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Prevalence of trachoma in Brazilian schoolchildren

ABSTRACT

OBJECTIVE: To estimate the prevalence and describe the distribution of trachoma among schoolchildren in Brazilian municipalities.

METHODS: Cross-sectional study, using cluster sampling, of the schoolchildren population of the Brazilian municipalities with Human Development Index – Municipal lower than the national average. This trachoma prevalence survey was conducted by the Ministry of Health, in the period 2002-2007. There were 119,531 schoolchildren selected from 2,270 schools located in 1,156 municipalities. The selected schoolchildren underwent an external ocular examination, with a magnifying glass (2.5X), to detect clinical signs of trachoma according to the WHO criteria. The prevalence of trachoma, by state and national level, and their respective 95% confidence intervals were estimated. Chi-square and Chi-square for trends tests were used to compare categorical variables.

RESULTS: There were 6,030 cases of trachoma detected, resulting in a prevalence of 5.0% (95%CI 4.5;5.4). There was no significant difference between the sexes. The prevalence of trachoma was 8.2% among children under 5 years of age, decreasing among higher age groups ($p < 0.01$). There was a significant difference in prevalence between urban and rural areas, 4.3% *versus* 6.2% respectively ($p < 0.01$). Cases were detected in 901 municipalities (77.7% of the sample), in all regions of the country. In 36.8% of the selected municipalities, the prevalence was higher than 5%.

CONCLUSIONS: The study shows that trachoma is a significant public health problem in Brazil, contradicting the belief that the disease had been controlled in the country. The survey provides a baseline for evaluating planned interventions aimed at achieving the goal of global certification of elimination of trachoma as a cause of blindness in Brazil by 2020.

DESCRIPTORS: Child. Trachoma, epidemiology. Cross-Sectional Studies. Epidemiological Surveillance.

INTRODUCTION

Trachoma, an inflammatory disease of the eye affecting the cornea and conjunctiva, the evolution of which involves chronic relapse, is caused by *Chlamydia trachomatis* serotypes A, B, Ba and C and is the main cause of preventable blindness in the world. The World Health Organization (WHO) estimates that there are 41 million individuals, worldwide, with active trachoma and 7.6 million with trichiasis, the clinical sequelae of the disease, while 1.3 million suffer serious visual impairment and blindness.[9,13] Trachoma is linked to poor socioeconomic conditions and poor sanitation and hygiene.

In Brazil, trachoma was considered a significant health problem until the first half of the 20th century. Prevalence in the country then declined markedly from the 1960s onwards. The Ministry of Health carried out a national survey in 1974-1976 and, concluding that trachoma had been eradicated in some regions and was at sub-endemic level in others, prioritized work in specific areas, so-called "endemic pockets", in which prevalence reached 30%.[4] However, various studies realized after the mid 1980s, in different regions and states, found prevalence varying between 1.5% and 47.7% for active trachoma and from 0.1% to 2.0% for trichiasis, including indigenous populations.[1,2,5-8,11,12,14,15]

The WHO considers trachoma to be a neglected disease. According to its criteria for eliminating the disease as a cause of blindness, the prevalence of trachomatous inflammation – follicular needs to be reduced to under 5% in children aged from one to nine, and prevalence of trachomatous trichiasis to less than one case per thousand inhabitants in a community or district.[a]

In 1997 the Alliance for the Global Elimination of Blinding Trachoma by 2020 was created, under WHO leadership.[b] Brazil has participated in this initiative from the start and the Ministry of Health has reiterated its adherence to the goals of elimination. Thus, in order to support actions to control it, a national survey was carried out to discover the prevalence and distribution of the disease among schoolchildren, as there are no up to date national data.

The aim of this study was to estimate the prevalence and describe the distribution of trachoma among Brazilian schoolchildren in municipalities with a Human Development Index – Municipal below the national average.

METHODS

A cross-sectional study was carried out with pupils from the first to fourth year of primary education, attending public schools in municipalities a Human Development Index – Municipal below the national average, and in the Distrito Federal (DF). The municipalities were chosen based on the knowledge that trachoma is more prevalent in poorer communities,[9] thus allowing the investigation to be more focused.

