

## Upward Trend in the Rate of Detection of New Cases of Leprosy in the State of Bahia, Brazil<sup>1</sup>

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Leprosy has become rarer worldwide. It is clear that the prevalence rate decreased: in 32 countries with the highest prevalence, it fell by 86.7% during the 1988–1999 period (<sup>12</sup>). It is not clear, however, that the new case detection rate is decreasing: in fact, the rate in the same period fell only 4.0% (<sup>12</sup>).

The prevalence rate in Brazil, the country with the second greatest number of cases of leprosy detected each year (<sup>12</sup>), has declined during the 1990s since the introduction of new criteria for releasing patients. Conversely, the new case detection rate (NCDR) has increased both in the 1980s and in the 1990s (<sup>2</sup>). A recent report from the Brazilian Ministry of Health showed a rise in the NCDR (per 10,000) among individuals aged 14 years old or younger in the whole country of 0.59 in 1994, 0.63 in 1995, 0.68 in 1996 and 0.72 in 1997 (<sup>7</sup>). In some places, this rise in the NCDR was observed before the implementation of multidrug therapy (MDT) and continued afterwards.

Motta, *et al.* (<sup>8</sup>), looked at Brazilian data from 1969 to 1987, a period during which the NCDR increased dramatically, and the proportion of paucibacillary cases also increased. The authors interpreted these findings as suggesting that the increase in NCDR reflected a real rise in the incidence of the disease rather than better detection.

In a more recent study, Andrade, *et al.* (<sup>1</sup>), looked at the NCDR from 1987 to 1995 for Brazil as a whole. They reported a statistically significant correlation between the annual national NCDR and the number of trained technicians from 1987 and 1995. The authors concluded that the increase in the NCDR in Brazil was due mostly to operational improvements.

The purpose of this text is to describe the trend in the NCDR in the State of Bahia, Brazil, during a period of 14 years, which includes the periods covered in the two studies by Motta, *et al.* (<sup>8</sup>), and Andrade, *et al.* (<sup>1</sup>). In this analysis we explore whether trends in age, sex, clinical form and grade of disability shed light on the reasons for the increase in the NCDR in Bahia.

### MATERIALS AND METHODS

This work presents a time-trend study of leprosy occurrence from 1974 to 1997 in the State of Bahia. This state is located in the Northeast Region of Brazil, with a population of nearly 12,530,000 inhabitants (census of 1996). The municipalities with the highest prevalence and detection rates are in the countryside.

The data were obtained from *Hospital de Referência Dom Rodrigo de Menezes* (HRDRM), the reference medical facility for leprosy in Bahia. Leprosy is reported through compulsory notification, by means of standard forms, which are forwarded from the health services to the State Health Department where the data on individual patients are stored in a computerized data file. This data set provided the numerators for the estimation of the annual NCDR. The population denominators were a linear interpolation from population estimates derived from four censuses (1970, 1980, 1991 and 1996) and extrapolations for 1997.

The trend in detection rate was presented

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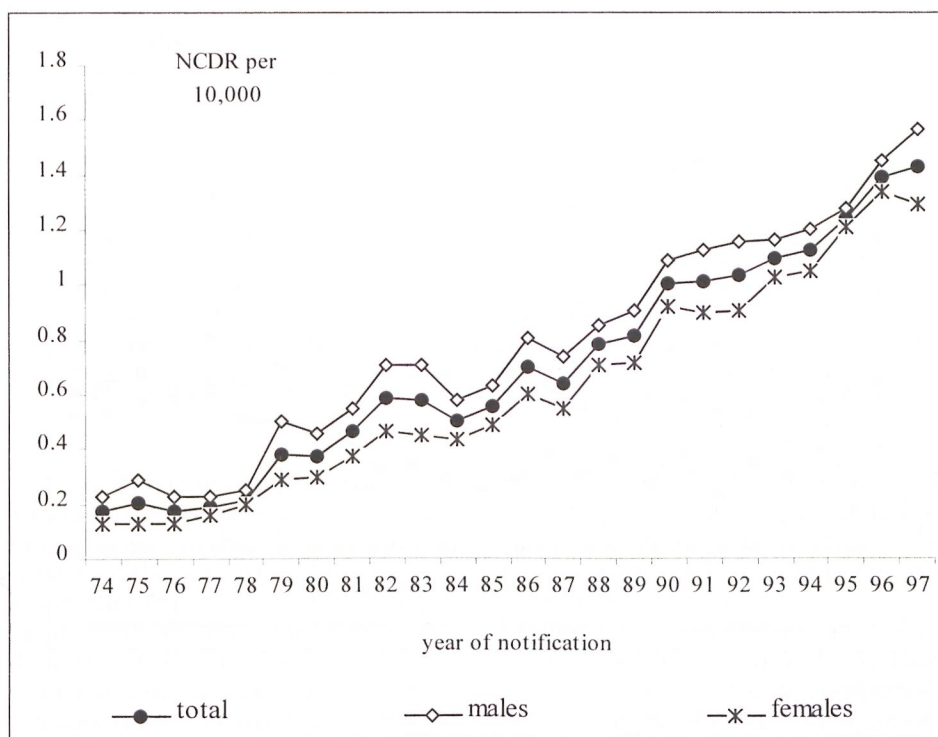


