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Trends in the incidence of AIDS-defining and non-AIDS-defining cancers in people living with AIDS: a population-based study from São Paulo, Brazil

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Abstract

People living with AIDS are at increased risk of developing certain cancers. Since the introduction of the highly active antiretroviral therapy (HAART), the incidence of AIDS-defining cancers (ADCs) has decreased in high-income countries. The objective of this study was to analyse trends in ADCs and non-AIDS-defining cancers (NADCs) in HIV-positive people with a diagnosis of AIDS, in comparison to the general population, in São Paulo, Brazil. A probabilistic record linkage between the 'Population-based Cancer Registry of São Paulo' and the AIDS notification database (SINAN) was conducted. Cancer trends were assessed by annual per cent change (APC). In people with AIDS, 2074 cancers were diagnosed. Among men with AIDS, the most frequent cancer was Kaposi's sarcoma (469; 31.1%), followed by non-Hodgkin lymphoma (NHL; 304; 20.1%). A decline was seen for ADCs (APC = −14.1%). All NADCs have increased (APC = 7.4%/year) significantly since the mid-2000s driven by the significant upward trends of anal (APC = 24.6%/year) and lung cancers (APC = 15.9%/year). In contrast, in men from the general population, decreasing trends were observed for these cancers. For women with AIDS, the most frequent cancer was cervical (114; 20.2%), followed by NHL (96; 17.0%). Significant declining trends were seen for both ADCs (APC = −15.6%/year) and all NADCs (APC = −15.8%/year), a comparable pattern to that found for the general female population. Trends in cancers among people with AIDS in São Paulo showed similar patterns to those found in developed countries. Although ADCs have significantly decreased, probably due to the introduction of HAART, NADCs in men have shown an opposite upward trend.

Keywords

South America, epidemiology, AIDS, HPV, HIV, cancer

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Introduction

Several studies have shown an increased risk for cancer among people living with HIV/AIDS (PLWHA); however, the risks have changed over time. Since the introduction of the highly active antiretroviral therapy (HAART), some countries have documented significant declines in AIDS-defining cancers (ADCs), namely Kaposi's sarcoma (KS), non-Hodgkin lymphoma (NHL) and cervical cancer (CC). In contrast to this, increasing trends in non-AIDS-defining cancers (NADCs) were found in many recent studies.[1–5] Most of the studies assessing cancer burden in PLWHA have been conducted in developed countries, such as the United States (US), Spain and Italy, where population-based

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cancer and AIDS registries coexist. Unfortunately, in many countries, both at high- and or middle-income levels, such studies are not feasible, due to the lack of population-based registries, or due to the inability of conducting record linkage because of anonymized records, poor database quality or intermittent data collection, among other constraints.

In Brazil, AIDS notification became mandatory in 1986 and cases diagnosed before that time were recorded retrospectively. The state of São Paulo has played a crucial role in the AIDS epidemic, having launched the first AIDS programme in the country, providing treatment free of cost.[6] São Paulo city has the highest percentage (12.6%) of all AIDS cases diagnosed nationally.[7] The city also has a population-based cancer registry, which covers the largest population in Brazil, and has uninterruptedly collected data on cancer incidence since 1997.

The present study analysed the trends in incidence of cancers in residents of São Paulo with HIV between 1997 and 2012, in comparison to the general population.

Methods

A total of 87,109 AIDS cases were diagnosed in HIV-positive persons aged ≥ 13 years in São Paulo from 1980 to 2013.[8] Between 1997 and 2012, the 'Population-based Cancer Registry of São Paulo' (PBCR-SP) registered 628,161 cancers (496,276 invasive) among São Paulo residents.