There was no age limit for the participants, any pupil attending the year groups in question being deemed eligible.

The survey was carried out between 2002 and 2007, using probabilistic sampling selected through a procedure of stratified cluster sampling.

The sample size was calculated considering a 5% prevalence of active trachoma, accepting a maximum sampling error of 1% in 95% of the possible samples. An additional 20% was added to compensate for losses, giving an estimated sample of 2,400 pupils. This number was then multiplied by three, as three strata were created, resulting in a total of 7,200 pupils for each state.

The municipalities of each state, with HDI-M below the nation mean, were stratified according to population (Demographic Census 2000), using terciles as cutoff points, constituting three population strata, namely: small, medium and large municipalities.

For each population strata, a list of all the public schools and their respective number of pupils in first to fifth grade was composed and ordered according to municipality and location of the school (urban or rural).[f] Next, a systematic sample was selected from each list so that the proportional distribution of schools according to municipality and location (urban or rural) was similar to that of the population strata. All of the pupils registered in the schools were included in the sample.

For the purposes of this study, the administrative regions corresponding to the satellite cities in Brasília,

[a] World Health Organization. Report of the 2nd Global Scientific Meeting on Trachoma; 2003 Aug 25-27; Geneva. (WHO/PBD/GET/03.1).
[b] World Health Organization. Planning for the Global Elimination of Trachoma (GET): report of a WHO Consultation. Geneva; 1997.
[c] Programa das Nações Unidas para o Desenvolvimento; Instituto de Pesquisa Econômica Aplicada; Fundação João Pinheiro. Atlas do Desenvolvimento Humano no Brasil. Brasília (DF); 1998 [cited 2013 Jun 26]. Available from: http://www.pnud.org.br/IDH/Atlas1998.aspx?indiceAccordion=1&li=li_Atlas1998
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[e] Companhia de Planejamento do Distrito Federal – CODEPLAN. Brasília (DF); 2003 [cited 2013 Jun 26]. Available from: http://www.codeplan.df.gov.br/images/CODEPLAN/PDF/Pesquisas%20Socioecon%C3%B4micas/idh.pdf
[f] Ministério da Educação. Censo Escolar da 1ª a 4ª série do ensino fundamental, disponibilizados nos anos 2001-2006.

DF, Midwestern Brazil, were considered to be municipalities. In the period in which the survey was carried out, the DF was constituted of 19 administrative regions, of which only two had HDI-M below the national mean.[c] Consequently, only one population strata was considered and, thus, the sample for the DF was 2,400 schoolchildren.

In this study, results of the survey carried out in the following states are presented: Acre, Alagoas, Bahia, Ceará, Distrito Federal, Goiás, Maranhão, Minas Gerais, Mato Grosso do Sul, Pará, Paraíba, Piauí, Rio Grande do Norte, Rio Grande do Sul, Roraima, Santa Catarina, Sergipe, São Paulo and Tocantins. The 3,484 municipalities with HDI-M below the national mean in these states had a population of 70,831,574 inhabitants, 122,833 public schools with 10,799,725 school children registered.

Two cut off values for the HDI-M were used due to the availability of information on HDI-M at the start of the study and its being updated after 2000 (0.724 in 1991 and 0.764 in 2000).[e]

Standardized external eye examinations using a magnifying glass (2.5X) in natural or artificial light were carried out by trained examiners. All of the selected schoolchildren were examined for signs of trachoma, according to WHO criteria:[18]

- trachomatous inflammation follicular: presence of at least five follicles of at least 0.5 mm in diameter, in the upper tarsal conjunctiva;
- trachomatous inflammation intense: presence of trachomatous inflammation, obscuring more than 50% of deep tarsal blood vessels;
- trachomatous scarring: presence of trachomatous scarring;
- trachomatous trichiasis: presence of at least one eyelash touching the eyeball or evidence of recent removal;
- corneal opacity: presence of corneal opacity, which obscures the pupillary edge.

The schoolchildren examined and the cases of trachoma detected were recorded on the appropriate forms and dealt with according to Ministry of Health norms.[g,h] Family contacts were examined and treated when trachoma was found. Analysis of the data considered the category "inflammatory trachoma or active trachoma", formed by the joining of the clinically active forms of the disease: trachomatous inflammation – follicular and intense.

