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Magnitude and trend of the AIDS epidemic in Brazilian cities, from 2002 to 2006

ABSTRACT

OBJECTIVE: To analyze different patterns of occurrence of AIDS in Brazilian cities between 2002 and 2006, associating trend and magnitude with socio-demographic indicators and local characteristics of the epidemic.

METHODS: This was an ecological study that categorized cities according to magnitude and trend of the epidemic and subsequently analyzed, considering social indicators, types of HIV transmission and year of first case reported. Data came from the Brazilian Epidemiological Surveillance System, the Brazilian Institute of Geography and Statistics and the United Nations Development Program for Brazil. Linear regression was used to estimate trend and chi-square statistics and ANOVA to analyze indicators.

RESULTS: A total of 4,190 cities (75.3%) reported AIDS cases between 2002 and 2006. Of these, 3,403 (81.2%) had an occurrence of "small magnitude" (mean = 4.7 cases), 367 (8.8%) of "average magnitude" (mean = 30.3 cases) and 420 (10.0%) of "great magnitude" (mean = 378.7 cases). Cases of "small magnitude" were associated with lower incidence; beginning of the epidemic after 1991; presence of one or two types of transmission; especially heterosexual contact; with occurrences of cases in one or two years of the period; and lower human development index (HDI). Those of a "great magnitude" were associated with larger cities and higher HDI; presence of all types of transmission; beginning of the epidemic between 1980/1991; and trend towards reduction/stabilization, especially due to a decrease in transmission among injecting drug users. Growth of the epidemic was concentrated in "small magnitude" cities, although without significance to the point of changing proportional participation (8.7%) of these cities in the group of cases in Brazil.

CONCLUSIONS: The AIDS epidemic remains concentrated in urban centers and the spread of cases to the countryside is characterized by irregular occurrence and small magnitude. Cities with low HDI and exclusive transmission through heterosexual contact showed low capacity of increase and the reduction of the epidemic is especially associated with the decrease in transmission among injecting drug users.

DESCRIPTORS: Acquired Immunodeficiency Syndrome, epidemiology. HIV Infections, epidemiology. Impacts on Health. Epidemiology, Descriptive. Brazil.

INTRODUCTION

Few health problems have accumulated a great number of studies to understand their behavior and determinants in such a short time, as is the case of

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AIDS.[11] However, the analyses that have defined the main trends of the epidemic, which still guide policies aimed at coping with this disease in Brazil, date from the late 1990s.[5,15,28,29] In this period, the concepts of "heterosexualization", "feminization", "interiorization" and "pauperization" were constructed, evidencing the spread of this disease in small- and medium-sized cities;[3,9,30] the predominance of heterosexual contact as the main mode of transmission;[5,15,28] the reduction in the male/female ratio, with a growing number of cases among women;[5,30] and the greater inclusion of impoverished groups in the epidemic, characterized by low level of education and professional qualification.[12,13,24,30] These analyses showed the concern to mark the transition in the epidemiological profile of AIDS, which was characterized by higher incidence in urban centers and certain high-risk groups in the 1980s.

Complementary analyses, which were subsequently performed, showed that the process of AIDS becoming more associated with poverty, women, heterosexuals and the Brazilian countryside occurred concomitantly with the following: the maintenance of high rates of prevalence in specific populations, notably homosexuals, injecting drug users (IDU), sex professionals and incarcerated populations;[2,8,12,18,25,a] the regional and social differences in Brazil, which caused different types of behavior of the disease, with the reduction in the number of cases in the Southeastern and Central-Western regions and increase in the Northern and Northeastern regions; and the increase in the number of cases among individuals aged more than 60 years and young homosexuals.[5,10,24]

In addition, intimately associated with the fact that the Southeastern region, particularly the state of São Paulo, has the greatest and oldest epidemics, epidemiological analyses began to show a stabilization in the general AIDS incidence and HIV prevalence rates in Brazil, in the 2000s.[10,11] Such stabilization occurred in high levels, with 35,000 annual cases recorded, an incidence rate of 19.0 cases per 100,000 inhabitants and an estimate of 630,000 individuals aged between 15 and 49 years and living with HIV.[4]

The majority of these studies analyzed information that had been consolidated on a national or regional level. In Brazil, there is a relative consensus that this level of aggregation may hinder the recognition of epidemiological patterns and the understanding of specific contexts associated with the health/disease process. In the AIDS field, very few studies have analyzed the epidemic on a municipal level, such as those performed by Bastos et al[3] and Szwarcwald et al.[30] Analyses with greater separation also enable local policies to be subsidized, emphasizing the responsibility of cities in the organization of health care promotion and network.