A probabilistic record linkage was conducted between the PBCR-SP (1997–2012) and the AIDS notification database SINAN (*Sistema de Informações de Agravos de Notificação*/Information System on Disease Notification) (1980–2013) containing AIDS cases. The Brazilian Ministry of Health preferably uses the AIDS case definition of the Centers for Disease Control and Prevention and alternatively the definition of Rio de Janeiro/Caracas.[9] Both registries cover the same territory: the city of São Paulo, which according to the 2010 census, comprises an area of 1521 km^2 and is home to 11,253,503 inhabitants (99.1% urban), corresponding to almost 6% of the Brazilian population. Its current human development index is 0.805.[10]

A probabilistic record linkage was conducted, in a multi-step process, using different blocking strategies. *Soundex*, which is the phonetic algorithm for indexing names by sound, was used in place of names for blocking. The blocking strategies contained a combination of *soundex* of the first name, *soundex* of the last name, decade of birth and sex. Full name and date of birth were used for calculating the weighted scores. Clerical review based on name, date of birth, mother's name and address, when available, was carried out in all steps to improve record linkage sensitivity. This process was conducted using the open source software OpenRecLink (version 2.9). After the identification of true matches, patients were excluded from the analysis if they had a cancer diagnosis 60 months or more prior to their AIDS diagnosis.

Cancers were grouped into two major categories: ADCs (KS, NHL and CC) and NADCs (all other cancers). The annual AIDS population according to gender and age group was estimated as the difference between cumulative cases and cumulative deaths per year.

The crude incidence rates were calculated according to gender, dividing the number of incident cases by the estimated AIDS population in a given year and presented as rates per 100,000 persons. Crude rates were also calculated according to the following age groups: 20–29, 30–39, 40–49, 50–59, 60–69 years. As for the general population, the denominator for rates was the resident population of São Paulo, as provided by the Brazilian Institute of Geography and Statistics.[10] Age-standardized rates (ASRs) by sex were calculated using the direct method based on the world population, as proposed by SEGI and modified by Doll and Waterhouse.[11]

In the descriptive analyses, persons with multiple cancer diagnoses were only included once (considering the first cancer). To assess trends in ADCs, NADCs and most incident cancers (anal, colorectal and lung cancers in men; breast and colorectal cancers in women) in the population with AIDS, the three-year moving average of the ASR was calculated. Subsequently, the annual per cent change (APC) was estimated, as follows: $APC = [\exp(\beta_{year}) - 1] \times 100$, and its respective 95% confidence intervals with exponentially transformed values using the Joinpoint software (version 4.2.0.2). Data from the PBCR-SP were analysed to assess trends in cancer incidence in the general population. The series of the PBCR-SP started in 1997. Since its trends are greatly affected by the AIDS epidemic, no specific trend analysis for the general population was conducted for KS.

To compare risk for cancer within age groups, the ratio between crude age-specific rates of the oldest age group (60–69 years) and the youngest (20–29 years) was calculated. All statistical analyses were stratified by sex.

This research obtained ethical clearance from the Ethics Review Board at the School Public Health, University of São Paulo (686.849), from the Municipal Health Secretariat of São Paulo (703.467) and from the University of Munich (233.15). After record linkage, the database was anonymized to ensure data privacy.

Results

Table 1 displays the main characteristics of all AIDS cases registered in São Paulo from 1980 to 2013.

Table 1. Socio-demographic characteristics of people diagnosed with AIDS, according to gender. São Paulo, 1980–2013.

	Total		Male		Female	
	n	%	n	%	n	%
Race/ethnicity						
White	21,935	25.2	15,360	24.2	6575	27.8
Black	4292	4.9	2715	4.3	1577	6.7
Asian	303	0.3	214	0.3	89	0.4
Pardo[a]	10,079	11.6	6484	10.2	3595	15.2
Indigenous	64	0.1	48	0.1	16	0.1
Unknown	50,436	57.9	38,616	60.9	11,820	49.9
Age at AIDS diagnosis (years)						
13–19	1453	1.7	963	1.5	490	2.1
20–29	22,818	26.2	16,044	25.3	6774	28.6
30–39	34,892	40.1	26,132	41.2	8760	37.0
40–49	18,944	21.7	13,964	22.0	4980	21.0
50–59	6548	7.5	4621	7.3	1927	8.1
60–69	1853	2.1	1258	2.0	595	2.5
≥70	423	0.5	311	0.5	112	0.5
Unknown	178	0.2	144	0.2	34	0.1
HIV exposure category						
Homosexual men	17,589	20.2	17,589	27.7	NA	NA
Bisexual	6001	6.9	5977	9.4	24	0.1
Heterosexual	31,550	36.2	14,832	23.4	16,718	70.6
Intravenous drug user	13,643	15.7	11,256	17.7	2387	10.1
Other	595	0.7	402	0.6	193	0.8
Unknown	17,731	20.4	13,381	21.1	4350	18.4
Total	**87,109**	**100**	**63,437**	**100**	**23,672**	**100**

