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The influence of increased access to basic healthcare on the trends in Hansen's disease detection ratein Brazil from 1980 to 2006

Influência do aumento do acesso à atenção básica no comportamento da taxa de detecção de hanseníase de 1980 a 2006

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ABSTRACT

Brazilian Hansen's disease detection rate rose during the 80s and 90s of the 20th century. The Brazilian health system reform happened during the same period. Detection rate is a function of the real incidence of cases and the diagnostic agility of the health system. Coverage of BCG immunization in infants was used as a proxy variable for primary healthcare coverage. A log-normal regression model of detection rate as a function of BCG coverage, time and time square was adjusted to data. The detection rate presents an upward trend throughout the period and with a downturn beginning in 2003. The model showed a statistically significant positive regression coefficient for BCG coverage, suggesting that detection rate behavior reflects the improvement of access to health care. The detection rate began a trend towards decline in 2003, indicating a new phase of Hansen's disease control.

Key-words: Leprosy. Health systems. Epidemiology. Health surveillance.

RESUMO

A taxa de detecção da hanseníase no Brasil aumentou nas duas últimas décadas do século XX, sendo que a reforma sanitária ocorreu no mesmo período. A taxa de detecção é função da incidência real de casos e da agilidade diagnóstica do sistema de saúde. Utilizou-se a cobertura vacinal por BCG como uma variável procuradora do acesso à atenção primária em saúde. Uma regressão log-normal foi ajustada à taxa de detecção de 1980 a 2006, com o tempo, tempo ao quadrado e da cobertura do BCG como variáveis independentes, sendo positivo o coeficiente de regressão desta última variável, sugerindo que o comportamento da taxa de detecção da hanseníase refletiu a melhora de acesso à atenção primária no período estudado. A tendência de aumento da taxa de detecção se reverte em 2003, indicando o início de uma nova fase no controle da hanseníase.

Palavras-chaves: Hanseníase. Sistemas de saúde. Epidemiologia. Vigilância epidemiológica.

Although over 25 years have passed since the introduction of multi-drug therapy (MDT), there is no clear evidence of its impact on the transmission of Hansen's disease (HD), also known as leprosy. In reality, more in-depth knowledge of the transmission of *Mycobacterium leprae* is still required[1] in order to inform control activities that could have a substantial impact upon transmission[8].

Using prevalence rate as the only parameter, HD is considered to be eliminated when the prevalence of known cases is less than 1 case per 10,000 inhabitants (equivalent to 10/100,000). Using this insufficient parameter, the objective of eliminating HD was reached in the vast majority of countries by 2005, with the exception of nine countries, including Brazil[12].

Even though the prevalence of known cases in the world has been significantly reduced through programs that focused on diagnosis, shorter treatment regimens and patient cure, the new case detection rate for HD remained high in most parts of the world, including Brazil, thus preventing the attainment of a prevalence rate of 1/10,000 inhabitants.

The detection rate is a function of the real incidence of cases and the diagnostic agility of the health system. A reduction in the correlation between the detection rate and the real incidence results in an increase in the hidden prevalence of cases, which is the main cause for continued disease transmission. Therefore, a decrease in HD transmission presupposes a reduction in the hidden prevalence through early detection, which reduces the duration of the active disease period prior to diagnosis.

Keeping in mind that HD is not a disease that leads to fatality, the hidden prevalence might be several times greater than the actual incidence. For example, in a highly endemic area where the average age of disease onset is low and where there is no viable health service, the HD hidden prevalence could be as much as 30 times higher than disease incidence. Imagine that health services are implemented in this same area, something that would

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lead to an increase in health coverage over time, the subsequent increase in the HD detection rate would reflect the surge in health system coverage and access to diagnosis and treatment. Once this coverage/access to diagnosis begins to stabilize, the detection rate would behave similarly over time, following the trends of the hidden prevalence. At this point in time, if the detection rate were higher than the real incidence rate, the hidden prevalence would tend to fall. The detection rate would decline as a function of the reduction of the hidden prevalence and over a period of time would tend to become equal to the real incidence rate, at which point a reduction in disease duration prior to diagnosis would no longer be possible.

The period under study corresponds to the beginning of health sector reform and consolidation of the SUS, guaranteed in the Constitution of 1988, when the right to universal healthcare was assured and the municipal level was defined as the key stakeholder of the system. As a consequence, during this period, a key transformation was witnessed from a health system that was concentrated in hospitals and largely available only to the large urban populations of the South-east region of the country, into a system where many health establishments, principally health units and centers, were extended into regions where few had existed previously. A few examples of this trend: the number of health units more than doubled, increasing from 18,489 in 1980 to 49,232 in 1994[5]; the coverage of the three doses of the DPT triple vaccine in infants went from 37.43% in 1980 to 85.64% in 2006 (DPT + Hib); poliomyelitis was eradicated from the country and measles was controlled. Health indicators that reflect improvements in socioeconomic indicators, as well as those in the health system, also showed considerable development. Life expectancy increased from 62.6 years in 1980 to 75.2 in 2003[6] and infant mortality fell from 82.8 per 1,000 live births in 1980 to 26.6 per 1,000 live births[3].