The variables analyzed were: presence of clinical signs of trachoma, age, sex and location of residence (state, municipality and rural or urban zone).

The prevalence of active trachoma was estimated for each state, referring to municipalities with HDI-M lower than the national mean, with the respective 95% confidence intervals according to sex, age group, urban or rural zone and clinical form. The estimates of prevalence were corrected for design effect and weighted according to the size of the school population of the eligible municipalities of each state.

To compare the categorical variables, the Chi-squared and Chi-squared for linear trend tests were used. Spatial-geographical distribution of the prevalence of trachoma was described for municipalities and state. The EpiInfo, version 6.4 and SPSS, version 12 applications were used to analyze the data.

Thus, 119,531 schoolchildren were examined, corresponding to 90.6% of the estimated sample of 132,000 pupils, distributed throughout 2,270 schools located in 1,156 municipalities. Losses (7.6%) occurred due to children being off school on the day of the eye exam and the parents or the child themselves refusing to take part. The state with the highest rate of losses was Alagoas (16.1%) and that with the lowest rate was Acre (0.3%). No differences were observed between the actually examined sample and the losses, in relation to distribution between rural and urban zones, nor in distribution according to sex and mean and median age. Moreover, it was noted that some schools sampled had a lower number of pupils than was recorded in the Ministry of Education (MEC) School Censusf, which explains the remaining difference between the estimated sample and the sample actually examined.

The research was approved by the Ethics Committee of the *Instituto Adolpho Lutz,* State Department of Health, Sao Paulo, in 5th April 2002.

RESULTS

Table 1 shows a description of the states in relation to the total number of municipalities, number of municipalities with HDI-M below the national mean and the number of schools and schoolchildren in these municipalities. According to the location of the school, 69.4% were in rural areas, although only 35.8% of total schoolchildren studied in one of these schools. In the states of Ceará and Maranhão the percentage of schoolchildren in the rural area was higher than in the urban area.

Of the total number of schoolchildren examined, 63,300 (53.0%) were male. The mean age of the

[g] Ministério da Saúde, Fundação Nacional de Saúde. Manual de controle do tracoma. Brasília (DF); 2001.
[h] Ministério da Saúde, Secretaria de Vigilância em Saúde. Portaria Nº 67, de 22 de dezembro de 2005. Inclui Azitromicina no tratamento sistêmico de tracoma. *Diario Oficial Uniao*. 23 dez 2005. Seção I:127.

Table 1. Description of the states in the study, according to the total number of municipalities, number of municipalities with Human Development Indices below the national mean, number of schools and pupils in the municipalities by urban and rural area. Brazil, 2002-2007.

State	Total	Municipalities with HDI-M < national mean		No of schools in municipalities with HDI-M < national mean				Nº of pupils in municipalities with HDI-M < national mean			
	n	n	%	Total	Urban area	Rural area	Rural area (%)	Total	Urban area	Rural area	Rural area (%)
Acre	22	22	100.0	1.494	190	1304	87.3	93.574	52.119	41.455	44.3
Alagoas	102	102	100.0	3.356	723	2633	78.5	465.187	251.947	213.240	45.8
Bahia	417	413	99.0	21.534	4.188	17.346	80.6	1.998.635	1.078.537	920.098	46.0
Ceará	184	183	99.5	9.809	1.705	8.104	82.6	928.568	438.518	490.050	52.8
Distrito Federal	19[a]	-2[a]	15.8	390	300	90	23.1	154.102	143.204	10.898	7.1
Goiás	246	194	78.9	4.380	2.726	1.654	37.8	465.668	425.400	40.268	8.6
Maranhão	217	216	99.5	11.228	1.678	9.550	85.1	798.986	360.639	438.347	54.9
Minas Gerais	853	662	77.6	15.332	9.715	5.617	36.6	1.347.968	1.144.273	203.695	15.1
Mato Grosso do Sul	79	59	74.7	1.154	956	198	17.2	219.463	194.222	25.241	11.5
Pará	144	140	97.2	14.122	2.583	11.539	81.7	1.065.606	555.260	510.346	47.9
Paraíba	223	222	99.6	5.970	1.210	4.760	79.7	512.007	288.183	223.824	43.7
Piauí	244	220	90.2	8.986	2.072	6.914	76.9	425.858	217.429	208.429	48.9
Rio Grande do Norte	167	165	98.8	3.291	806	2.485	75.5	284.551	167.247	117.304	41.2
Rio Grande do Sul	496	141	28.4	8.039	3.365	4.674	58.1	799.580	663.533	136.047	17.0
Roraima	15	14	93.3	618	105	513	83.0	42.908	29.800	13.108	30.5
Santa Catarina	293	65	22.2	7.188	3.432	3.756	52.3	457.049	381.376	75.673	16.6
Sergipe	75	74	98.7	1.554	366	1.188	56.2	178.609	93.844	84.765	47.5
São Paulo	645	373	57.8	1.983	937	1.046	52.7	376.588	325.958	50.630	13.4
Tocantins	139	136	97.8	2.405	567	1.838	76.4	184.818	125.617	59.201	32.0
Total	–	–	–	122.833	37.624	85.209	69.4	10.799.725	6.937.106	3.862.619	35.8