NA: not applicable.
[a]*Pardo* refers to multiracial persons of African ancestry.
Source: Epidemiological surveillance on STDs/AIDS, Municipal Department of Health, São Paulo, Brazil.

The majority of cases were men (72.8%), aged 20–49 years (88.5%) at AIDS diagnosis. The estimated number of persons living with AIDS increased substantially from 13,895 (of which 76.1% are males) in 1997 to 44,741 (of which 69.0% are males) in 2012. Young males (20–49 years) accounted for over 60% of the AIDS population at risk of cancer (data not shown).

Of all 496,276 invasive cancers diagnosed between 1997 and 2012, 2074 cancers occurred in 2000 persons with AIDS. Seventy-four persons were diagnosed with two primary site tumours, thus, the descriptive statistics shown in Table 2 was based on 2000 persons. The majority were male (1461; 73.0%), white (1111; 55.6%) and aged 30–49 years old at cancer diagnosis (1257; 62.9%). Heterosexual (674; 33.7%) and homosexual (447; 22.4%) practices were the most frequent stated categories of exposure to HIV.

Table 3 presents the number of cases and trend analyses of ADCs, NADCs, and most incident cancers in men and women both with AIDS and from the general population; in these analyses all 2074 cancers were considered. Most cancers (51.0%; 1057 out of 2074 cancers) in the AIDS population were classified as NADCs, corresponding to 56.7% cancers in women (n = 320). In men, ADCs were slightly more frequent than NADCs, representing 51.2% (n = 773) of all 1510 male cases. The five most incident cancers among men with AIDS were KS (469; 31.1%), NHL (304; 20.1%), anal cancer (63; 4.2%), colorectal cancer (59; 3.9%) and lung cancer (54, 3.6%). In the general male population, the most frequent cancer sites were prostate (23.4%), colon and rectum (9.5%), lung (7.2%), stomach (6.5%) and skin non-melanoma (6.1%) (data not shown).

In women with AIDS, CC (114; 20.2%), NHL (96; 17.0%), breast cancer (72; 12.8%), KS (34; 6.0%) and colorectal cancer (19; 3.4%) were the most incident cancers. In contrast, among women from the general population, breast (25.6%), colon and rectum (8.9%),

Table 2. Socio-demographic characteristics of 2000 people with AIDS and cancer, according to gender. São Paulo, 1997–2012.

	Total		Male		Female	
	n	%	n	%	n	%
Race/ethnicity						
White	1111	55.6	860	58.9	251	46.6
Black	143	7.2	84	5.7	59	10.9
Asian	14	0.7	10	0.7	4	0.7
Pardo[a]	255	12.8	159	10.9	96	17.8
Unknown	477	23.9	348	23.8	129	23.9
Age at AIDS diagnosis (years)						
13–19	16	0.8	9	0.6	7	1.3
20–29	348	17.4	241	16.5	107	19.9
30–39	733	36.7	534	36.6	199	36.9
40–49	528	26.4	397	27.2	131	24.3
50–59	277	13.9	210	14.4	67	12.4
60–69	82	4.1	55	3.8	27	5.0
≥70	16	0.8	15	1.0	1	0.2
Age at cancer diagnosis (years)						
13–19	8	0.4	6	0.4	2	0.4
20–29	225	11.3	163	11.2	62	11.5
30–39	650	32.5	467	32.0	183	34.0
40–49	607	30.4	438	30.0	169	31.4
50–59	348	17.4	271	18.5	77	14.3
60–69	135	6.8	95	6.5	40	7.4
≥70	27	1.4	21	1.4	6	1.1
HIV exposure category						
Homosexual men	447	22.4	447	30.6	NA	NA
Bisexual	179	9.0	179	12.3	–	–
Heterosexual	674	33.7	313	21.4	361	67.0
Intravenous drug user	145	7.3	105	7.2	40	7.4
Other	10	0.5	4	0.3	6	1.1
Unknown	545	27.3	413	28.3	132	24.5
Total	**2000**	**100**	**1461**	**100**	**539**	**100**