Fifteen years after the appearance of concepts of heterosexualization, feminization, interiorization and pauperization, the objective of the present study was to analyze the trend and magnitude of the AIDS epidemic in Brazilian cities, associating these aspects with socio-demographic indicators and local characteristics of the epidemic.

METHODS

An ecological study was performed, based on the analysis of cases of AIDS reported in Brazil, between 2002 and 2006. Epidemiological data were obtained from Brazil's Health Ministry and had been recorded by the epidemiological surveillance system until June 2008.[b] The social and demographic indicators were obtained from the *Instituto Brasileiro de Geografia e Estatística* (IBGE – Brazilian Institute of Geography and Statistics)[c] and the United Nations Development Program (UNDP).[d]

Cities were categorized into the following three groups to analyze the magnitude of the epidemic, according to the number of cases occurred between 2002 and 2006: great magnitude, with 50 or more cases in the period; average magnitude, with between 20 and 49 cases; and small magnitude, with 19 or fewer cases. The intervals used in the categorization of groups were defined from the analysis of distribution of the total number of cases per city, considering that no previous studies using the absolute number of cases for such categorization were found. This parameter was adopted in the present study as a way to minimize the great variation that incidence rates showed in cities with a small population due to the occurrence of a reduced number of cases.

Simple linear regression[32] of annual AIDS incidence rates between 2002 and 2006 was used to estimate the trend of growth of the epidemic, calculated with moving averages for each three years. This procedure was employed to minimize possible fluctuations that occurred as a result of irregular reporting. Only cities with cases recorded in at least three years were included

[a] Ministério da Saúde. Departamento de Informática do SUS. Tabulação de dados: casos de AIDS identificados no Brasil. Brasília; 2008[citado 2008 dez 19]. Disponível em:http://www.AIDS.gov.br/cgi/deftohtm.exe?tabnet/br.def

[b] Guimarães K, Godoi AMM, Merchán-Hamann E, Andrade JMJ. Avaliação da efetividade das ações de prevenção dirigidas às profissionais do sexo, em três regiões brasileiras. 1. ed. Brasília: Ministério da Saúde do Brasil, Secretaria de Vigilância em Saúde, Programa Nacional de DST/Aids, 2004.

[c] Instituto Brasileiro de Geografia e Estatística. Pesquisa de informações básicas municipais Brasília; 2001[citado 2008 dez 20]. Disponível em: http://www.ibge.gov.br/home/estatistica/economia/perfilmunic/defaulttab1_perfil.shtm

[d] Programa das Nações Unidas para o Desenvolvimento. Atlas do desenvolvimento humano. Brasília; 2004[citado 2008 Jun 18]. Disponível em: http://www.pnud.org.br/atlas/

in the analysis, for which it was relevant to analyze the trend in an interval of five years.

Cities with a positive significant variation ($p < 0.05$) in the linear regression were classified as growing epidemic, while those with a significant negative variation were decreasing epidemic.

Cities without a significant variation in linear regression ($p > 0.05$) had the dispersion of incidence rates analyzed by the coefficient of variation. Those with up to 20% of variation were classified as stabilized epidemics.

For cities with a coefficient of variation higher than 20%, the trend of the epidemic was estimated in a period of ten years (1997/2006). With this procedure, the increase in observation time minimized the effects of abrupt variations observed in one or two years, between 2002 and 2006, resulting from the notification system and which hindered the determination of a significant trend in the years that had been previously analyzed.

In the linear regressions, cities categorized by the trend of five years showed a determination coefficient (R^2) between 0.69 and 1.0, while, by the trend of ten years, coefficients were between 0.5 and 0.93. Due to the low level of explanation, cities with a coefficient lower than 0.5 were excluded.

After those stages, cities categorized according to magnitude and trend were analyzed based on the epidemiological and social and demographic characteristics, defined as follows: 1) Epidemiological characteristics – (a) time of appearance of AIDS in the city, known as "time of epidemic", calculated by the difference between 2008 and appearance of the first case in the city; (b) occurrence of cases per category of exposure, between 2002 and 2006, repeatedly counting the cases concomitantly recorded as "homosexuals/bisexuals", "IDUs" and "blood/blood product recipients", while the other categories used in the study were "heterosexual" and "HIV vertical transmission"; (c) variation in the number of new cases per category of exposure, considering the ratio of numbers recorded between 2002 and 2006 and between 1997 and 2001; (d) mean annual incidence between 2002 and 2006, calculated by the mean of annual occurrences of the population in 2004; and (e) male/female ratio. Moreover, the weight of each category of exposure in the reduction in global incidence was calculated, subtracting the number of cases between 1997 and 2001 and between 2002 and 2006 per category of exposure, and subsequently dividing this number by the sum of cases that had not occurred in the group of categories of exposure; and 2) Social and demographic characteristics: (a) municipal human development index (HDI-M); (b) size of the population (2004); (c) city included in the metropolitan area, capital or countryside; and (d) state/macro-region.

