID pandemic.

	Before COVID 2010-2019	**During COVID 2020-2022**	***P-value***
Total number of recorded leprotic patients in each period	267 (92.4%)	22 (7.6%)	**<0.001***
Average number of recorded leprotic patients /year	26.7±4.8	7.3±1.5	**<0.001***
Annual case detection rate (/1 million)	4.57 (3.06-5.34)	1.02 (0.86-1.32)	**0.011***

Data expressed as mean, standard deviation, median and range. and analyzed using chi-square test (X^2), independent t test (t), Mann-Whitney U test, *Significant.

Regarding the clinical types of leprosy during COVID pandemic (2020-2022), there were no significant differences' regarding clinical types of leprosy in comparison to the period before COVID pandemic (2010-2019) with non-significant P value (P = 0.717), (Table 3).

Table 3: Clinical types of leprosy before and during COVID pandemic.

Clinical type	**Before COVID (2010-2019)**	**After COVID (2020-2022)**	***P-value***
	No (%)	No (%)	
MB cases	241 (90.3%)	20(90.9%)	0.717
PB cases	15 (5.6%)	2(9.1%)	
Neural	10 (3.7%)	0.0%	
Histoid	1 (0.4%)	0.0%	

Data expressed as number and percentage and analyzed using chi-square test (X^2).

Conserving to, mode of detection, the most common mode of detection of newly recorded leprotic patients was through notification (204 patients) 71%, in comparison to other modes of detection. As well as, regarding type of patient detection, the most common type of newly recorded leprotic patients were newly discovered cases rather than re-entry, relapse, and transfer in patients (Table 4).

Table 4: Mode and type of detection of recorded leprotic patients through the study duration.

Mode of detection	**No.**	**%**
Notification	204	71%
Voluntary	46	16%
Contact survey	35	12%
Referral	2	0.7%
Mass survey	1	0.3%
Type of patient detection		
New case	274	94.8%
Re-entry	8	2.8%
Relapse after MDT	6	2.1%
Transfer in	1	0.3%

Data are expressed as number and percentage.

Regarding contact to leprosy patients, newly recorded leprotic patients with positive contacts were 30.8% and less common than cases with negative contacts 69.2%. Also, regarding leprosy patients with infected relatives, there was increase in new cases with negative infected relatives (95.5%) in comparison to new cases detected with positive infected relatives (4.5%). Furthermore, regarding leprosy patients with chronic illness, there was increase in new case detection without chronic illness (95.5%) in comparison to new cases detected with chronic illness (4.5 %), (Figure 3).