NA: not applicable.
[a]*Pardo* refers to multiracial persons of African ancestry.

thyroid (7.5%), cervix (5.2%) and skin non-melanoma (5.2%) were the most frequent cancer sites (data not shown).

As for the trend analyses in men with AIDS, a statistically significant decline was seen in general for ADCs (APC = −14.1%/year), but also in particular for KS (APC = −16.2%/year) and NHL (APC = −11.9%/year). In contrast to this, all NADCs decreased (APC = −9.7%/year) until the mid-2000s, when it started to increase (APC = 7.4%/year). Incidence of anal and lung cancer have significantly increased by 24.6 and 15.9%, respectively, whereas colorectal cancer remained stable. In the general male population, NHL, colorectal, lung and anal cancers had significant declines in incidence of −2.8, −1.3, −7.6, −5.9%/year, respectively (Figure 1(a) to (d)).

Among women with AIDS, a statistically significant decline was seen in general for ADCs (APC = −15.6%/year), and in particular for KS (APC = −26.7%/year), NHL (APC = −15.8%/year), CC (APC = −12.8%/year) and breast cancer (APC = −10.1%/year) in particular. In contrast to this, the incidence of colorectal cancer remained stable. Additionally, also for all NADCs (APC = −15.8%/year), the decline was significant. Declining trends in all cancers analysed were found for women from the general population.

Table 3. Trends in 2074 cancer cases found among 2000 people with AIDS and cancer and people from general population, according to sex. São Paulo, 1997–2012.

	Persons with AIDS				General population			
	n	APC	95% CI	p	n	APC	95% CI	p
Male[a]								
All AIDS-defining cancers	773	−14.1	−16.6; −11.6	<0.01	NA	NA	NA	NA
Kaposi sarcoma	469	−16.2	−18.8; −13.4	<0.01	NA	NA	NA	NA
Non-Hodgkin lymphoma	304	−11.9	−15.5; −8.2	<0.01	7719	−2.8	−3.5; −2.1	<0.01
All non-AIDS-defining cancers (1997–2005)[b]	361	−9.7	−12.2; −7.1	<0.01	NA	NA	NA	NA
All non-AIDS-defining cancers (2005–2012)	376	7.4	3.6; 11.4	<0.01	NA	NA	NA	NA
Anal cancer[c]	63	24.6	16.0; 33.9	<0.01	616	−5.9	−10.1; −1.5	<0.01
Colorectal cancer	59	−3.9	−11.5; 4.3	0.30	22,565	−1.3	−2.1; −0.5	<0.01
Lung cancer	54	15.9	6.9; 25.7	<0.01	17,082	−7.6	−8.3; −6.9	<0.01
Female[d]								
All AIDS-defining cancers	244	−15.6	−18.8; −12.3	<0.01	NA	NA	NA	NA
Cervical cancer	114	−12.8	−16.3; −9.2	<0.01	14,765	−8.2	−9.1; −7.3	<0.01
Non-Hodgkin lymphoma	96	−15.8	−20.0; −11.4	<0.01	7220	−2.4	−3.0; −1.7	<0.01
Kaposi sarcoma	34	−26.7	−34.7; −17.7	<0.01	NA	NA	NA	NA
All non-AIDS-defining cancers	320	−15.8	−20.0; −11.3	<0.01	NA	NA	NA	NA
Breast cancer	72	−10.1	−19.1; −0.2	<0.01	72,134	−1.8	−2.5; −1.1	<0.01
Colorectal cancer	19	1.9	−10.3; 15.8	0.70	24,975	−1.5	−2.3; −0.7	<0.01