FIG. 1. New case detection rate of leprosy per 10,000 inhabitants. Bahia, Brazil, 1974–1997.

according to the following variables: sex, year of birth, date of diagnosis, date of release, clinical form and disability. We used the clinical form classification adopted by the Brazilian leprosy control program in which cases are classified in four basic forms<sup>(10)</sup>: lepromatous, tuberculoid, indeterminate, and dimorphous. The NCDR was presented per 10,000 individuals. Sex ratio was defined as the male-to-female ratio of incidence rates, and age ratio as the ratio of the incidence rate among the 50-and-older age group to the incidence rate among the 14 and younger age group, as before presented in other studies cited by Irgens and Skjaeven<sup>(5)</sup>. Cases were classified for disability according to the more severe problem observed, in grade 1, 2 or 3<sup>(9)</sup>. We analyzed only cases with referred disability because the dates of disability were incomplete and we cannot discriminate between those referred but found to have no disability (grade 0) and those not referred for assessment (missing data). The curves representing the detection rate over time were smoothed using an exponential function and the parameters expressing the slopes of the curves were

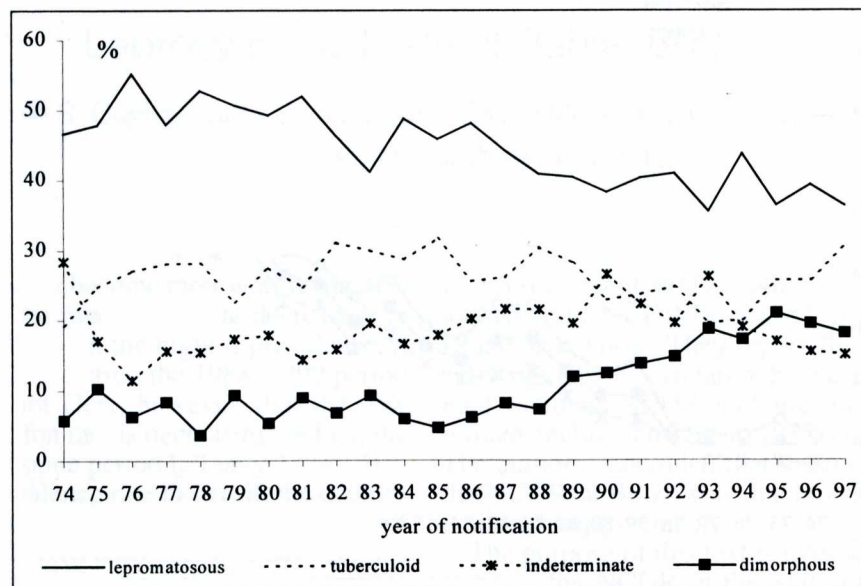
used to compare the trends according to different groups. Analysis about neonatal coverage rate is not included here because unfortunately this information is not available for the whole period; therefore, we can only say that neonatal BCG coverage rate was below 50% during the 1970s and the 1980s, increased markedly from the mid-1980s, and achieving around 90% in 1999 and onward.

## RESULTS

The data file contained 19,639 registered cases from 1974 to 1997, from which 767 cases were excluded for the following reasons: 102 cases imported from other states; 300 with diagnosis before 1974; 71 considered to be misdiagnosed after notification; 272 double-registered. Twenty-two cases had errors in the date of birth, and were excluded from any analysis that used age, but included in all other analyses. Thus, this analysis comprised 18,872 newly reported leprosy cases. For the whole period, 18.7% of the cases were reported in the capital, with the annual values ranging from 14.0% to 36.4%.

Figure 1 shows that the detection rate was stable for the first 5 years (1974–1978) of

Males



Females

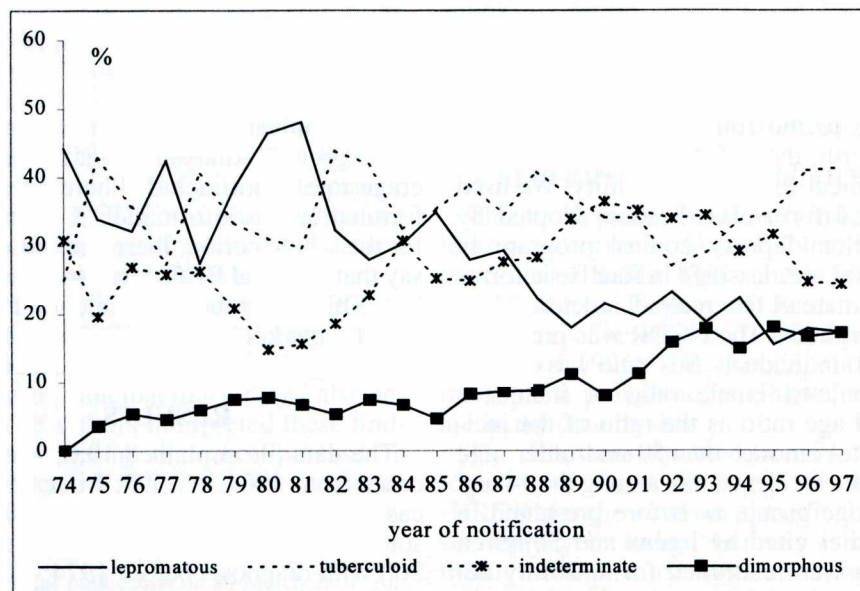


FIG. 2. Percentage of leprosy cases by clinical forms and sex, all ages. Bahia, Brazil, 1974–1997.