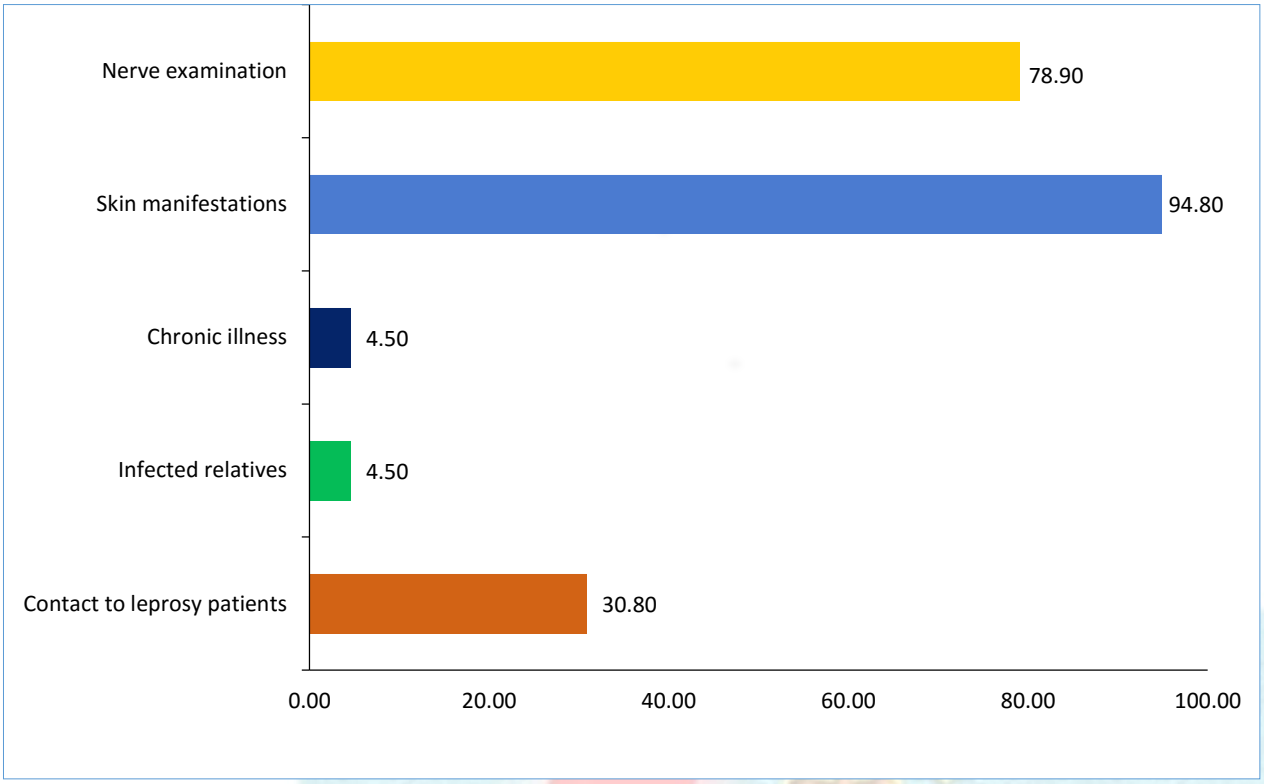

Figure 3: Contacts, infected relatives, chronic illness, skin manifestations and nerve examination of recorded leprotic patients through the study duration.

Regarding leprosy reaction, negative reactions was 81%, type-1 reaction was 5%, type-2 reaction was 10%, and unknown reaction was 4%. (Figure 4).

Regarding eye disability 93% of leprosy patients were grade 0, 2% of them were grade1, and 5% of them were grade 2. Regarding hand deformity, 65% of leprosy patients were grade 0, 19% of them were grade 1 and 16% of them were grade 2. Regarding feet deformity, 63% of leprosy patients were grade 0 , 25% of them were grade 0 , and 12% of them were grade 2.

Regarding muscle strength, strong muscle power was 92%, weak muscle power was 7%, and cases with paralyzed muscles were 1%, (Table 5). Also, there was no affection of visual acuity in all cases. Regarding new leprosy cases with ulcers, there was increase in new case detection with negative ulcer (91%), in comparison to new cases detected with positive ulcers (9%). Regarding relapse, newly discovered leprotic patients without relapse were 98%, while new cases detected with positive relapse were 2%, (Table 5).

