

# Leprosy Among Industrial Workers in Bombay, India. Studies in Retrospect and Prospect<sup>1</sup>

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Antileprosy measures carried out in Bombay, India, have been described earlier (<sup>2</sup>). In the absence of specific protection, leprosy control is being attempted by early detection and mass treatment. Long-term results of dapsone monotherapy in lepromatous cases (<sup>6</sup>), problems of defaulters in treatment (<sup>3</sup>), as well as problems, causes, and follow up of defaulters among bacteriologically positive cases (<sup>5</sup>) have been described elsewhere.

In the absence of intensive surveillance of the 8.2 million citizens of Greater Bombay, group surveys are being undertaken. Surveys of intrafamilial contacts of all types of leprosy cases (<sup>2</sup>) as well as of students in schools (<sup>1</sup>) have been presented. In the present study, various attributes involving leprosy patients among industrial workers are presented in a retrospective analysis of 3692 patient workers. Subsequently, a prospective, cross-sectional survey of 18,621 industrial workers is presented, along with the methodology and problems involved.

## MATERIALS AND METHODS

**First retrospective study.** Data were collected on new cases registered at the outpatient clinic of the Acworth Leprosy Hospital for a period of ten years from 1966 through 1975. The cases were further studied in relation to the industry involved, i.e., textile mills, factories, government, and semi-government or public institutions. Here the objective was to study the proportion of industrial worker patients among all patients.

**Second retrospective study.** In this retrospective study, for the years 1975 through 1981, 3692 industrial worker patients were studied from the registers more extensively for the following factors: Regularity in attendance, type of leprosy, deformity status, source of referral, type of occupation, state of origin of the patients, etc. The types of leprosy are lepromatous, borderline (BL, BB, BT), and tuberculoid. Deformity includes wasting of muscles or contractures or ulcers, but excludes more peripheral anesthesia.

**Prospective study.** A cross-sectional survey of industrial workers for evidence of "skin disease" including leprosy has been underway since the year 1978. Because of the social stigma and the possibility of removal of the detected patients from the service, initial, exhaustive spadework was necessary. The industrial physicians were presented with the data collected from the first retrospective study and had to be convinced of the necessity of such a survey to be carried out by us. They, in turn, convinced management, the workers, and also the union leaders. The survey was carried out by our team, consisting of a leprologist and paramedical workers at the industrial establishments, so that the loss in production was minimized. Once management was convinced, a written guarantee was obtained from them that they would not remove from service any worker who was found to be suffering from leprosy. Management was informed of only the gross number of leprosy cases and other skin diseases, while the secrecy of individual patients was maintained by us. Detected patients were individually instructed to attend our nearby centers for bacteriology as well as for treatment. More than 18,000 workers have been examined so far (Table 1). This was a service project for detection and treatment of cases; no research regarding various attributes of the workers was intended.

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TABLE 1. *Density of population, prevalence rate of resident leprosy cases, and case detection rate among industrial workers in Greater Bombay.*

Major divisions	Area in sq. kilometers	Population (1981)	Density (persons/sq. kilometer)	Total resident active cases	Prevalence rate (0/00)	Industrial workers		
						Examined	Cases detected	Detection rate (0/00)
City (Wards A-G)	69	3,285,040	47,810	16,278	5	7,218	97	13.4
Suburbs (H, K, L, M & N)	92	3,073,981	15,982	19,656	6	7,763	157	20.2
Extended suburbs (P, R, S & T)	177	1,884,384	10,606	10,410	6	595	18	30.2
Total	438	8,243,405	18,833	46,344	6	15,576 + 3,045 <sup>a</sup>	272 +44 <sup>a</sup>	17.5 14.4 <sup>a</sup>
						18,621	316	17.0

<sup>a</sup> There were 3045 workers examined who could not be classified by ward.

#### DATA, ANALYSIS AND DISCUSSION

An estimated 4 million leprosy cases in a population of 680 million Indians (1981 census) gives a prevalence rate of 5.8 per 1000. The population has doubled in the last 34 years. The area of India is 3.29 million square kilometers, hence the density of population is 207 per square kilometer. In 1971, 20% of the population was in urban areas; this has increased to 24% in 1981. Thus, there has been an urban shift. In the state of Maharashtra (of which Bombay is the capital), the population in urban areas is the highest at 35%. Production from agriculture has doubled, and it has increased six times in industry in the last 34 years. Since most of the industries are in urban areas, the population in search of jobs has shifted to urban areas.