the series, but since 1979 it has presented an upward trend. One hundred forty-six cases were detected in 1974, in contrast to 353 in 1979. From 1978 (when the NCDR was still stable) to 1997 the rate of detection of new cases increased from 0.22 to 1.43 per 10,000 inhabitants. The average annual detection rate within the period 1979–1997 (when the

NCDR was increasing) rose by nearly 7.4% for both sexes [95% confidence interval (C.I.), 6.7–8.1]. However, this trend was not the same for males and females: it was 6.4% (95% C.I., 5.7–7.2) for males and 8.5% (95% C.I., 7.9–9.2) for females.

Figure 2 presents the proportional distribution of new cases according to clinical

TABLE 1. Sex ratio and 95% confidence interval (CI) for leprosy by clinical form, age and time period. Bahia, Brazil, 1974–1997.

Age	Period year	Lepromatous ratio (CI)	Dimorphous ratio (CI)	Tuberculoid ratio (CI)	Indeterminate ratio (CI)
0–14 years	1974–78	1.58 (0.46–6.15)	(imprecise numbers)	1.24 (0.54–2.89)	0.91 (0.36–2.24)
	1979–83	0.83 (0.45–1.53)	1.38 (0.38–5.51)	1.01 (0.63–1.62)	1.33 (0.78–2.30)
	1984–88	1.50 (0.99–2.29)	1.53 (0.62–4.00)	1.01 (0.70–1.47)	1.09 (0.72–1.65)
	1989–93	1.99 (1.34–2.98)	2.14 (1.27–3.72)	0.83 (0.61–1.11)	1.01 (0.78–1.31)
	1994–97	2.05 (1.22–3.52)	1.60 (0.92–2.86)	0.91 (0.66–1.25)	0.85 (0.62–1.18)
15–older	1974–78	2.42 (1.91–3.10)	2.94 (1.48–6.25)	1.29 (0.96–1.72)	1.24 (0.87–1.78)
	1979–83	2.16 (1.88–2.50)	1.84 (1.30–2.62)	1.27 (1.08–1.50)	1.50 (1.19–1.89)
	1984–88	2.18 (1.92–2.47)	1.11 (0.84–1.46)	1.02 (0.89–1.16)	0.95 (0.81–1.11)
	1989–93	2.45 (2.20–2.73)	1.34 (1.15–1.56)	0.93 (0.83–1.03)	0.79 (0.71–0.88)
	1994–97	2.62 (2.33–2.95)	1.27 (1.11–1.46)	0.78 (0.70–0.86)	0.65 (0.57–0.74)

form and sex. The lepromatous form has always predominated among males. The proportion of all cases in this clinical form has decreased slightly over time. This proportion was higher (mean of 47.9%) between 1974 and 1987 than in the 1988–1997 period (mean of 36.0%). There was however an increase in the proportion of dimorphous forms observed from early 90s so that the proportion of multibacillary (MB) forms (dimorphous and lepromatous) remained stable. Among females, until the mid-1980s there was similar proportion of tuberculoid and lepromatous forms; and a subsequent reduction in the proportion of lepromatous cases, so that the paucibacillary (PB) forms predominated after this period. The proportions of lepromatous forms in the 1974–1987 period averaged 35.4% (range 27.9–48.0), and in 1988–1997 averaged 19.6% (range of 17.3–23.2). As lepromatous form decreased there was an increase in the proportion of dimorphous forms. Despite this increase and differing from the pattern in males, the main forms of leprosy among females have been tuberculoid and indeterminate from the late 1980s to 1997.

The NCDR for clinical forms presented different average rate of increase for males and females within the period 1979–1997 (figure not shown). Among males, the average annual rate of increase was 4.8% (95% C.I., 4.0–5.4) for the lepromatous form, 5.8% (95% C.I., 4.4–7.2) for tuberculoid, and 7.1% (95% C.I., 5.4–8.8) for indeterminate. Among females, the corresponding values were 3.4% (95% C.I.; 2.2–4.5), 8.9% (95% C.I.; 7.4–10.5), and 11.9%

(95% C.I.; 9.9–13.9) respectively. Therefore, for tuberculoid and indeterminate forms, the increase was larger in women than in men, and for lepromatous cases larger in men than in women.