The association between city characteristics, magnitude and trend of the epidemic was evaluated with the use of Pearson's chi-square statistics for categorical variables and, when these were significant with p values <0.05, standardized residual analysis (Zres) was applied, read as out of the standard when values were higher than $|1,96|$.[26] ANOVA was used for continuous variables, applying Bonferroni inequality to test multiple differences among means.

RESULTS

Between 2002 and 2006, a total of 186,283 cases of AIDS were recorded in Brazil, corresponding to 36.8% of the number known since the onset of the epidemic and mean annual incidence of 19.9 cases per 100,000 inhabitants. These cases were recorded in 4,190 cities, corresponding to 75.3% of the 5,564 cities comprising this country. The mean number of cases observed per city was 44.6 and the median was 4.

Of all these cities, 81.2% (3,403) were characterized as showing an "occurrence of small magnitude", with a mean number of cases of 4.7 and a median of 3; irregular time distribution, with 54.6% reporting occurrences in only one or two years in the period; and onset of the disease having been reported 11.6 years before on average (Tables 1 and 2). This group was comprised of 94.8% of the cities that recorded the onset of the disease in the last 15 years and 8.7% (16,126) of cases of AIDS known between 2002 and 2006, a percentage that was 4.0% (3,971) between 1992 and 1996.

Cities with up to 19,000 inhabitants (98.4%, Zres=37.0) were concentrated in the small magnitude category, in addition to those situated in the countryside (85.2%, Zres=22.9), in the Northeastern (88.9%, Zres=8.4) and Northern regions (88.6%, Zres=3.4) and in the state of Minas Gerais (86.0%, Zres=3.3) (Table 1).

The profile of transmission of these cities was characterized by showing one single category of exposure to HIV (59.4%, Zres=26.1), considering that 44.3% (Zres=22.6) included cases among heterosexuals exclusively. In this group, lower proportions of cities with cases among homosexuals/bisexuals (30.2%), IDUs (12.9%), vertical transmission (9.2%) and blood/blood product recipients (0.8%) were also observed (Table 1). As a result, the male/female ratio was lower in the groups analyzed, becoming almost equal to each other (1.2:1) (Table 2).

Data showed that, the smaller the magnitude of occurrence, the lower the number of categories of exposure existing in the city and the more restricted to heterosexual transmission this occurrence is. Such trend did not change substantially with the evolution of the epidemic in the last 15 years. Of all 1,383 cities with one or two categories of exposure between 1992 and 1996, 79.5% (Zres=25.9) remained with this

Table 1. Magnitude of the AIDS epidemic, according to demographic and epidemiological characteristics of the cities with cases of AIDS. Brazil, 2002-2006.