APC: annual per cent change; CI: confidence interval; NA: not applicable.
[a]Cancer cases add up to 1510 in men with AIDS.
[b]Segment provided by Joinpoint.
[c]2002 onwards.
[d]Cancer cases add up to 564 in the women with AIDS.

The analysis of crude rates stratified by age group revealed that the risk for all ADCs (KS, NHL and CC) increased with age (Figure 2(a) and (b)). Risk for all NADCs among persons with AIDS was 38.3-fold in men and 35.6-fold in women, when comparing the oldest (60–69 years) to the youngest age group (20–29 years).

Discussion

This is the first study in Brazil estimating the incidence of cancer in patients with AIDS at a population level. Our results reveal a high and changing cancer burden in this population, as found in similar studies conducted in North America and Europe, as well as a multicentre cohort study performed in Rio de Janeiro (Brazil) and Nashville (US).[2,4,5,12,13]

Although approximately half of cancers identified in our study were classified as ADCs, their incidences have dramatically declined in São Paulo, but remain at high rates when compared to the general population. Declining trends in ADCs have been documented in several studies, with one of the most probable contributors to this being the introduction of HAART in 1996.[2,5] Treatment with HAART, if timely, alters the course of HIV infection by preventing or reversing profound immunosuppression, and thereby, decreasing susceptibility of developing AIDS-defining illnesses, including ADCs.[14,15] Despite efforts to scale up HIV testing and early diagnosis, late entries to HIV care are still very frequent worldwide and could prevent further reduction in ADCs burden.[16,17] A study conducted in Brazil revealed that between 2003 and 2006, 43.6% of persons aged 15 and older diagnosed with AIDS entered HIV care late, either having CD4+ cell counts $\leq$200 cells/mm^3, an AIDS-defining illness at the initial examination or having died within the first 20 days of entry.[18] In these cases, delayed introduction of HAART could be less effective in improving the immune system and its ability to control oncogenic viruses, such as Epstein–Barr virus (risk factor for NHL) and human herpes virus 8 (associated with KS), increasing the overall risk for ADCs.

On the other hand, since 2013, the Brazilian Ministry of Health encourages the immediate initiation of antiretroviral therapy among all individuals diagnosed with HIV infection, regardless of CD4+ cell counts.[19] This measure could lead to further declines in ADCs, by preventing persons diagnosed with HIV only from developing AIDS and its defining illnesses.

Steep reduction (APC = −15.8% in women; −11.9% in men) in NHL in the AIDS population could have