Table 1 presents the sex ratio (males/females) in NCDR over time, broken down by age group, clinical forms and period. Two patterns can be observed. First, among lepromatous cases, the rate in males was higher than in females over the whole period, except for 1979 to 1983. Second, among people aged 15 years or older with tuberculoid or indeterminate forms, the NCDR started higher among men than among women, but from 1984-onward the NCDR increased more among females than males.

Figure 3 shows the NCDR among children aged 0–14 years by sex and clinical forms. The overall NCDR increased over the period, with no clear difference in average annual rate of increase between males (10.1%; 95% C.I.: 8.7–11.6) and females (9.4%; 95% C.I.: 8.2–10.6). There were, however, changes in the distribution of clinical forms according to sex. Among males, over time there was a slightly greater increase in NCDR of tuberculoid and indeterminate rates over lepromatous rates. The NCDR of all clinical forms increased during the period. Among females there was a sustained increase in tuberculoid and indeterminate forms, which predominated since 1988. Unlike males, the increase in the NCDR was mainly due to indeterminate and tuberculoid forms, as the rate of detection of lepromatous and dimorphous forms has been stable over time, except for a peak of incidence in 1990.

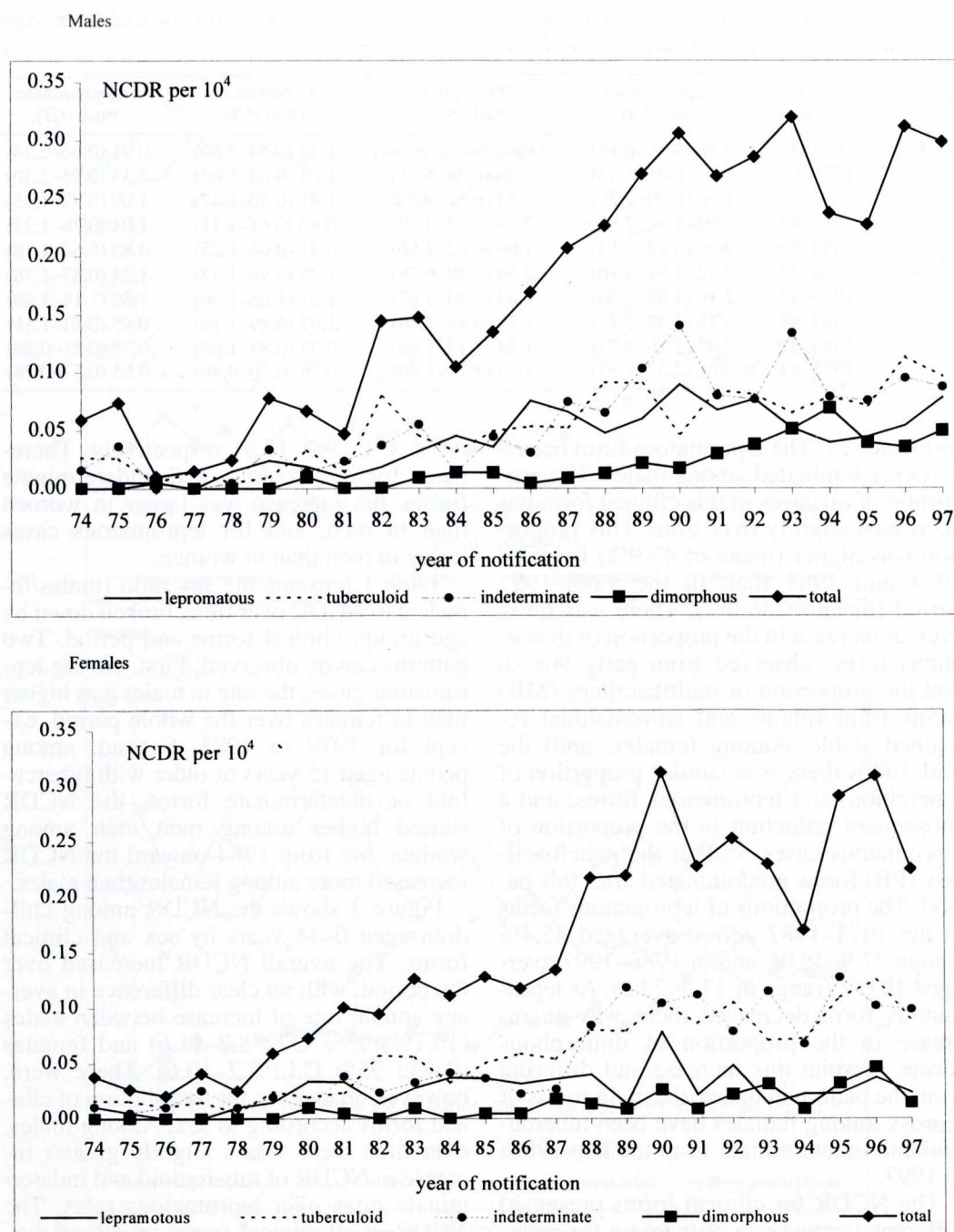


FIG. 3. New case detection rate of leprosy per 10,000 among individuals aged 0–14 years by sex and clinical form. Bahia, Brazil, 1974–1997.