Demographic and epidemiological characteristics	Magnitude of the epidemic										
	Great			Average			Small			Total	
	More than 50 cases			Between 20 and 49 cases			Between 1 and 19 cases				
	n	%	Zres[a]	n	%	Zres[a]	n	%	Zres[a]	n	%
Cities	420	10.0	-	367	8.8	-	3403	81.2	-	4190	100
Mean HDI-M	0.79	-	-	0.75	-	-	0.69	-	-	0.71	-
Area where city was included in											
Capital	27	100	15.6	-	0.0	-1.6	-	0.0	-10.8	27	100
Metropolitan area	130	44.8	20.4	56	19.3	6.6	104	35.9	-20.5	290	100
Countryside	263	6.8	-24.3	311	8.0	-5.8	3299	85.2	22.9	3873	100
Population (thousands of inhabitants)											
More than 500	36	100	18.1	-	0.0	-1.9	-	0.0	-12.5	36	100
200 to 499	93	98.9	29.0	1	1.1	-2.7	-	0.0	-20.4	94	100
100 to 199	125	91.2	32.2	9	6.6	-0.9	3	2.2	-24.1	137	100
50 to 99	129	41.6	19.2	110	35.5	17.3	71	22.9	-27.3	310	100
20 to 49	37	3.8	-7.5	206	20.9	15.4	741	75.3	-5.4	984	100
Up to 19	-	0.0	-28.0	41	1.6	-21.4	2588	98.4	37.0	2629	100
Region											
Northern	20	6.3	-2.3	16	5.1	-2.3	279	88.6	3.4	315	100
Central-Western	24	6.5	-2.4	32	8.6	-0.1	316	84.9	1.9	372	100
Northeastern	58	4.5	-7.9	85	6.6	-3.3	1141	88.9	8.4	1284	100
Southeastern	216	15.9	8.8	153	11.3	4.0	986	72.8	-9.7	1355	100
Southern	102	11.8	1.9	81	9.4	0.7	681	78.8	-2.0	864	100
Number of existing categories of exposure											
One	-	0.0	-18.7	11	3.0	-16.1	1730	59.4	26.1	1741	47.0
Two	10	2.4	-11.2	89	24.3	-0.2	902	31.0	8.7	1001	27.0
Three	79	18.8	4.3	178	48.5	22.1	245	8.4	-19.3	502	13.6
Four	254	60.5	38.2	87	23.7	10.0	36	1.2	-36.7	377	10.2
Five	77	18.3	25.5	2	0.5	-2.1	1	0.0	-18.2	80	2.2
Number of years with cases of AIDS recorded (2002-2006)											
One	0	0.0	-12.7	0	0.0	-11.8	1074	31.6	18.3	1074	25.6
Two	0	0.0	-10.4	0	0.0	-9.6	784	23.0	14.9	784	18.7
Three	0	0.0	-8.9	1	0.3	-8.1	609	17.9	12.7	610	14.6
Four	0	0.0	-8.3	12	3.3	-5.7	524	15.4	10.5	536	12.8
Five	420	100	34.4	354	96.5	30.3	412	12.1	-48.4	1186	28.3
Cases recorded only due to heterosexual contact											
Yes	0	0.0	-16.3	11	3.0	-13.9	1508	44.3	22.6	1519	36.3
No	420	100	16.3	356	97.0	13.9	1895	55.7	-22.6	2671	63.7
Cases recorded according to categories of exposure											
Sexual contact	420	100	-	367	100	-	2836	86.3	-	3623	89.0
Homosexual/bisexual contact	418	99.5	-	318	86.6	-	994	30.2	-	1730	42.5
Heterosexual contact	420	100	-	367	100	-	2673	81.3	-	3460	84.9
IDU	389	92.6	-	229	62.4	-	424	12.9	-	1042	25.6
Blood/blood product recipients	82	19.5	-	15	4.1	-	25	0.8	-	122	3.0
Vertical transmission	349	83.1	-	152	41.4	-	302	9.2	-	803	19.7

HDI-M: Human development index of the city
IDU: Injecting drug user
[a] Values in bold mean they are out of the standard in terms of the expected distribution: > 1,96 indicates excess of cities and < -1,96 indicates lack of cities.

Table 2. Mean of absolute and relative incidences, "time of epidemic", cases of AIDS and male/female ratio in cities categorized according to magnitude and trend of the epidemic. Brazil, 2002-2006.

Epidemiological indicators	Magnitude			Trend			Brazil (4,190 cities)
	Great	Average	Small	Increase	Stabilization	Reduction	
Annual incidence per 100,000 inhabitants	27.7	18.6	8.1	13.1	20.0	17.9	11.0
"Time of epidemic" (years)	20.7	17.6	11.6	14.2	17.4	16.7	13.1
Cases of AIDS	378.7	30.3	4.7	30.8	150.9	154.9	44.5
Male/Female ratio	1.5	1.7	1.2	1.3	1.4	1.4	1.1

same characteristic between 2002/2006; and 94.0% of the cities with exclusive heterosexual transmission between 1992/1996 showed occurrences of small magnitude between 2002/2006, with 79.1% recording cases in only one (47.3%, Zres=2.2) or two categories of transmission (31.8%, Zres=3.9).

The cities categorized in the group with great magnitude, i.e. 50 or more cases between 2002 and 2006, appeared in reduced numbers (420 – 10.0%) and concentrated the highest proportion of individuals with AIDS in Brazil (85.4%) from 2002 to 2006. In addition, they showed a high level of urbanization and better social indicators and included all capitals, 95.1% of the cities with more than 100,000 inhabitants and 64.2% of the Brazilian population. They were situated (49.3%) in the states of São Paulo, Rio de Janeiro and Rio Grande do Sul and had a mean HDI-M higher than 0.79, close to those of highly developed countries (Table 1).

These cities stood out as they showed one of the highest gender ratios (1.5/1), diversified forms of transmission and a concentration of old epidemics. In 94.5% of them, the first cases were recorded in 1991, and in 97.6%, cases were distributed in three or more categories of exposure, combining infections caused by heterosexual and homosexual contacts, IDUs and vertical transmission between 2002 and 2006, which were observed in 100%, 99.5%, 92.6% and 83.1% of these cities, respectively (Tables 1 and 2).