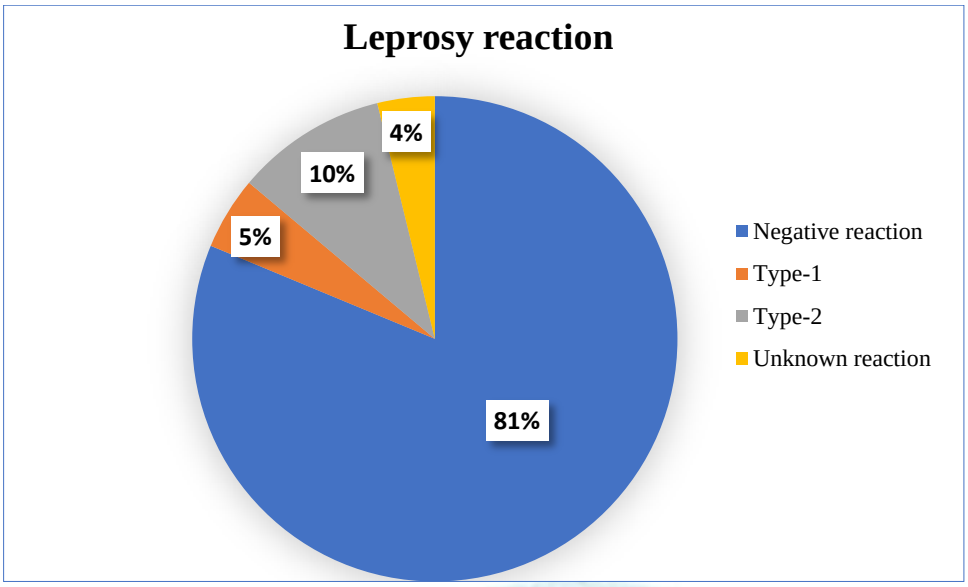

Figure 4: Leprosy reaction of recorded leprotic patients through the study duration.

Table 5: Complications of recorded leprotic patients through the study duration (2010-2022).

Complications	No.	%
Eye disability		
Grade 0	270	93.4%
Grade 1	5	1.7%
Grade 2	14	4.8%
Hand deformity		
Grade 0	188	65%
Grade 1	55	19%
Grade 2	46	16%
Feet deformity		
Grade 0	182	63%
Grade 1	72	25%
Grade 2	35	12%
Muscle strength		
Strong	267	92.4%
Weak	19	6.6%
Paralyzed	3	1%
Ulcer	27	9.3%
Relapse	7	2.4%

Data are expressed as number and percentage.

Regarding during COVID pandemic (2020-2022), there were no significant differences' regarding complications of leprosy in comparison to the period before COVID pandemic (2010-2019) with non-significant P values, (Table 6).

Table 6: Comparison of complications of leprosy between periods before and during COVID pandemic. Data expressed as number and percentage.

Complications	Before covid (2010-2019)	During covid (2020-2022)	P-value
Eye disability			
Grade 0	248(92.9%)	22(100%)	
Grade 1	5(1.9%)	0 (0%)	0.737
Grade 2	14(5.2%)	0 (0%)	
Hand deformity			
Grade 0	176(65.9%)	12(54.5%)	
Grade 1	47(17.6%)	8(36.4%)	0.128
Grade 2	44(16.5%)	2(9.1%)	
Feet deformity			
Grade 0	170(63.7%)	12(54.5%)	
Grade 1	67(25.1%)	5 (22.7%)	0.282
Grade 2	30(11.2%)	5 (22.7%)	

Data are expressed as number and percentage.

DISCUSSION

In the current study, we found that all newly detected leprosy cases were more than 14 years of age except 2 pediatric cases of 12 and 13 years old reported through the study. The youngest patient was 12 years old while the oldest was 81 years old with the median age was 48 years. This finding is in correlation with Ramadan et al. (2007) who showed that the age of the studied leprosy patients recorded ranged from 4 to 80 years with a higher incidence present in the age 40–50 years with the least incidence of patients was detected in the age of 0–10 years. The prolonged incubation periods are in line with the theory explaining that leprosy disease appearance in elderly individuals may be related to endogenous re-activation of bacillus that was acquired early in life and remained latent inside the body (Hegazy et al., 2002). In disagreement with the previous results, international data on age-specific new case-detection rates vary. Peaks in the age group 10–20 have been observed several times.

The causes that may underlie this variation include the role of household transmission and the period of the incubation time, which may be related to the type of leprosy. In addition, the extent of natural immunity, factors related to sex, endemicity levels of leprosy, and operational factors (case detection methods), may be relevant (Alrehaili 2023).

Our study has demonstrated that Annual case detection rate of leprosy which was estimated by number of reported leprosy cases in relation to the population number in the governorate measured by the central agency for public mobilization and statistics in each year has decreased gradually from 2010 to

2022 with the highest annual case detection rate in 2010 and lowest in 2022. Annual case detection rate of leprosy in Dakahlia has stepped down from 4.001/1 million in 2010 to 0.861 /1 million in 2022.and these records are very promising. This is in agreement with previous epidemiological research of Amer et al. in Egypt from 2005 to 2009 who showed that there was a reduction from 1.64 in 2005 to 0.97 per 100 000 populations in the new case detection rate in 2009 (Mansour and Amer, 2014). Also, our results are in agreement with previous study done in different governorates in Egypt including Dakahlia from 2013 to 2017 in which annual case detection rate has decreased gradually from 5.22/million (0.052/10 000) in 2013 to 3.04/million (0.030/100 000) in 2017 through years (Sharshar et al., 2021).