Table 1 shows that Bombay has a population of about 8.2 million and has an area of 438 square kilometers; population density is about 18,800 per square kilometer. The number of active, resident leprosy cases is 46,344; the prevalence rate, 6 per 1000. The number of bacillary positive cases is

8574. Thus about 20% of the cases are bacillary positive.

Table 2 reveals the number of new cases registered at the Acworth Leprosy Hospital and its nine peripheral centers. The cases are further divided into resident cases (i.e., those who resided in Bombay for more than three years at the time of registration) and nonresident cases. As many as 40% of the new cases are from out of Bombay, i.e., from other parts of the state or from other states in India.

In the first retrospective study, of the 19,452 new, adult resident cases registered at Acworth Leprosy Hospital clinic during a ten-year period (1966 through 1975), 6462 (33%) were from industry (Table 3). Table 4 shows the distribution of these 6462 cases in the different major establishments.

In the second retrospective study, 3692 industrial patient workers (registered from 1975 through 1981) were identified. Since the majority of industrial workers in Bombay are adult males, details of age and sex were not studied. Of the 3692 patient workers, 2803 (76%) were tuberculoid, 500 (14%)

TABLE 2. *Resident and nonresident new cases registered at outpatient clinic of Acworth Leprosy Hospital by year.*

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Total
Resident	3628	4437	4183	4586	4588	4720	4941	4141	3920	3407	42,551
Nonresident	2725	2726	3266	3338	3313	3885	2907	1938	1950	1920	27,968
Total	6353	7163	7449	7924	7901	8605	7848	6079	5870	5327	70,519

TABLE 3. *Number of worker-patients among total resident adult patients.*

Years	Total new cases	Adults	Workers
1966-1970	10,545	9,163	2,785
1971-1975	11,840	10,289	3,677
Total	22,385	19,452	6,462

TABLE 4. *Distribution of 6462 workers by institution.*

Institution	1966-1970	1971-1975	Total
Mills	1051	1160	2211
Factories and firms	920	1061	1981
Government and semi-government	814	1456	2270
Total	2785	3677	6462

were borderline, and 389 (10%) were lepromatous. Of the 3692 patients, 2803 (76%) were negative for bacilli and 889 (24%) were bacteriologically positive. A study of regularity of treatment in each type revealed a significant chi-square value ( $p < 0.001$ ). The percentages of regular clinic attendees among lepromatous and borderline patients were 40 and 42, respectively. However, of the 2803 tuberculoid cases, only 846 (30%) were regular (Table 5). Deformity and regularity in attendance at the clinic for dapsone tablets are not interrelated (Table 6). Of these 3692 patients, 558 (15%) came on their own (or came voluntarily); whereas 3134 (85%) were directed to attend our hospital by doctors, employers, etc. (Table 7). Of the 558 cases who came on their own, only 158 (28%) were regular; whereas of the 3134 cases who were directed to come, 1057 (34%) were regular. These differences are statistically significant ( $p < 0.02$ ). Cases coming on their own are supposed to be already motivated and should have been more regular. How-

TABLE 6. *Deformity and regularity of treatment.*

Regularity	Deformed		Non-deformed		Total
	No.	(%)	No.	(%)	
Regular	202	(35)	1013	(32)	1215
Dropped	371	(65)	2106	(68)	2477
Total	573	(100)	3119	(100)	3692

TABLE 7. *Source of referral and regularity of treatment.*

Regularity	Voluntary or self-referred		Referred by others		Total
	No.	(%)	No.	(%)	
Regular	158	(28)	1057	(33)	1215
Dropped	400	(72)	2077	(67)	2477
Total	558	(100)	3134	(100)	3692

ever, the referred cases were actually more regular, probably because the regulations require them to attend for three monthly treatments and/or check-ups. Occupation and regularity of treatment are associated (Table 8). Patients belonging to the white collar class (and educated) are more regular in attendance ( $p < 0.02$ ). State of origin and regularity of treatment are not interrelated, i.e., patients from endemic and nonendemic areas are more or less equally regular (or irregular) in attendance (Table 9).