Diversified forms of transmission in cities with great epidemics have been observed since 1991, when 64.5% of these cities were already showing three or more categories of exposure; 82.5% reported cases in homosexuals, 75.8% in IDUs and 73.3% in heterosexuals. The time factor seemed to be more relevant to consolidate the profile of transmission observed in the beginning of the epidemic, rather than to significantly change it.

Epidemics with average magnitude, situated in medium-sized cities, with between 20,000 and 99,000 inhabitants, corresponded to the smaller group in number of cities (397 – 8.8%) and cases of AIDS (6.0%). These cities, with a mean HDI-M of 0.75, are situated especially in the Southeastern region (Zres=4.0), particularly in the states of São Paulo (24.0%, Zres=6.0) and Rio de Janeiro (5.2%, Zres=6.0) (Table 1).

In the majority of cities with an average magnitude (65.4%, Zres=15.0), the onset of the disease occurred between 1980/1991, with the first case having been reported 17.6 years before on average. In these cities, diversity of categories of exposure occurred in a proportion smaller than that in cities of great magnitude. However, in 72.7% of the situations, cases were recorded in three or more categories of exposure, representing an important proportion of cities with cases recorded due to homosexual/bisexual contact (86.6%) and IDU (62.4%) (Tables 1 and 2).

As regards the trend of the epidemic, 2,332 cities recorded cases of AIDS in at least three years between 2002 and 2006, totaling 98.1% (182,747) of all occurrences found in Brazil in this period. Of these, the trend of increase in the epidemic was observed in 48.5% (927) (annual mean of 2.2 cases/100,000 inhabitants), that of stabilization in 26.6% (509) (annual mean of -0.1 cases/100,000 inhabitants) and that of reduction in 24.8% (474) (annual mean of -3.1 cases/100,000 inhabitants) (Table 3). In all, 422 (18.1%) cities were excluded from the analysis as they showed a coefficient of variation of mean incidence rates higher than 20% or determination coefficient (R^2) lower than 0.5. These cities, which represented 2.2% (3,981) of cases in the period, were concentrated in the group of those with up to 50,000 inhabitants (94.8%) and showing a small magnitude (89.8%).

Although being the largest group, cities with a trend of increase showed the smallest number of cases (28,556, 16.0%); the lowest mean incidence rate, 13.1 cases/100,000 inhabitants; and the first case having been recorded 14.1 years before on average. In addition, they were concentrated in the group of cities with occurrences of small magnitude (60.7%, Zres=13.3), in the Northern (75.8%, Zres=6.3) and Northeastern regions (65.1%, Zres=8.7), in those with less than 19,000 inhabitants (63.6%, Zres=9.3) and a relatively low mean HDI-M of 0.71 (Tables 2 and 3).

The increase in the epidemic in this group was mostly supported by the rise in the number of cases among heterosexuals, which was 2.7 times higher between 2002 and 2006 than between 1997 and 2001 (Figure 1). This trend was observed in 79.7% of the cities in this group.

Table 3. Epidemiological and geographic characteristics of the cities with cases of AIDS per trend of the epidemic. Brazil, 2002-2006.