In our study, a significant decrease found in recorded leprotic patients during the years of COVID pandemic in Egypt (22 patients, 7.6%) in comparison to new case detection rate before COVID pandemic (267 patients, 92.4%). The lowest annual case detection rate during years of COVID may be due to the decreased number of reported leprosy cases in these years due to COVID pandemic restrictions and resultant decrease in disease transmission in Egypt. Also, in a previous study conducted in Egypt, the annual case detection rate of leprosy has decreased from 0.17/10 000 in 2010 to 0.075 in 2016 (WHO, 2017), indicating that Egypt has achieved the WHO goal in elimination of leprosy, and it happened as early as 1994 at the national level. However, Egypt is still counted in the top 22 countries of global priority among WHO regions and globally for the number of new cases detected and the number of grade 2 disabilities (WHO, 2017).

This in contrary to previous study done in India, Brazil, and Indonesia, in which leprosy remains a problem in the high-endemic regions, in which new case detection rate remains unchanged (Blok et al., 2015). This different annual case detection rate in the current study compared with previous studies may be due to genetic, environmental, socioeconomic, or educational differences. Although the immunobiology of leprosy has received much attention over the years, individual differences in resistance and response to bacilli are yet to be elucidated.

In the current study, we found that male predominance in 69% of cases.This is in contrary to old study by Ferreira and his colleges. Male was significantly affected in our study versus the old study. This may be resulting from the underutilization of the health services by women (Ferreira et al., 2017). A similar observation was reported by EMRO office at the regional level, where 33% of new cases were women (WHO, 2002). Also, the higher male: female ratio in our study could be due to increased opportunities for contact in males and the rising trend in females could be due to an increased health care-seeking attitude in them as well as changing social perceptions toward female healthcare. The sex distribution has social-implications since women affected by leprosy face higher levels of stigmatization and social isolation than affected men (Luka, 2010).

Mode of detection in our study either passive through notification (71%) and voluntary reporting (16%) or active through contact surveys (12%) or mass surveys (0.3%). The most common mode of

detection of newly recorded leprotic patients was passively through notification (204 patients) 71%, in comparison to other modes of detection. This is in contrary to previous study done by Govindasamy in which The Awareness intervention appears to be more effective in detection of new cases, compared to other modes of detection (Govindasamy K, et. al., 2021).

Regarding contact to leprosy patients, newly recorded leprotic patients with positive contacts were 30.8% and less common than cases with no contacts 69.2%. This may be explained that not everyone with M. leprae infection develops leprosy, and disease transmission does not always happen when people contact with infected individuals. This is supported by coexistence of healthy individuals in the same home as a leprosy patient and the existence of clinical leprosy in non-contact individuals (Reyila et al., 2019). This is consistent with findings by Fine et al. (1997), who discovered that home contact only accounted for 15% to 30% of cases. It appears that the non-contact group is the source of the majority of newly discovered leprosy cases.

As regards bacteriology in the current study, we found that 65.7 % of cases were positive. This is in agreement with another study done by Quilter who proves that smear positivity stands out as a single, dominant variable predicting risk factor of leprosy development amongst HH contacts (Quilter et al., 2020).

Regarding the clinical types of leprosy, MB was detected in 261 (90%) of cases, PB was in 17 (6%) of cases, neural leprosy was in 10 (3%) cases, and histoid type was in one case. This was in agreement with the results of McCormick et al. (2019), who showed that most cases had multi-bacillary leprosy (69.23%). Also, these results are in agreement with previous epidemiological study by Mansour and Amer in Egypt from 2005 to 2009 in which multibacillary cases are the commonest of all clinical types (Mansour and Amer, 2014). In contrast to the findings of our results, Ramadan et al. showed that regarding the bacteriological results, the percentage of multibacillary patients among the newly detected cases during the period 1995–2005 was 42% (Ramadan et al., 2007). This increase in positive cases in our results (90%) than that of Ramadan (42%) may be due to the increase in screening and detection methods in our study.