As shown in Table 10, of the 2803 tuberculoid cases, 377 (13%) had deformity; whereas 18% of borderline cases and 27% of lepromatous cases had deformity ( $p < 0.001$ ). Contrary to common clinical belief, more of the lepromatous cases than of the borderline cases have deformities here. It is likely that some of the lepromatous cases might have evolved from the reacting or untreated borderline cases who were already deformed. Bombay is a highly industrialized place, and people from all over India

TABLE 5. *Type of leprosy and regularity of treatment.*

Regularity	Tuberculoid		Borderline		Lepromatous		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Regular	846	(30)	212	(42)	157	(40)	1215	(33)
Dropped	1957	(70)	288	(58)	232	(60)	2477	(67)
Total	2803	(100)	500	(100)	389	(100)	3692	(100)

TABLE 8. *Occupation and regularity of treatment.*

Regular- ity	Unskilled		Semi-skilled		Skilled		White collar		Total
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	
Regular	280	(34)	130	(31)	601	(32)	204	(37)	1215
Dropped	549	(66)	284	(69)	1298	(68)	346	(63)	2477
Total	829	(100)	414	(100)	1899	(100)	550	(100)	3692

TABLE 9. *State of origin and regularity of treatment.*

Regular- ity	Nonendemic area		Endemic area		Total
	No.	(%)	No.	(%)	
Regular	290	(32)	925	(33)	1215
Dropped	604	(68)	1873	(67)	2477
Total	894	(100)	2798	(100)	3692

come to this city in search of jobs. Of the 3692 cases, 894 (24%) were from nonendemic areas; whereas 2798 (76%) were from endemic areas of India (Table 11). Of the 894 cases who came from nonendemic areas, 80% were tuberculoid and the remaining 20% were bacteriologically positive. However, of the 2798 cases who originated in the Indian states or areas known for the endemicity of leprosy, 75% were bacteriologically negative and 25% were positive ( $p < 0.005$ ). This is rather surprising, since we expect that people who come from endemic areas and who turn out to be leprosy cases usually develop the tuberculoid type of leprosy. Of the 3692 cases, only 558 (15%) came on their own. In both of the groups the maximum number of cases are tuberculoid. Lepromatous cases make up a larger proportion of the patients who are self-referred compared to those patients who are referred by others ( $p < 0.05$ ) (Table 12).

The occupations of the patients are classified as either unskilled, semi-skilled,

skilled, or white collar (Table 13). Surprisingly, the maximum proportion of those who came on their own were unskilled (and presumably uneducated) workers ( $p < 0.001$ ). Of the 3692 cases, 573 (16%) had deformity. The highest proportion of deformity was among the unskilled workers, 175 (21%); whereas a smaller proportion of skilled (13%) and white collar workers (14%) had deformity. Thus, in the absence of care of the hands and feet, hard manual labor probably leads to gross deformity. Deformity and source of referral are not interrelated. Even patients coming on their own (and hence already motivated) are as liable to get deformity as are the referred cases (Table 15). It is likely that physiotherapeutic care is not reaching them adequately or it is not availed of by them. Seventeen percent of the cases from endemic areas had deformity as compared to 11% of those coming from nonendemic areas (Table 16). The difference is significant ( $p < 0.001$ ). Thus the question is why do more patients from endemic areas get deformity. Table 6 shows that deformity is not related to regularity, and Table 10 indicates that regularity is not related to the state of origin. However, since deformity occurs more in bacillary positive cases (Table 10) and since more of the cases from endemic areas get bacillary positive type leprosy, it is natural that more of the patients from endemic areas get deformity because of their bacillary positive type of leprosy. It is also possible that people from

TABLE 10. *Type of leprosy and deformity.*

Deformity	Tuberculoid		Borderline		Lepromatous		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Deformed	377	(13)	91	(18)	105	(27)	573	(16)
Non-deformed	2426	(87)	409	(82)	284	(73)	3119	(84)
Total	2803	(100)	500	(100)	389	(100)	3692	(100)

TABLE 11. *Type of disease and state of origin.*

State of origin	Tuberculoid		Borderline		Lepromatous		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Nonendemic	718	(80)	104	(12)	72	(8)	894	(100)
Endemic	2085	(75)	396	(14)	317	(11)	2798	(100)
Total	2803	(76)	500	(14)	389	(10)	3692	(100)

TABLE 12. *Type of disease and source of referral.*

Source of referral	Tuberculoid		Borderline		Lepromatous		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Self-referred	399	(72)	71	(13)	88	(15)	558	(100)
Referred by others	2404	(77)	429	(14)	301	(9)	3134	(100)
Total	2803		500		389		3692	