Geographic and demographic characteristics	Trend of the epidemic									Total	
	Increase			Stabilization			Reduction				
	n	%	Zres[a]	n	%	Zres[a]	n	%	Zres[a]	n	%
Cities	927	48.5	-	509	26.6	-	474	24.8	-	1910	100
Inhabitants	38212144	25.4	-	62342821	41.5	-	49630272	33.0	-	150185237	100
Mean HDI-M	0.71	-	-	0.75	-	-	0.76	-	-	0.73	-
Area where city was included in											
Capital	7	25.9	-2.4	13	48.1	2.5	7	25.9	0.1	27	100
Metropolitan area	64	26.1	-7.5	104	42.4	6.0	77	31.4	2.6	245	100
Countryside	856	52.3	8.0	392	23.9	-6.6	390	23.8	-2.5	1712	100
Population (thousands of inhabitants)											
More than 500	9	25.0	-2.9	16	44.4	2.4	11	30.6	0.8	36	100
200 to 499	11	11.7	-7.3	41	43.6	3.8	42	44.7	4.6	94	100
100 to 199	32	23.4	-6.1	70	51.1	6.7	35	25.5	0.2	137	100
50 to 99	101	35.9	-4.6	108	38.4	4.8	72	25.6	0.3	281	100
20 to 49	346	52.1	2.3	175	26.4	-0.2	143	21.5	-2.4	664	100
Up to 19	428	61.3	8.5	99	14.2	-9.4	171	24.5	-0.2	907	100
Region											
Northern	94	75.8	6.3	17	13.7	-3.4	13	10.5	-3.8	124	100
Central-Western	97	50.5	0.6	50	26.0	-0.2	45	23.4	-0.5	192	100
Northeastern	329	65.1	8.7	106	21.0	-3.4	70	13.9	-6.6	505	100
Southeastern	257	35.7	-8.7	211	29.3	2.1	251	34.9	7.9	719	100
Southern	150	40.5	-3.4	125	33.8	3.5	95	25.7	0.4	370	100
Magnitude of the epidemic											
Great	78	18.8	-13.7	201	48.3	11.3	137	32.9	4.3	416	100
Average	141	43.0	-2.2	121	36.9	4.6	66	20.1	-2.2	328	100
Small	708	60.7	13.3	187	16.0	-13.1	271	23.2	-2.0	1166	100
Record of cases per category of exposure											
Sexual contact	900	97.1	-	508	99.8	-	474	100	-	1882	98.5
Homosexual/bisexual contact	534	576	-	413	81.1	-	328	69.2	-	1275	66.8
Heterosexual contact	884	95.4	-	504	99.0	-	472	99.6	-	1860	97.4
IDU	285	30.7	-	317	62.3	-	247	52.1	-	849	44.5
Blood/blood product recipient	25	2.7	-	54	10.6	-	27	5.7	-	106	5.5
Vertical transmission	225	24.3	-	258	50.7	-	175	36.9	-	658	34.5
Existing number of categories of exposure											
One	258	28.5	7.0	51	10.0	-7.4	98	20.7	-7.4	407	21.6
Two	364	40.2	6.5	120	23.6	-5.2	137	28.9	-2.2	621	32.9
Three	178	19.6	-2.6	140	27.6	3.6	102	21.5	-0.4	420	22.2
Four	97	10.7	-8.9	150	29.5	7.0	114	24.1	3.2	361	19.1
Five	9	10.7	-8.9	47	9.3	6.7	23	4.9	0.8	79	4.2

HDI-M: Human development index of the city
IDU: Injecting drug user
[a] Values in bold mean they are out of the standard in terms of the expected distribution: > 1,96 indicates excess of cities and < -1,96 indicates lack of cities

The increase in the number of cases among homosexuals (1.3 time in the periods analyzed) and a lower stabilization/reduction than the national mean of cases occurred among IDUs (1.0), blood/blood product recipients (0.5) and vertical transmission (1.0) also contributed to the growth of the epidemic (Figure 1).

The cities with a trend of reduction represented the second largest group in: population (33.0%), number of cases (41.1%) and mean annual incidence rate (17.8 cases/100,000 inhabitants). In addition, they were characterized as epidemics that had a great magnitude (32.9%, Zres=4.3), were old, had begun 17.1 years before on average and were situated in the Southeastern region (34.9%, Zres=7.9), especially in the state of São Paulo (46.8%, Zres=10.6) and in cities with between 200,000 and 499,000 inhabitants (44.7%, Zres=4.6) and a relatively high HDI-M of 0.76 (Tables 2 and 3).

The trend of reduction in this group was found among IDUs (0.71), blood/blood product recipients (0.41) and vertical transmission (0.62), while it stabilized among homosexuals/bisexuals (0.99) and increased among heterosexuals, who showed the lowest ratio of growth (1.50 times) among groups studied (Figure 1).

The reduction in incidence in these cities was associated with the following, in order of importance: (1) decrease in the epidemic among IDUs, responsible for 46.1% of expected cases, that did not occur in such cities, when the 1997/2001 and 2002/2006 periods were compared; (2) lower rate of growth among heterosexuals, equivalent to 56.3% of the ratio observed in cities with growing incidence; (3) being the only group with stabilization of cases among homosexuals, an aspect observed in 65.9% of the cities in this group; and (4) greater reduction in vertical transmission, which tends towards stabilization in the remaining groups (Figures 1 and 2).

Cities with stabilization of the epidemic comprised the greatest number of cases (43.0%), mean annual incidence (20.0 cases/100,000 inhabitants) and population (41.5%), including the highest proportion of Brazilian capitals (13), cities with more than 100,000 inhabitants (47.7%) and 42.4% (Zres=6.0) of those situated in metropolitan areas. In addition, they concentrated epidemics of great (48.3%, Zres=11.3) and average magnitude (36.9%, Zres=4.6), which recorded the first case 17.8 years before on average (Tables 2 and 3). This profile is similar to those of cities where the first cases in Brazil were recorded.

Stabilization of incidence was related to an epidemiological profile that associates characteristics of the epidemics that are increasing and reducing, situating these cities on an intermediate level. Cases among homosexuals/bisexuals (1.2 times) and heterosexuals (2.01 times) continued to increase, while decreasing or stabilizing among IDUs (0.91) and vertical transmission (0.97) (Figure 1).