The proportion of cases aged 0–14 years among the total of leprosy reported cases varied over time (data not presented). Among males, the proportion was 2.3% in the 1974–1979, and increased over time, reaching 9% in 1982 and 12%

in 1987. Since then, the values remained stable around 9%–10%. Conversely, among females no marked changes was observed, and during the entire period of 1974–1997 the proportions were around 9%–10%.

TABLE 2. Age ratio and 95% confidence interval (CI) of leprosy by clinical form, sex and time period. Bahia, Brazil, 1974–1997.

Sex	Period year	Lepromatous ratio (CI)	Dimorphous ratio (CI)	Tuberculoid ratio (CI)	Indeterminate ratio (CI)
Males	1974–78	36.92 (17.77–88.77)	(imprecise numbers)	10.94 (5.91–21.32)	8.95 (4.22–20.24)
	1979–83	37.16 (23.91–60.57)	19.33 (8.74–53.06)	12.02 (8.32–17.72)	6.86 (4.46–10.70)
	1984–88	15.31 (11.54–20.59)	10.38 (5.53–20.66)	9.52 (7.08–12.94)	5.17 (3.58–7.52)
	1989–93	16.20 (12.73–20.85)	10.94 (7.87–15.45)	8.77 (6.81–11.37)	3.28 (2.54–4.25)
	1994–97	17.82 (13.11–24.69)	11.68 (8.08–17.31)	7.75 (5.97–10.13)	3.18 (2.30–4.39)
Females	1974–78	19.53 (7.34–65.33)	(imprecise numbers)	8.46 (4.12–18.41)	4.23 (1.79–10.15)
	1979–83	13.73 (8.84–22.05)	11.54 (4.04–4.29)	8.92 (6.06–13.37)	3.61 (2.01–6.47)
	1984–88	10.77 (7.51–15.75)	17.04 (8.26–39.55)	8.25 (9.31–6.92)	4.93 (3.36–7.28)
	1989–93	11.18 (7.85–16.26)	15.51 (9.77–25.71)	6.78 (5.35–8.64)	3.53 (2.75–4.53)
	1994–97	15.16 (9.72–24.68)	17.84 (11.39–29.27)	9.10 (7.15–11.69)	3.77 (2.85–5.01)

Table 2 shows the age ratio of the NCDR among people aged 50 years or older and people aged 0–14 years, broken down by sex, year period and clinical forms. The highest age ratios were among males with lepromatous cases, but this has declined markedly over time. Moreover, there was a reduction in the ratios among males with indeterminate clinical form. There were no clear changes in the age ratio among females.

Figure 4 shows age-specific NCDR in children aged 0–14 years in consecutive birth cohorts. Those who were born in 1974–1978 constituted the first cohort. The second cohort, constituted by those who

were born in 1979–1983, has a higher NCDR from age 6 (~1985), until the end of the study period, with the exception of age 12. The third cohort, those born in 1984–1988, has a higher NCDR than the first cohort from age 3 (~1987) to age 10, with a decrease in the rate starting at age 9 (~1995). The last cohort, those born in 1989–1993, has only 8 years of follow-up. The NCDR is the same as the first cohort until age 7 and lower at age 8 (in 1997).

Figure 5 shows the proportion of new leprosy cases according to how they were detected. Completeness of data in the notification system was poor at the beginning of the study period, but had a gradual and

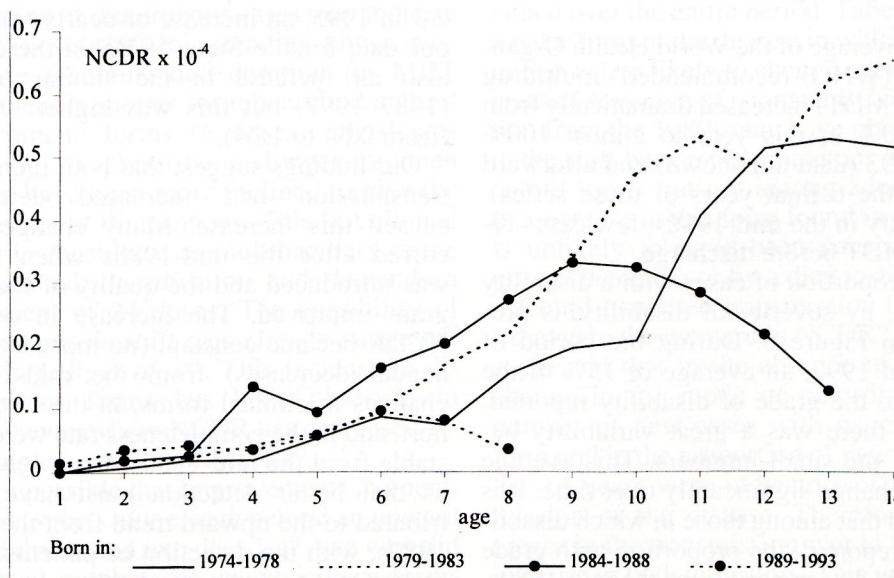


Fig. 4. New case detection rate of leprosy per 10,000 by birth cohort (among those born in 1974–1978, 1979–1983, 1984–1988, 1989–1993). Bahia, Brazil, 1974–1997.