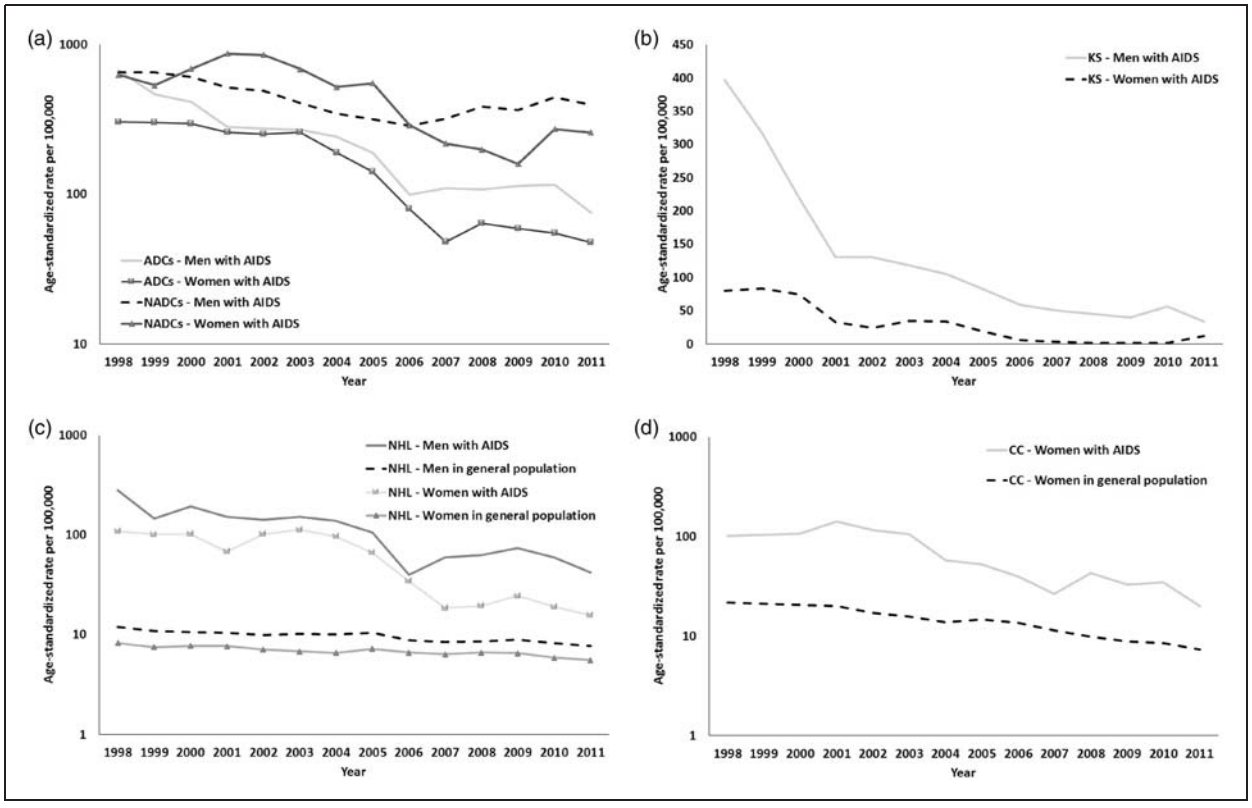

Figure 1. (a) Age standardized incidence rates of AIDS-defining and non-AIDS-defining cancers in the AIDS population according to gender. São Paulo, 1997–2012. Rates are presented based on three-year moving average and displayed on a logarithmic scale. (b) Age standardized incidence rates of Kaposi's sarcoma in the AIDS population according to gender. São Paulo, 1997–2012. Rates are presented based on three-year moving average. (c) Age standardized incidence rates of non-Hodgkin lymphoma in the AIDS population and in the general population according to gender. São Paulo, 1997–2012. Rates are presented based on three-year moving average and displayed on a logarithmic scale. (d) Age standardized incidence rates of cervical cancer in the AIDS population and in the general population. São Paulo, 1997–2012. Rates are presented based on three-year moving average and displayed on a logarithmic scale.