DISCUSSION

Although there is a great number of cities with at least one case of AIDS between 2002 and 2006, the epidemic remains concentrated in a relatively small group of cities in Brazil, characterized by urban condition, better development indices, epidemics of great magnitude and diversity of forms of transmission, combining sexual contact, IDUs, blood/blood product recipients and

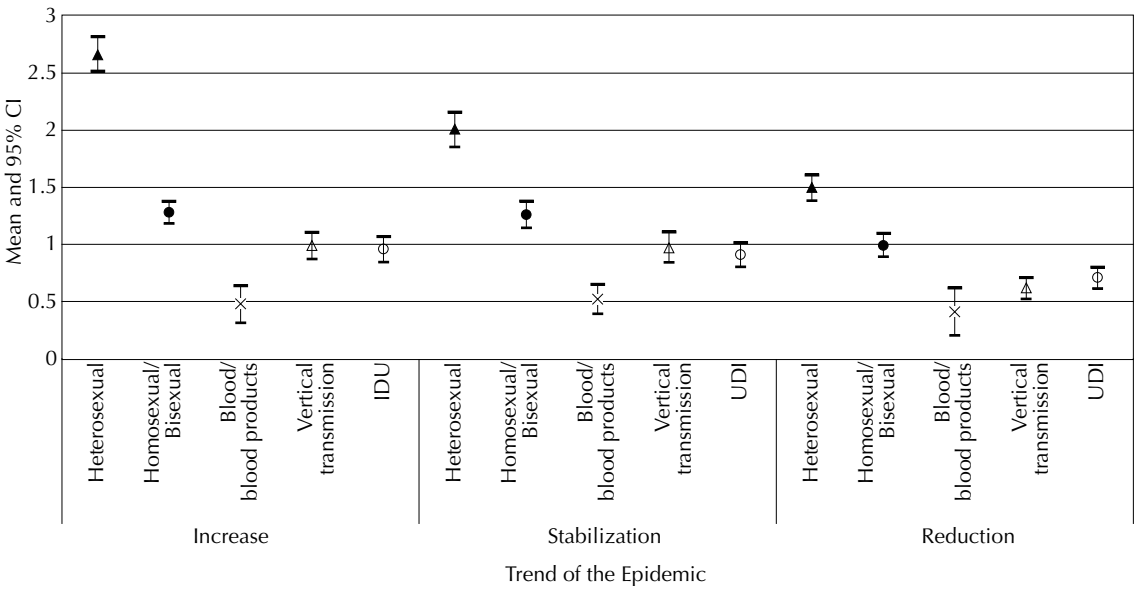

Figure 1. Mean variation and 95% confidence interval of number of cases of AIDS, comparing the 2002-2006 and 1997-2001 periods, per category of exposure and trend of cities. Brazil, 2002-2006.

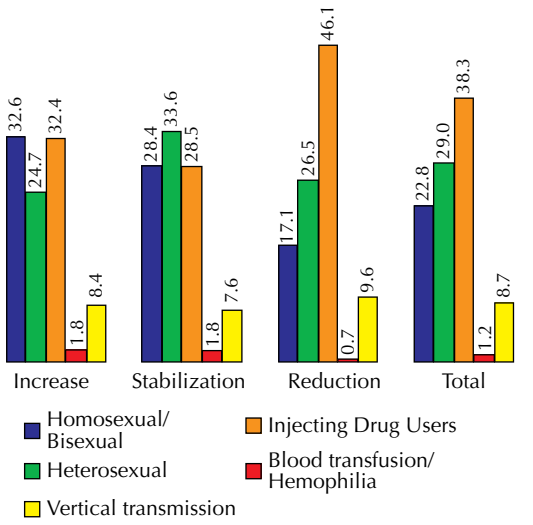

Figure 2. Proportional weight of categories of transmission in the reduction in number of cases, comparing the 2002-2006 and 1997-2001 periods. Brazil, 2009.

vertical transmission. This epidemiological profile has been relatively consolidated since the 1990s, when a substantial number of cities with great epidemics were already reporting the first cases.

In this context, the process of spread towards the countryside[3,5,29,30] is characterized by irregular occurrences of small magnitude, comprising less than 10% of the cases present in Brazil, in the last 15 years. The difference in the understanding of characteristics of the territorial expansion of the epidemic could be associated with the methodology of analysis used, which, unlike other studies, did not previously stratify cities according to the population or region, nor did it use the incidence rate to analyze the magnitude and time frequency of occurrences.