MB patients are considered more infectious, thus more likely responsible for disease transmission (International Federation of Anti-Leprosy Association London, 2001) which is why it is important to know the proportion of MB patients among newly detected cases. This is in agreement with several studies reported a high incidence of MB cases in Dakahlia, Kalyubia, and Sohag governorates (95.3, 95.7, and 92.7%, respectively) (Wadie, 2007; 2010; El-Dawela et al., 2012). In the year 2010, the number of MB cases detected in Egypt was 601 cases among 680 newly detected cases (88.38%) (WHO, 2011). This is in contrary to only a study in Gharbia governorate conducted during the period from 1994 to 2005 (Ramadan et al., 2007). It was only that MB cases comprised 49.52% of 622 newly detected cases. Almost all observations point to the high incidence of MB leprosy in Egypt. This high proportion may indicate a

delay in detection of leprosy; however, it may also be influenced by changes in the clinical definition of MB leprosy (a case with ≥ 5 skin lesions) proposed by the WHO since the introduction of MDT (International Federation of Anti-Leprosy Association London, 2001).

In our study, grade 2 eye disability was detected in 4.8 %, grade 2 hand deformity was 16%, while grade 2 feet disability was 12%. The percentage of grade 2 disabilities is an important indicator as it can be measured, and it explains delays in case diagnosis. Most epidemiology researches on disabilities are based on cross-sectional surveys (International Federation of Anti-Leprosy Association London, 2001). Feet disability was the commonest site of complication attributed to the fact that anesthesia of feet remained unrecognized and came to light only when patients presented with ulceration (Chavan and Patel, 2011). Literature suggests that females are at greater risk for developing trophic ulcers of feet. And this may be due to the lack of knowledge about the disease and the ignorance about the lifestyle modifications to be adopted, as well as the inaccessibility to the healthcare system in the female population (Chavan and Patel, 2011).

Regarding relapse, newly discovered leprotic patients without relapse were 98%, while new cases detected with positive relapse were 2%. This is in contrary to a previous study by Martha through 11 years study in which there was a high relapse rate in the Colombian population (Martha et. al., 2012). One of the best methods for evaluation of the effectiveness of a chemotherapeutic regimen is the monitoring of relapses after the completion of the treatment protocol (Girdhar et al., 2000). Only seven cases showed relapses during our study. This indicates that early case detection and prompt treatment with MDT remains the cornerstone of control programs.. This is in line with a previous cohort study from four districts in South India with low risk of relapse and deformity among leprosy patients (Rajkumar P. et. al., 2021). But, our results are in disagreement with previous studies in which the incidence of relapse was greater than observed in our study (Ana Cláudia, et. al., 2022, Sharshar et al., 2021).

Finally, there are some limitations of our study, as a single center study. Thus, more studies in different areas are needed to help implement all necessary health measures and procedures to prevent and reduce the annual case detection rate of leprosy disease and reduce its risk.

CONCLUSION

The results of this retrospective analysis of leprosy data showed a decrease in the annual case detection rate of new leprotic patients through the study period (289 patients from 2010 to 2022) in comparison with the previous old studies in Egypt. Annual case detection rate of leprosy in Dakahlia has stepped down from 4.001/1 million in 2010 to 0.861/1 million in 2022. and these records are very promising. During COVID pandemic, there was a significant decrease in the average number of recorded leprotic patients/year, as well as annual case detection rate (0.99 /1 million) of leprosy when compared to their average number/year and annual case detection rate (4.46 /1 million) before COVID pandemic.

DECLARATIONS

Consent for publication: authors have red and revised well for the manuscript and agree to publishing.

Availability of data and material: Data supporting the study are presented in the manuscript or available upon request.

Competing interests: There is no conflict of interests.