Therefore, the study of the variation of the HD detection rate over time requires the incorporation of a variable that reflects the modifications in the health system over this period.

Other factors that have influenced the registered detection rate are operational changes in the epidemiological surveillance system, some of which are well-known, others are less so. Certainly, it is possible to imagine that epidemiological surveillance systems may vary operationally from year to year, but not in a stable way for one or two decades, in a similar proportion or consistently increasing or decreasing. Extended time series epidemiological data, such as those used for the detection rate in Brazil, are necessary for any inference of the true tendency of this indicator. The statistical adjustment of the time series data seeks to capture tendencies in this indicator, considering any variations as random. In addition to the description of this process, adjustment of the model allows for the prediction of future values through extrapolation for the following years. These predictions presume that there are no fundamental changes in the tendencies of the detection rate in relation to those seen in the past.

The choice to reorganize the Brazilian health system strengthened the primary care level above all others. This was conducted using other international models as a reference, with the guiding principles of solidarity, equality and integrality. In Brazil, the term *basic healthcare* is used more often than *primary care*, and its expansion took place because of successful national experiences at the time, beginning with the community health agents program and evolving into the family health strategy.

The continuation of this revolution has been made clearer with the publication of the National Policy for Basic Healthcare in 2006, in which this level of care is given greater autonomy as the organizing force behind the entire health system with a more horizontal and less hierarchical design.

In 2007, 27,000 family health teams existed in Brazil with more than 200,000 community health agents, covering a population of over 85 million Brazilians.

In this study, we looked at the trends in HD detection in the country from 1980 to 2006, comparing its variation with that of a proxy variable for basic healthcare coverage over the same period.

MATERIAL AND METHODS

The number of new cases of HD notified from 1980 to 2004 was extracted from publications issued by the Ministry of Health[7], and the totals for 2005 and 2006 were extracted from the National HD Control Program of the Secretariat of Health Surveillance, located in the Ministry of Health. Demographic data came from the DATASUS website[2].

As the proxy variable for primary healthcare coverage, the coverage rate for BCG vaccine in infants (0-1 year old) from 1980 to 2007 was chosen. These data were extracted from the National Immunization Program, also in the Secretariat of Health Surveillance of the Federal Ministry of Health.

The notified HD case detection rate and immunization coverage for each year were adjusted to a time-homogeneous parabolic function through a log-normal regression.

The correlation coefficient was also estimated between the HD detection rate and the BCG vaccine coverage per year and adjusted to a log-normal regression model with detection rate as the dependent variable and BCG coverage, time and time square (t^2) as the independent variables. This was a model where the logarithm of the detection rate is a time-homogeneous parabolic function and a linear function of the BCG vaccine coverage in infants.

The statistical regressions were performed using the *Statística* software[11].

RESULTS

The HD detection rates per year are presented in **Table 1**. The adjustment to the parabolic model of detection data was appropriate, given that the two parameters included are statistically significant (time and time sq) and had estimated parameters with contrary signs (positive regression coefficient for time and negative for time sq). This indicates

that the upward tendency in the detection rate is not the same throughout the period and shows a downturn beginning in 2003 (**Table 2**).

The BCG vaccine coverage was likewise adjusted to the parabolic model, with the two parameters included also proving to be statistically significant with estimated parameters presenting contrary signs (**Table 2**). This shows that the increasing trend is not the same over the entire period, it decreased over time and then stabilized when coverage reached 100%.

The correlation between these two variables was statistically significant and equal to a CI of 0.95. The model that included vaccine coverage as the independent variable also presented three significant parameters, which included the positive regression coefficient for coverage (**Table 2**), demonstrating that an increase in vaccine coverage means in increase in the detection of HD, according to the model.

Figure 1 shows the variation of the detection rate per 100,000 inhabitants and the prediction of the time-homogeneous parabolic function model and the prediction of the model as a function of time and BCG coverage. **Figure 2** determines the percentage of vaccine coverage and the prediction of the time-homogeneous parabolic function model.

TABLE 1

Number of new hansen disease cases and detection rate, Brazil, 1980-2006.