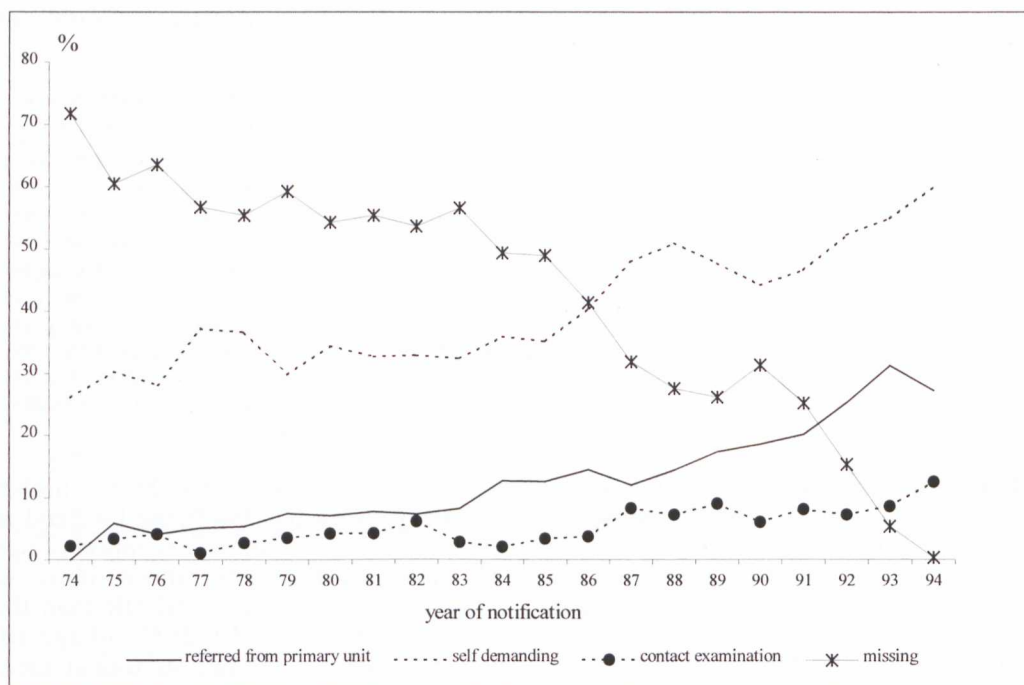


FIG. 5. Percentage of new leprosy cases according to form of detection. Bahia, Brazil, 1974–1994.

marked improvement during the period, mainly from the mid-1980s. The means by which cases were detected did not change noticeably over time. The majority of cases were detected by passive surveillance based on self-reporting to the health care facilities.

The coverage of the World Health Organization (WHO)-recommended multidrug therapy (MDT) increased dramatically from 1988: 50% in this year to almost 100% since 1993 (data not shown) and afterward (during the 6 final years of these series). Previously in the mid-1980s, few cases received MDT before discharge.

The proportion of cases with a disability detected, by severity of disability, is presented in Figure 6. During the period of 1974 and 1997, an average of 15% of the cases had the grade of disability reported. Initially there was a great variability because of the small numbers. This average did not change significantly over time. It is observed that among those in which disability was reported, the proportion with grade 3 or grade 2 decreased since the mid-1980s, in addition to a proportional increase of those with grade 1.

## DISCUSSION

Some of our findings are similar to the national data presented in previous studies. For instance, Andrade, *et al.* (1), reported in their paper an increase in the Brazilian NCDR from 1.4 (per 10,000) in 1987 and 2.3 in 1995, an increase of nearly 60%. In our data for the State of Bahia there was also an increase in the similar period (1987–1997) but this was higher: 93.8% (from 0.64 to 1.24).

Our findings suggest that both increased transmission and increased detection caused this increase. Many changes occurred after the mid-1980s when MDT was introduced and the quality of the program improved. The increase in overall NCDR became constant (no more isolated annual decreases) from the mid-1980s, changes in clinical forms, in the birth cohort, and in the completeness rate were also stable from the mid-1980s. So, it seems to us that better detection must have contributed to the upward trend from the mid-1980s, with the detection of patients at an earlier stage of disease leading to an increased proportion of tuberculoid and indeterminate forms.