HDMI-M: Human Development Index - Municipal
[a] Administrative regions

sample was 9.4 years old, with a median of nine years old (maximum and minimum values were 19 and four years old, respectively). The age group from five to nine years old was the most common (58.4%), followed by the age groups from ten to 14 (38.7%), 15 and over (2.7) and from zero to four years old (0.2%). The latter is made up of a population below school age, but which regularly attended the year groups participating in this sample.

There were 6,030 cases of trachoma, both active and scarring forms, detected. Of these, 98.8% presented the trachomatous inflammation – follicular clinical form, 0.03% trachomatous inflammation – intense and 0.05% trachomatous scarring. No cases of trachomatous trichiasis or corneal opacity were detected in the sample studied (Table 2).

The 5,968 diagnosed cases of active trachoma resulted in an estimated prevalence of 5.0% (95%CI 4.6;5.4) for the municipalities with HDI-M below the national mean in the 18 states studied and the DF.

Schoolchildren in 1,156 municipalities were examined, corresponding to approximately 21% of the municipalities in Brazil, with cases of trachoma being detected in 901 municipalities (77.9%). Of the total municipalities studied, 431 (37.3%) had schools with a prevalence of trachoma ≥ 5% and, in 255 (22.1%) of the municipalities there were no cases of trachoma detected in the schools visited (Table 3). The highest rates of prevalence were found in the states of Ceará and Acre and the lowest in the Distrito Federal and Mato Grosso do Sul (Table 4).

Table 5 shows the prevalence of active trachoma according to sex, age and location of the school. There was no difference between sex (p = 0.699). The prevalence of trachoma decreased with age (under 5s: 8.2%; five to nine years old: 5.3% ten to 14 years old: 4.6%; 15 and over: 3.6%; p < 0.01). A total of 3.196 (4.3%) cases of active trachoma occur in urban areas and 2.772 (6.2%) in rural areas (p < 0.01).

Table 2. Prevalence of trachoma by clinical form. Brazil, 2002-2007.

Clinical form	Cases	Prevalence (%)
Trachomatous inflammation follicular	5,958	4.90
Trachomatous inflammation intense	34	0.03
Trachomatous scarring	60	0.05
Trachomatous trichiasis/ corneal opacity	–	–
Total	6,030[a]	5.00

[a] Includes cases with two clinical forms

DISCUSSION

Cases of trachoma were detected in all regions, contradicting the belief that it was under control in the South and South East of the country. Trachoma still occurs more frequently in populations in rural areas, concurring with national and international literature.[3,4,8,19] There was no difference with regards to the distribution of cases by sex, which is consistent with data reported in Brazilian studies of schoolchildren.[1,2,5,10,11] Distribution according to sex in Brazil differs from other countries, where higher prevalence among females has been observed.[16]

In this study, the schoolchildren's eye examinations were carried out over a mean period of two months in each state. Difficulties were encountered travelling in areas which were difficult to reach and a smaller number of pupils were registered by the Ministry of Education (MEC) Censusf especially in schools in rural areas. In spite of the large distances and logistical difficulties in some areas, the sample coverage was satisfactory and the losses deemed to be low. Therefore, the results of this study are valid and can be extrapolated to other municipalities with HDI-M lower than the national average.