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Authors' contributions:

The authors confirm that they have all necessary patient permission paperwork in their possession. The patient(s) has/have consented in the form for the publication of his/her photos and other clinical data in the journal. The patients are aware that although every attempt will be made to hide their identity and that their names and initials will not be published, anonymity cannot be ensured.***Acknowledgements:*** Not applicable

Authors' information (optional): Not applicable

REFERENCES

Alencar C. H., Ramos Jr A. N., dos Santos E. S., Richter J. & Heukelbach J. 2012. Clusters of leprosy transmission and of late diagnosis in a highly endemic area in Brazil: focus on different spatial analysis approaches. Tropical Medicine & International Health, 17: (4), 518-525.

Alrehaili J. 2023. Leprosy Classification, Clinical Features, Epidemiology, and Host Immunological Responses: Failure of Eradication in 2023. Cureus, 15(9), e44767.

Ana Cláudia, Diogo Fernandes, Douglas Antunes , Maria Aparecida, Marcela Araujo de Oliveira Santana , Bruno de Carvalho Dornelas 2022 . Leprosy Relapse: A Retrospective Study on Epidemiologic, Clinical, andTherapeutic Aspects at a Brazilian Referral Center Author links open overlay panel. 118, 44-51

Banerjee S, Biswas N, Kanti Das N, Sil A, Ghosh P, Hasanoor Raja AH, et al. 2011. Diagnosing leprosy: revisiting the role of the slit-skin smear with critical analysis of the applicability of polymerase chain reaction in diagnosis. Int J Dermatol, 50:1522-1527.

Blok, D.J., De Vlas, S.J. & Richardus, J.H. 2015. Global elimination of leprosy by 2020: are we on track. Parasites Vectors 8, 548

Britton W. J. a. L., D. N. 2004. Leprosy. Lancet, 363: 1209–1219.

Bruce, S., T. L. Schroeder, K. Ellner, H. Rubin, T. Williams, and J. E. Wolf, Jr. 2000. Armadillo exposure and Hansen's disease: an epidemiologic survey in southern Texas. J. Am. Acad. Dermatol. 43:223-228.

Chavan L. B. & Patel P. 2011. Epidemiology of disability in incident leprosy patients at supervisory urban leprosy unit of Nagpur city. National Journal of Community Medicine, 2: (01), 119-122.

El-Dawela R. E., Mohamed A. S. & Yousef F. 2012. Analysis of newly detected leprosy in Sohag Governorate, Upper Egypt, 2004–2008. Leprosy review, 83: (1), 71-79.

Ferreira S. M. B., Yonekura T., Ignotti E., Oliveira L. B. d., Takahashi J. & Soares C. B. 2017. Effectiveness of rifampicin chemoprophylaxis in preventing leprosy in patient contacts: a systematic review of quantitative and qualitative evidence. JBI Database of Systematic Reviews and Implementation Reports, 15: (10), 2555-2584.

Fine P. E. M., Steme J. A. C., Ponnighaus J. M., Bliss L., Saul J., Chihana A., et al. 1997. Household and Dwelling Contact as Risk Factors for Leprosy in Northern Malawi. American Journal of Epidemiology, 146: (1), 91-102.

Ghosh S. & Chaudhuri S. 2015. Chronicles of Gerhard-Henrik Armauer Hansen's life and work. Indian journal of dermatology, 60: (3), 219.

Girdhar B. K., Girdhar A. & Kumar A. 2000. Relapses in multibacillary leprosy patients: effect of length of therapy. Leprosy review, 71: (2).

Govindasamy K, John AS, Lal V, Arif M, Solomon RM, Ghosal J, et al. 2021. A comparison of three types of targeted, community-based methods aimed at promoting early detection of new leprosy cases in rural parts of three endemic states in India. PLoS ONE 16(12): e0261219.

Hegazy A. A., AbdelHamid I. A., Ahmed E. S. F., Hammad S. M. & Hawas S. A. 2002. Leprosy in a high annual case detection rate Egyptian village: epidemiology and risk factors. International Journal of Dermatology, 41: (10), 681-686.