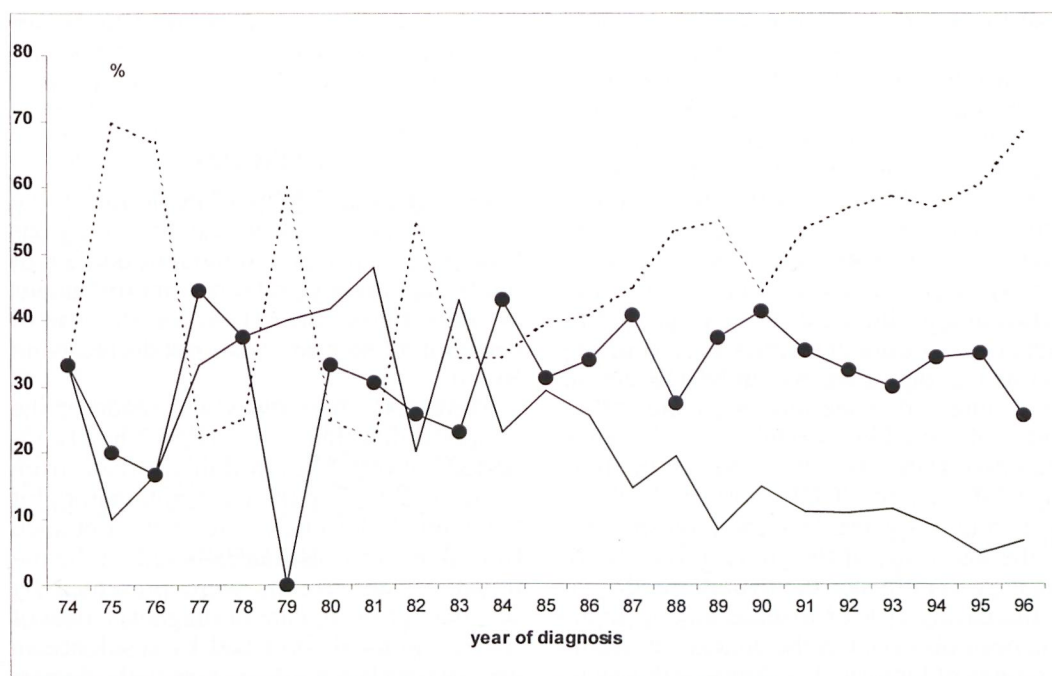


FIG. 6. Percentage of cases with grade of disability was reported. Dotted line, grade 1. Straight line and circle, grade 2. Straight line, grade 3.

Interestingly, while detection of lepromatous cases decreased, dimorphous cases increased. It is possible that the proportion of lepromatous forms decreased because of an increased detection of cases in the earlier stages of the disease. However, increased detection of dimorphous cases may indicate a diagnosis shift by attending physicians. As the recommended duration for MDT treatment is shorter for tuberculoid and indeterminate forms (6 doses), physicians wishing to prescribe a longer regimen might have been more inclined to give the diagnosis of dimorphous. This last clinical form is considered as multibacillary in the operational classification and demands a treatment of 24 doses. The possibility of this diagnosis shift was already suggested by Martelli, *et al.* (6). This increase in dimorphous forms has been observed in Brazil even where NCDR has decreased after implementation of MDT (11).

Is it possible that improvements in operational aspects alone were behind an upward trend that lasted two decades? And why did detected numbers of paucibacillary forms increase as well? The upward trend described in our study was present before

MDT implementation and continued afterward, while the improvement in the completeness of records was observed mainly from mid-1980s. So, it seems to us unlikely that operational changes alone can be responsible for this increase in NCDR sustained over the entire period. Tuberculoid is a polar form of the disease in which the definition is less likely to change over time. Increased coverage of neonatal BCG vaccination from the 1980s may have played a role in the shift between lepromatous and tuberculoid forms but not among adults. Thus, the increase in this form found in our study is unlikely to have been caused by improved detection or by a diagnostic shift.

Could increased transmission have contributed to the increase in NCDR? Htoon (3) suggested that in the absence of a drastic change in the mode of case-finding, the number of new cases with paucibacillary form and in the proportion of new cases under 14 years were indicators of the transmission of the disease. Therefore, an increase in the transmission would lead to an increase in both indicators. This would happen as a consequence of two mechanisms. First, higher intensity of infection would



lead to an earlier exposure in life and thus to an earlier age of onset of the disease. Second, this would lead to an increase in the proportion of cases with clinical forms with shorter incubation periods, that is, tuberculoid and indeterminate forms and consequently a decrease in the age of onset. This is consistent with the findings that the average age at onset tends to be lower when the prevalence rates are high<sup>(5)</sup> and vice versa, and an increase in the rates of paucibacillary during epidemics<sup>(9)</sup>. According to this paradigm, the rise in NCDR among the young and in the rate of paucibacillary forms observed in this study would suggest increased transmission. However, the finding of decreased NCDR in recent birth cohorts might suggest decreased transmission in the last years of the study, probably too recently to influence the overall trend.

Increasing risk of disease among males has been observed in the context of declining rates of leprosy<sup>(4,5)</sup>. Areas with low incidence rates have a higher male:female ratio.<sup>(4,5)</sup> Therefore, we can hypothesize that during increasing transmission the male:female ratio would decrease. In this study, an increased NCDR of tuberculoid and indeterminate cases was observed among women. However, the sex ratio has not always had that pattern<sup>(4)</sup> and it is likely that this pattern depends on males and females having different levels of exposure, and this reflects sociologic patterns that vary in different places.