The World Health Organization the disease to be under control when the prevalence of active trachoma is less than 5% in children aged between one and nine years

Table 3. Distribution of the number of municipalities with Human Development Indices below the national mean according to prevalence of trachoma in the regions of the country. Brazil, 2002-2007.

Prevalence of trachoma by municipalities (%)	Region										Brazil	
	North		Northeast		Southeast		South		Midwest			
	n	%	n	%	n	%	n	%	n	%	n	%
0	25	12.7	163	26.7	22	23.2	37	21.2	8	10.1	255	22.1
< 5	91	45.9	235	38.5	44	46.3	53	30.5	47	59.5	470	40.6
5 |- 10	43	21.7	120	19.7	20	21.0	53	30.5	18	22.8	254	22.0
≥ 10	39	19.7	92	15.1	9	9.5	31	17.8	6	7.6	177	15.3
Total	198	100.0	610	100.0	95	100.0	174	100.0	79	100.0	1,156	100.0

Table 4. Number of children examined and prevalence of trachoma in schoolchildren in municipalities with Human Development Indices below the national mean. Brazil, 2002 to 2007.

State	Examined	Cases	Prevalence	95%CI
	n	n	%	%
Acre	6,969	549	7.9	6.1;9.7
Alagoas	6,318	298	4.7	3.6;5.9
Bahia	5,943	210	3.5	2.6;4.4
Ceará	6,131	536	8.7	7.2;10.3
Distrito Federal	2,087	31	1.5	1.1;1.9
Goiás	6,233	322	5.2	3.8;6.5
Maranhão	5,735	237	4.1	3.0;5.3
Minas Gerais	5,892	283	4.8	2.6;7.0
Mato Grosso do Sul	6,344	214	3.4	2.4;4.4
Pará	6,950	457	6.6	5.0;8.2
Paraíba	6,253	233	3.7	2.9;4.5
Piauí	4,782	212	4.4	3.4;5.5
Rio Grande do Norte	6,212	226	3.6	2.8;4.5
Rio Grande do Sul	7,190	332	4.6	3.7;5.5
Roraima	6,986	313	4.5	3.7;5.3
Santa Catarina	7,932	472	6.1	5.2;6.9
São Paulo	8,001	330	4.1	2.9;5.4
Sergipe	6,318	368	5.8	4.3;7.4
Tocantins	7,255	407	5.6	4.3;6.9
Brasil	119,531	6,030	5.0	4.5;5.4

Table 5. Prevalence of active trachoma in schoolchildren according to age group, sex and area in which the school is located. Brazil, 2002 to 2007.

Variable	Examined	Active trachoma		95%CI
	n	n	%	%
Age group (years)[a]				
0 to 4	232	19	8.2	5.2;12.3
5 to 9	69,402	3,702	5.3	5.2;5.5
10 to 14	46,005	2,111	4.6	4.4;4.8
15 and over	3,190	114	3.6	3.0;4.3
Total	118,829	5,946	4.9	4.9;5.1
Sex[b]				
Male	63,300	3,175	5.0	4.8;5.2
Female	56,231	2,793	5.0	4.8;5.1
Total	119,531	5,968	5.0	4.7;5.0
Area[c]				
Urban	74,996	3,196	4.3	4.0;4.4
Rural	44,535	2,772	6.2	6.0;6.5
Total	119,531	5,968	5.0	4.8;5.0

[a] χ^2 tendency = 48.88 ($p < 0.01$)
[b] $\chi^2 = 0.149$ ($p = 0.699$)
[c] $\chi^2 = 226.92$ ($p < 0.01$)

old.[i] However, rates of prevalence equal to or higher than 5% were found in various states and in all regions, indicating the need to maintain a program to control trachoma in Brazil.