Year	Number of new reported cases	Rate per 100,000 population
1980	14,515	12.1963463
1981	17,133	14.1414873
1982	16,994	13.7298371
1983	18,798	14.8714411
1984	18,854	14.6126066
1985	19,265	14.6346905
1986	18,476	13.7645888
1987	19,685	14.3916462
1988	26,578	19.0824047
1989	27,837	19.6429519
1990	28,482	19.7667087
1991	30,094	20.4964431
1992	33,396	22.4610402
1993	34,251	22.5994895
1994	33,190	21.590297
1995	36,263	23.2720226
1996	40,505	25.7878385
1997	45,125	28.2673808
1998	42,444	26.2339775
1999	42,389	25.8552381
2000	41,305	24.3257962
2001	44,609	25.8774251
2002	47,506	27.2033456
2003	49,026	27.7176838
2004	49,366	27.5621207
2005	49,506	26.8785454
2006	46,535	24.9155899

TABLE 2

Estimated parameters of the log-normal model.

Estimated parameters of the model: ln (rate) = a+b*t+c*t^2				
Parameter	Estimated	Standard error	Wald test	p-value
Intercept (a)	2.349168	0.059194	1574.987	0.000000
t(b)	0.075886	0.008068	88.476	0.000000
t^2(c)	-0.001531	0.000252	37.038	0.000000
Estimated parameters of the model: ln (coverage) = a+b*t+c*t^2				
Parameter	Estimated	Standard error	Wald test	p-value
Intercept (a)	3.873017	0.056388	4717.599	0.000000
t(b)	0.067228	0.007698	76.275	0.000000
t^2(c)	-0.001507	0.000238	40.140	0.000000
Estimated parameters of the model: ln (rate) = a+b*t+c*t^2+d*cov				
Parameter	Estimated	Standard error	Wald test	p-value
Intercept (a)	2.006333	0.116498	296.5969	0.000000
t(b)	0.050793	0.017561	8.3656	0.003824
t^2(c)	-0.000988	0.000439	5.0716	0.024320
Coverage (d)	0.006090	0.002485	6.0083	0.014238

t: time, t^2: time squared, cov: coverage, a: intercept, b: regression coeficient of time, c: regression coeficient of time squared, d: regression coeficient of time of coverage.

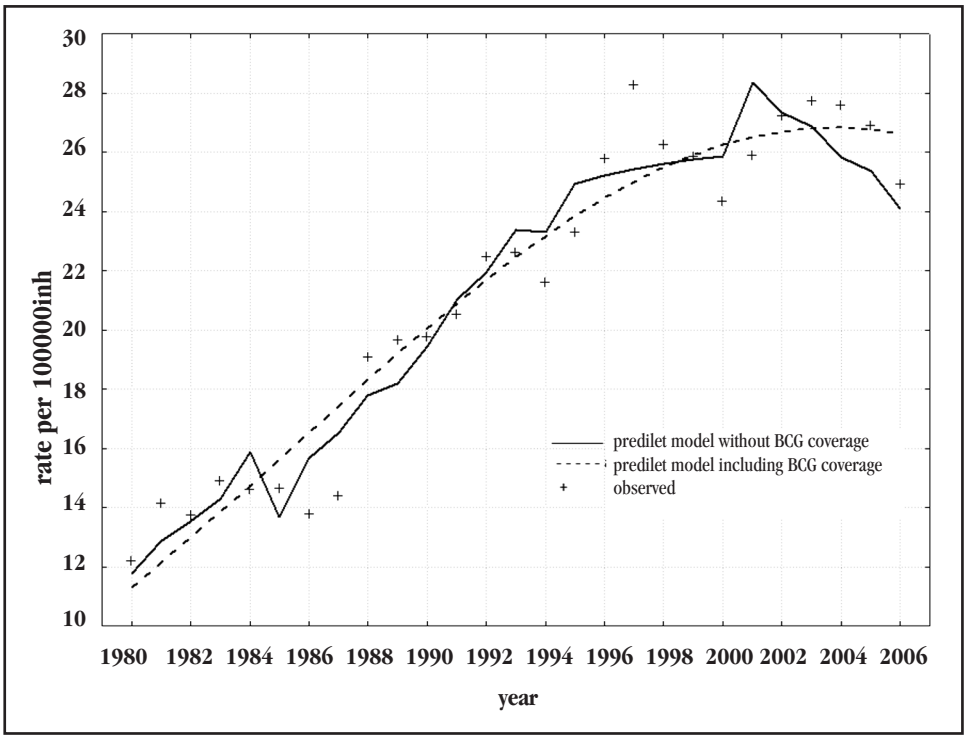

FIGURE 1

Leprosy detection rate. Brazil, 1980 to 2006.