The increase in the NCDR gives the opportunity to study and to develop epidemiological indicators for leprosy in a context of increased detection rates, a situation rarely found in such a scale elsewhere. However, it is not possible to disentangle the effects of operational changes from actual changes in transmission. Brazil is a large country with a continually increasing NCDR in many states, but with a huge diversity in economical and social development, performance of the surveillance services and operational changes. In our opinion this diversity makes it very difficult to draw a uniform picture of what is causing this trend in leprosy in the country as a whole whether epidemiological or operational indicators are used. We suggest that it is necessary to perform further analysis of data from local registers, ideally including changes in BCG

coverage and in socioeconomic patterns, allowing for regional differences in the mix between improved detection and increased transmission.

## SUMMARY

**Background.** The worldwide fall in the rate of detection of new cases of leprosy has been partly attributed to the introduction of multidrug therapy and other improvements in control programs. However, the rate of detection of new cases has not decreased in Brazil.

**Methods.** An analysis was made of the temporal distribution of 18,872 newly reported leprosy cases in Bahia, Brazil, from 1974 to 1997. Population denominators for the annual detection rate were obtained from population estimates based on the national census. Trends were presented by sex, date of birth, date of diagnosis, date of release, clinical form and by residence in areas which had notified cases in the 5 years prior to the rise in detection rate.

**Results.** There was a marked increase in the new case detection rate (NCDR) in the State of Bahia, from 0.19 to 1.43 cases per 10,000 inhabitants during the study period, an increment of nearly 7% to 8% per year. This increase was also observed in people aged 14 years and younger. During this period tuberculoid and indeterminate forms have become predominant among women and younger people. The average age of male cases has shifted toward younger ages.

**Conclusions.** We interpret this pattern to mean that the increase in NCDR reflects a real increase in incidence of leprosy, whether or not accompanied by improved detection.

## RESUMEN

**Panorama.** La caída a nivel mundial en la tasa de detección de nuevos casos de lepra ha sido atribuida, en parte, a la introducción de la poliquimioterapia y a la mejoría en los programas de control de la enfermedad. Sin embargo, la tasa de detección de nuevos casos de lepra no ha disminuido en Brasil.

**Métodos.** Se hizo un análisis sobre la distribución temporal de 18,872 casos nuevos de lepra detectados entre 1974 y 1997 en Bahía, Brasil. Los parámetros para la detección de casos tomaron en cuenta los datos de los censos nacionales de la población. Se registraron el sexo, la fecha de nacimiento, la fecha de diagnóstico, la fecha de alta, la forma clínica y el tiempo

de residencia de los pacientes en áreas donde se habían notificado casos de lepra en los últimos 5 años del estudio.

**Resultados.** Hubo un marcado incremento en la tasa de detección de nuevos casos (TDNC) en el estado de Bahía, de 0.19 a 1.43 casos por 10,000 habitantes, durante el período de estudio, un incremento que fue cercano al 7–8% anual. Este incremento también se observó en la población de 14 años y menores. Durante este período, las formas tuberculoide e indeterminada de la lepra fueron predominantes entre las mujeres y la gente joven. La edad promedio de los casos masculinos también se observó desplazada hacia los grupos más jóvenes.

**Conclusiones.** El incremento en la tasa de detección de nuevos casos de lepra, refleja no sólo el resultado de la aplicación de mejores programas de detección de casos, sino también un incremento real en la incidencia de la enfermedad en este estado de Brasil.

### RÉSUMÉ

**Contexte.** La chute globale du taux de détection des nouveaux cas de lèpre a été attribuée en partie à l'introduction de la polychimiothérapie ainsi qu'à la mise en œuvre d'améliorations des programmes de contrôles.

**Méthodes.** La distribution temporelle de 18 872 nouveaux cas de lèpre, provenant de la région de Bahia au Brésil, fut analysée entre 1974 et 1997. Les dénominateurs de population appliqués aux taux de détection annuels furent obtenus à partir d'estimations de la population, eux-mêmes extrapolés à partir du recensement national. Les tendances furent présentées par genre, date de naissance, date du diagnostic, date de sortie d'hospitalisation, forme clinique et par résidence dans les régions qui ont eu des cas mentionnés dans les 5 années précédant la hausse du taux de détection.

**Résultats.** Il a été observé une augmentation marquée du taux de détection de nouveaux cas (TDNC) dans l'état de Bahia, de 0,19 à 1,43 cas pour 10 000 habitants pendant la période étudiée, par incréments de 7% à 8% par an. Cette augmentation a aussi été observée dans la population âgée de 14 ans et moins. Durant cette période les formes tuberculoïdes et indéterminées sont devenues prédominantes parmi les femmes et les plus jeunes. L'âge moyen des cas masculins a aussi diminué.

**Conclusions.** Nous interprétons cette tendance comme suit: l'augmentation de TDNC reflète une augmentation réelle de l'incidence de la lèpre, qu'elle soit ou non accompagnée de l'amélioration de sa détection.

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