International Federation of Anti-Leprosy Association London 2001. The interpretation of epidemiological indicators in leprosy. ILEP, technical guide.

Luka E. 2010. Understanding the stigma of leprosy. South Sudan Med J, 3: 45-48.

Mansour A. & Amer A. 2014. Epidemiological study of leprosy in Egypt: 2005-2009. Egyptian Journal of Dermatology and Venerology, 34: (1), 70-73.

Manandhar U, Adhikari R, &Sayami G. 2013. Clinico-histopathological correlation of skin biopsies in leprosy. Journal of Pathology of Nepal, 3:452-458.

Martha inírida Guerrero-guerrero, Sandra Muvdi-arenas, Clara inés León-franco. 2012; Relapses in multibacillary leprosy patients: A retrospective cohort of 11 years in Colombia; Leprosy Review;; 83; 3; 247-260;

McCormick C. D., Lea J., Stryjewska B. M., Thompson A. & Fairley J. K. 2019. Trends of leprosy and multibacillary infection in the state of Georgia since the early 1900s. PLoS Neglected Tropical Diseases, 13: (10), e0007713.

Montoya D. & Modlin R. L. 2010. Learning from leprosy: insight into the human innate immune response. Advances in immunology, 105: 1-24.

Quilter E. E. V., Butlin C. R., Singh S., Alam K. & Lockwood D. N. J. 2020. Patients with skin smear positive leprosy in Bangladesh are the main risk factor for leprosy development: 21-year follow-

up in the household contact study (COCOA). PLoS Neglected Tropical Diseases, 14: (10), e0008687.

Ramadan W. M., Hassan A. M. & El Tatawy R. A. 2007. Study of 622 new leprosy patients detected over a period of twelve years (1994–2005) in Tanta University. J Pan-Arab League Dermatol, 18: 59-73.

Rajkumar P., Chethrapilly Purushothaman, G. K. Ponnaiah, M. Shanmugasundaram, D. Padma & Mehendale S. M. 2021. Low risk of relapse and deformity among leprosy patients who completed multi-drug therapy regimen from 2005 to 2010: A cohort study from four districts in South India. PLoS neglected tropical diseases, 15(11), e0009950.

Reyila V. P., Betsy A., Riyaz N., Sasidharanpillai S., Sherjeena P. V. B., Majitha M. P., et al. 2019. Clinico-epidemiological Study of Disability Due to Leprosy at the Time of Diagnosis among Patients Attending a Tertiary Care Institution. Indian J Dermatol, 64: (2), 106-111.

Santos V. S., Santos L. C., Lôbo L. V. R., Lemos L. M. D., Gurgel R. Q. & Cuevas L. E. 2015. Leprosy and disability in children younger than 15 years in an endemic area of northeast Brazil. The Pediatric Infectious Disease Journal, 34: (3), e44-e47.

Sharshar P., Maraee A., Farag A. A. & Ibrahem R. L. 2021. Epidemiology of leprosy in Nile Delta, Egypt: a 5-year survey. Menoufia Medical Journal, 34: (2), 451-455.

Wadie N. 2007. Retrospective analysis of prevalence and increased incidence of leprosy in Qalyubia governorate. J Pan Arab League Dermatol, 27–35.

WHO 2002. Annual report of the regional director. Alexandria, Egypt: EMRO, WHO, 5: (1), 135–136.

WHO 2011. Leprosy-global situation. Wkly Epidemiol Rec, 86: 389–400.

WHO 2012. Expert committee on leprosy, 8th report. WHO, Technical Report Series, Geneva.;968:5–10.

WHO 2015. Global leprosy update, 2014: need for early case detection. Weekly Epidemiological Record= Relevé épidémiologique hebdomadaire, 90: (36), 461-474.

WHO 2017. Data at regional and global level. Number of new leprosy cases.

WHO 2019. Leprosy. East Mediterranean: EMRO. Available at: www.emro.who.int/health topics/leprosy/index.html.

WHO. 2022 . Guidelines for the diagnosis, treatment, and prevention of leprosy.