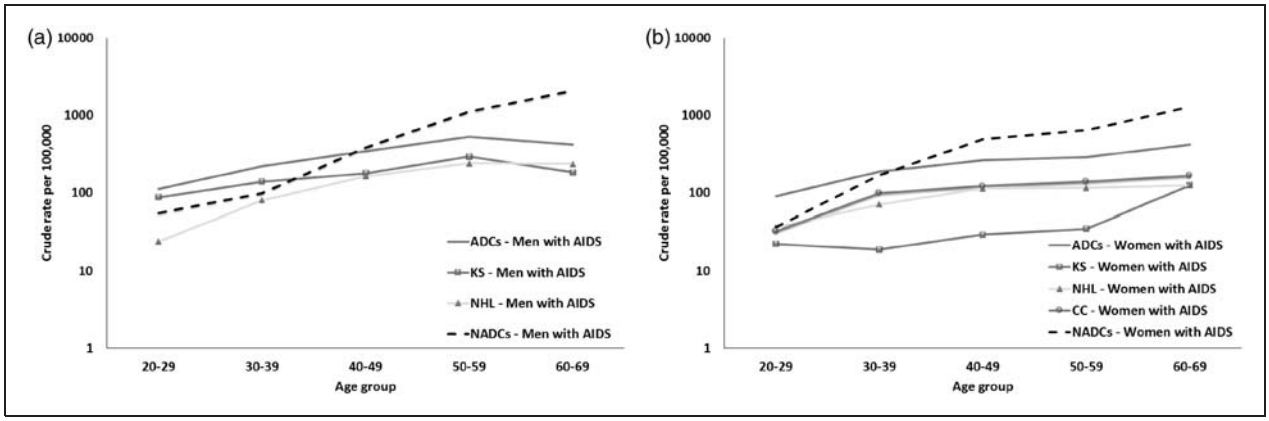

Figure 2. (a) Crude incidence rates for AIDS-defining cancers, non-AIDS-defining cancers, Kaposi's sarcoma and non-Hodgkin lymphoma in men with AIDS according to age group. Sao Paulo, 1997–2012. Rates are displayed on a logarithmic scale. (b) Crude incidence rates for AIDS-defining cancers, non-AIDS-defining cancers, Kaposi's sarcoma, non-Hodgkin lymphoma and cervical cancer in women with AIDS according to age group. Sao Paulo, 1997–2012. Rates are displayed on a logarithmic scale.

contributed to declining trends at the general population level (APC = −2.4% in women; −2.8% in men), as they account for 4% of all cases. Similar declining patterns for CC were identified in women with AIDS and women from the general population. In both cases, the propagation of Pap smear screening may have contributed to this epidemiological pattern as the test can identify cervical lesions before they evolve to CC. In São Paulo, over 90% of female inhabitants belonging to the screening target group reported to have had at least one Pap smear in the last three years.[20]

Conversely, NADCs have become progressively crucial over the years. In both men and women, incidence of NADCs surpassed ADCs in the mid-2000s, but in men, the incidence has been particularly increasing since 2005, driven by lung and anal cancers. Other NADCs, such as female breast and colorectal cancers in the AIDS population follow the pattern of the general population. In São Paulo, coverage of the breast cancer screening programme is about 80%.[20]

The increasing trend in lung cancer among men is not surprising. According to the Brazilian Ministry of Health, the prevalence of smoking among PLWHA ranges from 50 to 70%,[19] which is considerably higher than that of the general population (14.9% in 2013 in São Paulo).[20] Recent data from the US revealed that lung cancer has decreased more rapidly in PLWHA than in the general population, though the authors believe that this might result from a faster decline in smoking prevalence in the first group.[2] In São Paulo there are no data suggesting changes in smoking prevalence in this population. In line with our results, lung cancer in PLWHA in Italy has increased in the post-HAART era when compared to the pre-HAART era.[5] Previous studies have shown that higher incidence of lung cancer in this population is mainly attributable to tobacco smoking rather than other cofactors.[21] There is an ongoing debate on the effectiveness of screening for lung cancer, and until there is enough evidence to adopt it, management of this malignancy must focus on strategies to promote tobacco cessation.

As for anal cancer in the male population with AIDS, there is a clear increasing trend since 2002, which is contrary to the drop observed in the general population. Similar results have been reported in Italy and the US, though in the US increasing trends in anal cancer in the AIDS population have been identified as driving the upward trend in the general population.[2,5] Anal cancer has been strongly linked to persistent HPV infection and tobacco smoking,[22] and the risk among PLWHA is as high as 37-fold when compared to the general population.[23] A multicentre study in Brazil of 445 HIV-positive men, found a 65.6% prevalence of HPV DNA in anal swabs, with 40.7% detected as oncogenic HPV strains.[24] In an effort towards early detection of anal cancer and its precursor lesions in PLWHA, the Brazilian Ministry of Health has recommended since 2013 annual anal Pap smears for patients who have receptive anal intercourse, HPV infection history, or abnormal vulvar or cervical histology.[19] This strategy could lead to changes in anal cancer burden in the high-risk population in the future.[25]