The majority of positive cases found were of active trachoma, as the sample was composed primarily of children and adolescents. The data concur with those presented in the literature, as the scarring form of the disease is more commonly found in adults and in populations over the age of 60.[4,16] The expected rates of prevalence of the active forms might have been higher if the sample had included pre-school children, as they are recognized to be the main reservoir of the etiologic agent in populations where trachoma is endemic. In spite of this possible limitation, the rates of prevalence found are enough to characterize the persistence of active trachoma at levels of medium to high endemicity in a large proportion of the municipalities in Brazil.

Another possible limitation of the study would be the use of a definition of the case based on clinical criteria. This definition would be highly sensitive, but the positive predictive value (PPV) would fall as prevalence became lower. In fact, a lower PPV in the group of municipalities with very low prevalence should be considered when interpreting the results of the survey. However, only 25.3% of the municipalities had a rate of prevalence below 1%. Apart from trachoma, there are no other forms of follicular conjunctivitis which occur in an endemic form. In addition, adopting criteria for diagnosing trachomatous inflammation – follicular, which requires the presence of at least five follicles of 0.5mm in diameter in the upper tarsal conjunctiva, leads not only to the exclusion of other types of conjunctivitis which are characterized by smaller follicles, or those located outside of the upper tarsal conjunctiva, but also a lack of sensitivity, as cases of trachoma which are in the initial stage or in the process of resolution may have fewer than five follicles or of a smaller diameter.

This study did not enable the situation of the clinical sequelae of trachoma in the country to be analyzed. The most common clinical form of the disease was the least serious form. However, a significant proportion of the municipalities had a prevalence sufficiently high to maintain the risk of trachomatous scarring evolving if activities of monitoring and surveillance of trachoma are not implemented, in conjunction with inter-sectoral actions promoting health and improvements in socio-economic conditions and educating the populations.

[i] World Health Organization. Primary health care level management of trachoma. Geneva; 1989.

The municipalities with municipal human development indices above the national mean were not included in this study. However, most of these studies have pockets of poverty, with populations who live in conditions of risk of suffering trachoma. It is recommended to develop and carry out surveys of the prevalence of trachoma in the municipalities with HDI-M above the national mean, in order to discover the epidemiological reality and the progress towards achieving the goals of eliminating trachoma causing blindness, recommended by the WHO.

Trachoma is a chronic disease and changes in the epidemic profile depend not only on specific interventions of prevention and control, but also on policies of developing and improving the living and health care conditions of the majority of the populations. Thus, in spite of the period of the study covering the years 2002 to 2007, it is postulated that the possible changes in living conditions in progress during this period had not yet affected the prevalence indicators. The increasing coverage of social programs aimed at reducing poverty and inequality should have an impact on the prevalence of trachoma, although this effect will only be observable in the mid to long term. The reduction in the prevalence of trachoma is linked to improvements in living conditions, sanitation and personal hygiene practices, which will follow from increasing income. Thus, the results of this study will serve as a baseline for evaluating the possible effects of interventions aimed at reducing poverty.

The occurrence of high rates of prevalence of trachoma in rural areas shows the need for more interventions aimed at improving living and health care conditions for the country's rural population. However, it should be considered that, due to the accelerate process of urbanization which has taken place over the last four decades, more than 70% of the population of Brazil live in areas considered to be urban, requiring the development of studies with a new view of the epidemiology of the disease for the peripheries of large and medium sized cities and the adoption of policies which include exclusion and different levels of access to health care services, place in which trachoma continues to occur in the poorest populations. The existence of trachoma in a population is an indicator of precarious living and health care conditions.

There are few national data available on the prevalence of trachoma in emerging countries, which makes it difficult to compare the results found in this study. The reports which exist refer to regions or to subgroups of specific age groups. The rates of prevalence found in the literature varied from 36.6% in the Nile Delta in Egypt to 60% in hyper-endemic communities in Tanzania.[20] In Australia, prevalence of between 0.6% and 7.3% were found in Aborigines between five and 15 years old and in Mexico, in Chiapas, the estimated prevalence of trachomatous inflammation – intense was 25% in children under ten.[16,17]

In conclusion, this study shows that trachoma is still a significant health problem in Brazil, with municipalities with medium and high rates of prevalence. The data shown can be a reference in drawing up national and state plans for eliminating trachoma as a cause of blindness by 2020, as recommended in the World Health Organization directive.[a]

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