TABLE 13. *Occupation and source of referral.*

Source of referral	Unskilled		Semi-skilled		Skilled		White collar		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Self-referred	179	(22)	51	(12)	229	(12)	99	(18)	558	(15)
Referred by others	650	(78)	363	(88)	1670	(88)	451	(82)	3134	(85)
Total	829	(100)	414	(100)	1899	(100)	550	(100)	3692	(100)

TABLE 14. *Occupation and deformity.*

	Unskilled		Semi-skilled		Skilled		White collar		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Deformed	175	(21)	66	(16)	255	(13)	77	(14)	573	(16)
Non-deformed	654	(79)	348	(84)	1644	(87)	473	(86)	3119	(84)
Total	829	(100)	414	(100)	1899	(100)	550	(100)	3692	(100)

TABLE 15. *Deformity and source of referral.*

	Self-referred		Referred by others		Total	
	No.	(%)	No.	(%)	No.	(%)
Deformed	89	(16)	484	(15)	573	(16)
Non-deformed	469	(84)	2650	(85)	3119	(84)
Total	558	(100)	3134	(100)	3692	(100)

TABLE 16. *Deformity and state of origin.*

	Nonendemic		Endemic		Total	
	No.	(%)	No.	(%)	No.	(%)
Deformed	99	(11)	474	(17)	573	(16)
Non-deformed	795	(89)	2324	(83)	3119	(84)
Total	894	(100)	2798	(100)	3692	(100)

TABLE 17. *Deformity and duration of stay in Bombay.*

	Duration of stay				Total	
	>4 years		<4 years			
	No.	(%)	No.	(%)	No.	(%)
Deformed	488	(15)	85	(19)	573	(16)
Non-deformed	2762	(85)	357	(81)	3119	(84)
Total	3250	(100)	442	(100)	3692	(100)

TABLE 18. *State of origin and source of referral.*

State of origin	Self-referred		Referred by others		Total	
	No.	(%)	No.	(%)	No.	(%)
Nonendemic	118	(13)	776	(87)	894	(100)
Endemic	440	(16)	2358	(84)	2798	(100)
Total	558		3134		3692	

endemic areas have been living with the disease around them for a long time and hence are generally less careful or even apathetic.

Those who had been staying in Bombay for more than four years at the time of registration had less deformity than those who had been staying for less than four years (Table 17). The difference is significant ( $p < 0.025$ ). This is probably due to better facilities in the city. Origin and source of referral are not interrelated (Table 18). Thus more of the patients from endemic areas should know about the disease and should have come on their own as compared to those originating from nonendemic areas. However, this is not so.

**Prospective study.** In this cross-sectional survey, 18,621 industrial workers have been examined from eight different establishments in different parts of Greater Bombay. The results are as follows: A total of 18,621 workers were examined and 316 cases detected for a case-detection rate of 17 per

1000. Twenty bacillary positive cases were found (6% of the cases), and 51 patients had deformities (16% of the cases).

Table 2 shows that 42,551 new resident cases were registered in ten years, making the new case registration average rate 4255 per year. The majority of these cases are registered by passive detection, i.e., not through field surveys. Active case detection through surveys of schools, slum dwellers, family contacts, and industrial workers is compared in Table 19. Among the group surveys, the case-detection rate is naturally highest in the group of intrafamilial contacts (31 per 1000), followed by the industry group (17 per 1000), and then slums (9 per 1000) and schools (5 per 1000). Contacts are under surveillance in all projects. Although slum dwellers yield many cases, the usual disadvantages of slum surveys are lack of cooperation, migratory habits in a few slums, less number of cases getting registered after detection, and subsequent greater rate of

TABLE 19. *Comparative case detection rates.*

Group surveyed	No. examined	Cases detected	Case-detection rate (0/00)
Schools	547,902	3038	5.5
Contacts	111,426	3533	31.7
Slums <sup>a</sup>	431,199	3808	8.8
Industries	18,621	316	17.0

<sup>a</sup> Slum surveys carried out by three other organizations in Bombay.

drop outs. Further, quite a few cases are already registered in other projects and therefore there may be some duplication.

In contradistinction, industrial workers are an organized group, supervised by cadres of industrial physicians, labor welfare officers, personnel officers and, if necessary, union leaders. Thus this group of industrial workers should be examined on a priority basis in endemic, industrialized areas.