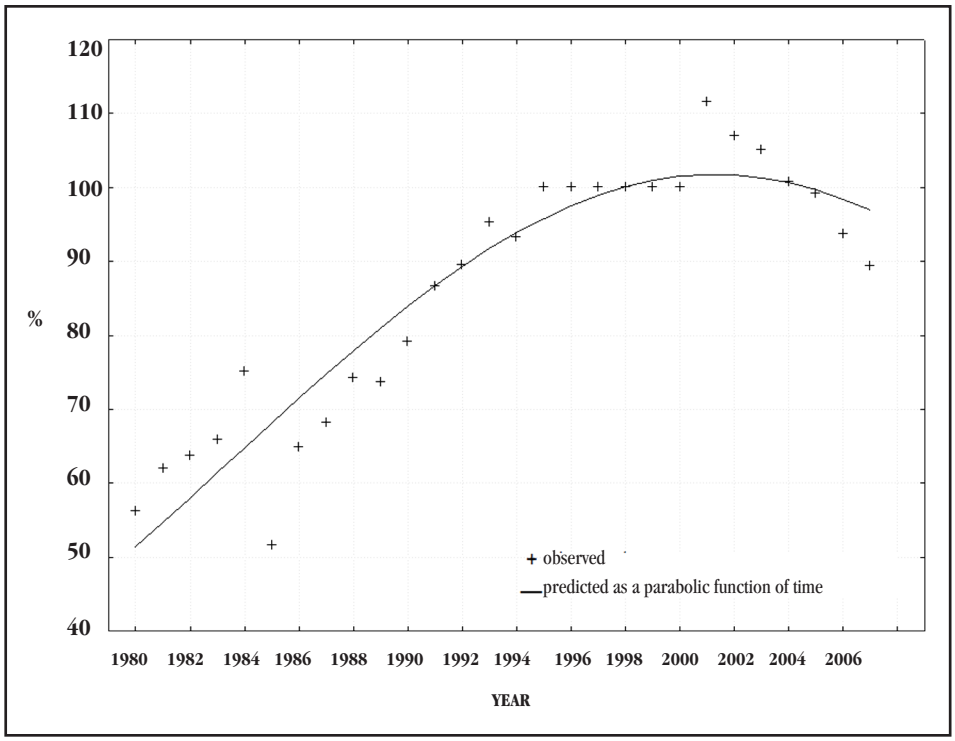

FIGURE 2

BCG immunization coverage among infants. Brazil, 1980 to 2007.

DISCUSSION

The use of log-normal regression is customary for epidemiological surveillance[4 9], given that the use of logarithms as a linking function permits the adaptation of the model to rates and proportions. Residual examination was conducted to guarantee the appropriateness of this choice.

Without a doubt, the trend in the HD detection rate in Brazil can be correctly described using a parabolic model, indicated a reduction in the pace of rate increase over time. It reached a point of stability and has since initiated a downward phase, as has already been reported in a smaller data series[10].

The choice of BCG vaccine coverage in infants as a proxy variable for the increase in basic healthcare coverage over this period was made primarily due to the difficulty of finding public time series data since 1980 from health centers, such as proportion of hospital births or others. Given the availability of immunization coverage data, we opted for the BCG vaccine because it is very rarely applied in public campaigns, rather it requires a visit to a health unit. The fact that some coverage totals go beyond 100% is due to problems in the denominator used, since it was based on the estimates of live births made by the IBGE for the entire period in question and also because imprecise data were registered regarding the age of the vaccinated child in the patient's medical records or given inaccurately by the parent or guardian.

The high correlation between the HD detection rate and BCG immunization coverage in infants, as well as its statistically significant inclusion in a regressive model, strongly suggests that the diagnostic capacity of existing cases is related to access to health centers. It is undeniable that as a result of the development of the SUS, access to health units has improved, principally when assessing rural populations and small-scale municipalities that have improved substantially over the last two decades. This fact, taken in isolation, could explain the ascendant tendency of the HD detection rate since 1980. If this hypothesis is true, a continual reduction in the hidden prevalence would be observed, revealed by a shorter timeframe between the onset of symptoms and diagnosis. The decline in hidden prevalence has a limit because, even in ideal situations, the diagnosis of skin diseases depends on the cultural importance given to skin lesions, as well as health-seeking habits among the population. An example of this is the period of time a patient waits to self-present for a cutaneous lesion or any other clinical sign that is not interpreted as threatening. Once the limit of reduction in hidden prevalence is met, the new case detection rate tends to reflect the real incidence of the disease.

Our statistical analysis of the data presented shows that the detection rate of HD cases began a trend towards an epidemiological decline in Brazil in 2003. This indicates that a new phase of control of the Hansen's disease endemic is currently occurring.

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