In Brazil, the occurrence of cases in small-sized cities does not necessarily imply the onset of epidemics that will be consolidated with time. Thus, it is possible that epidemics categorized as concentrated[2] will show a specific geographic distribution, strictly associated with the presence of contexts that increases infection in particular groups. In the Brazilian case, these contexts are essentially urban and enable, from social relationships and individual practices, to enact situations of vulnerability, such as sexual intolerance and violence, into actual possibilities of new infections.[1,22,23]

In this circumstance, it is possible to raise the hypothesis that the magnitude of the epidemic among heterosexuals is associated, to a large extent, with the occurrence of cases due to drug use and homosexual/bisexual contact, without which it shows low capacity to spread and induce epidemics of great magnitude. This hypothesis is corroborated by the fact that cities with the greatest reductions among homosexuals/bisexuals and IDUs led to the lowest ratios of growth among heterosexuals; in addition to findings from other studies that showed the association among drug use, homosexual/bisexual contact and growth in heterosexual transmission.[6,7,14,18,20]

In other words, it could be affirmed that the magnitude of the epidemic in a certain area is associated with the diversity of forms of transmission, with epidemics of greater magnitude being observed in places with more interaction among categories of sexual exposure, drug use and being a blood/blood product recipient.

It is relevant to observe that, although there was a reduction in the number of cases,[10,11] drug use and homosexual/bisexual contact continue to be relevant in the epidemic. These groups show the highest risks of infection[2,17] and trend of growth in more than 30% of the cities analyzed. In the case of drug use, the reduction in sharing of needles/syringes is not necessarily reflected in prevention of sexual transmission;[19] likewise, the increase in crack use implies greater risk of infection.[25]

Another important aspect refers to the fact that the process of impoverishment associated with the epidemic, described in previous studies,[12,13,30] was not found in the present study. As observed,[16] the relationship between AIDS and poverty is complex and, in certain contexts, populations with better economic level show a higher prevalence of HIV, even in areas with low social indicators, as is the case of Sub-Saharan Africa. Thus, findings could be revealing that the AIDS epidemic in Brazil predominantly occurs in contexts showing the highest level of human development and that the process of impoverishment is not associated with classic indicators of poverty, but rather with social differences and poor areas that are characteristic of urban centers.[13,30]

Cities with a trend of reduction or stabilization represent the highest number of cases in Brazil and include the oldest epidemics with the greatest magnitudes. These cities are the ones probably responsible for the trend of stabilization found in this country, as described by Fonseca & Bastos[11] and Dourado et al.[10] However, stabilization/reduction in incidence must be analyzed with caution, because it is restricted to the following circumstances: these cities (1) maintain high incidence rates; (2) show reduction that is highly concentrated in the IDU category, representing the majority of cases that would stop occurring; (3) are restricted to part of the Brazilian territory, especially to the oldest epidemics situated in the Southern and Southeastern regions; (4) maintain the occurrence of cases associated with blood/blood product recipients and vertical transmission, considering the existing technological possibilities of prevention;[21,27] and (5) show reduction in cases among homosexuals/bisexuals and IDUs,

which occurs especially in cities with global reduction in the epidemic.

Growth in the epidemic is also observed in a significant number of cities that show occurrences of great (78) and average (141) magnitude in the Northern and Northeastern regions. Growth in these regions[10,12] is corroborated by the greater prevalence of sexually transmitted diseases, unprotected sexual practices and low number of anti-HIV tests performed, especially observed in the Northern region.[31]

Findings from the present study must be considered according to their limitations and specificities. The possibility of this analysis having found an epidemiological transition cannot be disregarded, after which cities with a small magnitude, low HDI and transmission based on heterosexual contact begin to show frequent and regular occurrences. This aspect becomes relevant when considering that the patterns analyzed refer to infections that had occurred from seven to ten years before. Likewise, patients residing in small-sized cities can obtain the diagnosis/health care in great urban centers, hiding the magnitude of this disease in cities in the countryside. Moreover, the quality of information must be considered, in view of the number of cases with ignored category of exposure. It should be emphasized that 168 cities with a determination coefficient (R^2) between 0.5 and 0.69 were included, causing the classification of trend of increase/reduction in the epidemic in these places to be less accurate. However, this group represents only 8.8% of the total analyzed.

Despite these specificities, it should be emphasized that the control of the epidemic in Brazil will be more effective if it adopts the premises that public policies must be designed according to the profile of cities. Priority cities are those presenting greater magnitude, where global stabilization of the epidemic hides the epidemiological reality of certain groups and cities and where prevention must consider the interrelation among forms of transmission, developing strategies that combine, in given social contexts, the specificities of sexual contact, drug use, vertical transmission and blood products recipients; and the fact that small cities must be monitored to perform interventions in advance.

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