#### SUMMARY

The problem of leprosy in Greater Bombay, India, is presented. Antileprosy measures carried out in this dense, industrialized, endemic urban area are briefly described. The role of survey of various groups of people in case detection is then highlighted. A retrospective study showing the proportion of industrial workers among new, resident leprosy cases is presented. In another retrospective study, various attributes of workers, such as state of origin, source of referral, religion, regularity in attendance, deformity status, nature of occupation, etc., are studied and their significance delineated. This has resulted in undertaking a cross-sectional, prospective survey of over 18,000 industrial workers where the case detection rate turned out to be over 17 per 1000. Accordingly, arguments are advanced for recommending surveys of industrial workers in the scheme of leprosy control in endemic urban areas. A study of socio-economic and cultural attributes of workers and their relatives in maintaining the endemicity is felt distinctly feasible.

#### RESUMEN

Se presenta el problema de la lepra en Bombay, India. Se describen brevemente las medidas antileprosas

en esta densa e industrializada área urbana donde la lepra es endémica y se subraya el papel de varios grupos de gente en la detección de casos. Se presenta un estudio retrospectivo que muestra la proporción de trabajadores industriales entre los nuevos casos de lepra en la población residente. En otro estudio retrospectivo se analizan varios atributos de los trabajadores tales como lugar de origen, sitio de tratamiento, religión, regularidad en su asistencia a los centros de control, estado de deformación, naturaleza de su ocupación, etc. Todo esto dió como resultado que se iniciara un estudio prospectivo transversal de más de 18,000 trabajadores industriales donde la frecuencia de detección de casos resultó ser de más de 17 por 1000. Según los hallazgos, se presentan los argumentos en favor del estudio de los trabajadores industriales dentro del esquema de control de la lepra en áreas endémicas urbanas. Pensamos que el estudio de las condiciones socioeconómicas y culturales de los trabajadores y sus familiares puede ayudarnos a entender su participación en la endemicidad de la lepra.

#### RÉSUMÉ

On a étudié le problème de la lèpre dans la métropole du Grand Bombay, en Inde. Des mesures de lutte contre la lèpre ont été mises en oeuvre dans cette région urbaine dense, industrialisée et endémique. L'importance pour la détection d'enquêtes menées dans différents groupes de population a été mise en évidence. On a eu recours à une étude rétrospective pour calculer la proportion de travailleurs industriels parmi les nouveaux cas de lèpre détectés dans la population résidente. Dans une autre étude rétrospective, on a étudié les différentes caractéristiques de ces travailleurs, telles que la province d'origine, le mode de détection, la religion, l'assiduité au traitement, les mutilations, et le type de travail; la signification de ces différentes caractéristiques a été analysée. On a alors procédé à une étude transversale prospective de plus 18.000 travailleurs industriels; le taux de détection a dépassé 17 pour mille. En conséquence, on présente une série d'arguments qui militent en faveur de la conduite de telles enquêtes dans les populations de travailleurs industriels, dans le cadre de la lutte contre la lèpre en région urbaine endémique. On estime qu'il est possible de réaliser une étude des facteurs socio-économiques et culturels de ces travailleurs et de leur famille, en vue d'établir leur rôle dans le maintien de l'endémicité.

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#### REFERENCES

1. KOTICHA, K. K. Case detection through school surveys in Greater Bombay. *Lepr. India* **45** (1976) 75-77.
2. KOTICHA, K. K. and NAIR, P. R. R. Anti-leprosy

- measures in Bombay, India—an analysis of 10 years' work. *Bull. WHO* **54** (1976) 67-77.
3. Koticha, K. K. and NAIR, P. R. R. Defaulters in treatment of leprosy—a retrospective study of 42,000 cases. *Int. J. Lepr.* **47** (1979) 50-55.
  4. KOTICHA, K. K., NAIR, P. R. R. and JUWATKAR, P. S. A study of 922 bacteriologically positive leprosy cases. *Int. J. Lepr.* **50** (1982) 330-334.
  5. KOTICHA, K. K., PATRE, B. B. and NAIR, P. R. R. Problems of urban leprosy control with special reference to case holding. *Int. J. Lepr.* **52** (1984) 482-487.
  6. KOTICHA, K. K. and SANE, A. B. Effect of dapsone in the elimination of *M. leprae* from the skin of lepromatous patients. A study of 609 cases. *Int. J. Lepr.* **39** (1971) 829-837.