Our findings are closer to that of industrialized countries, probably due to two aspects: the characteristics of the AIDS epidemic and the access to antiretroviral therapy. In São Paulo, AIDS is still more prevalent in men, with homosexual exposure to HIV representing an important mode of transmission. However, male-to-female ratio of AIDS cases has dramatically fallen from 26:1 in 1985 to 2:1 in 2011.[26] In the US and Western European countries, the populations of PLWHA have similar features, whereas in sub-Saharan Africa, women are disproportionally more affected by AIDS and heterosexual infection is predominant.[27] Concerning antiretroviral therapy, provided in Brazil since 1996, treatment is free of cost to all patients in need. Thus, regardless of a patient's economic condition, treatment is universal.[28]

The analysis of crude rates by age groups highlights that as patients age the risk for cancer increases, but the risk is more pronounced for NADCs. Incidence of NADCs peaks at older ages, a pattern observed for most cancers in the general population. Polesel et al.,[5] when assessing NADCs in PLWHA in Italy, concluded that the strong changes in crude rates were driven by the ageing of the AIDS population.[5]

As for limitations, this study is restricted to the AIDS population and does not examine HIV-only patients. Even though the city of São Paulo occasionally provided notices regarding HIV infection, notification has only recently become mandatory (in June 2014). Thus, data for HIV-only cases for the study period are not precise and was therefore not analysed. Information on clinical data, including CD4+ cell count, viral load and antiretroviral therapy was not assessed because it is not routinely collected by the AIDS registry (SINAN).

The shorter coverage period of the PBCR-SP has limited our analysis to the post-HAART era. It would have been valuable to understand the risk for cancer in this population before HAART became fully available.

Three main sources of cancer underestimation may have occurred in our study. First, this study relies on probabilistic record linkage itself. This method is not error free and might have failed in the identification of some of those PLWHA who had cancer in the study period. To minimize this issue and improve our data matching sensitivity, a multi-step process was carried

out and clerical review was employed. Even so, some degree of underestimation may have occurred. Nevertheless, this strategy has also been employed to estimate cancer incidence in PLWHA in other countries and is the primary source of population-based data.

A second factor that could result in cancer underestimation is outmigration. Residents of São Paulo who were diagnosed with AIDS and outmigrated later could not be captured by our database linkage. There are no data on the percentage of outmigration among AIDS patients, but available information from a report assessing incident cancer cases registered in São Paulo revealed that 4% of deaths were registered outside the municipality (outmigration).[29] If one assumes that the percentage of AIDS cases that moved to other municipalities is similar and that not all of them would develop cancer, then outmigration would not greatly interfere with our findings.

Lastly, PLWHA who are unaware of their status may have been misclassified in our study, and therefore failed to contribute to the cancer burden in persons with AIDS. Nevertheless, this is to be expected in studies, which are based on passive case finding.

Despite the aforementioned constraints, the present study provides valuable population-based information from a developing country. The current body of knowledge is composed mainly of research conducted in developed countries with this study providing aggregated data from a developing country known for its particular plan to fight AIDS. Our findings highlight a marked decrease in ADCs for both genders and a recent increase in NADCs among men, mainly driven by lung and anal cancers. Stratification by gender was important to identify different patterns in cancer trends. This suggests that exposure to risk factors for cancer, such as smoking, varies according to gender and has to be accounted for in explanations of gender differences. In addition, women tend to seek health care more frequently than men do and this might have affected the risk of cancer.[30]

Risk for cancer in persons with AIDS increases dramatically as they age, with a similar pattern seen in the general population. Because PLWHA are living longer and reaching older ages due to advances in disease treatment, cancer in this population will remain an important issue to be addressed. Strategies to promote lifestyle changes to reduce or eliminate modifiable risk factors such as tobacco smoking, as well as screening and early cancer detection are key points for the management of cancer in PLWHA.

Declaration of conflicting interests

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