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The association of neoplasms and HIV infection in the correctional setting

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Summary

HIV-associated immunosuppression has been linked to an increased risk of a number of cancers, including Kaposi sarcoma (KS), non-Hodgkin's lymphoma (NHL), and invasive cervical cancer. Because prison inmates constitute one of the highest HIV/AIDS prevalent populations in the US, understanding the link between HIV infection and cancer in the correctional setting holds particular public health relevance. The study population consisted of 336,668 Texas Department of Criminal Justice inmates who were incarcerated, for any duration, between 1 January 1999 and 31 December 2001. Inmates diagnosed with HIV infection exhibited elevated rates of KS, NHL, anal cancer, and Hodgkin's disease, after adjusting for age and race. The elevated rates of cancer among HIV-infected individuals, particularly prison inmates, may be mediated, in part, by high-risk behaviours. HIV-associated risk behaviours, including unsafe sexual practices, injection drug use, and prostitution may be associated with cancer-related risk behaviours, such as smoking, excessive alcohol consumption, and poor diet. It will be important for future investigators to examine the association between HIV infection and cancer risk with sufficiently large study cohorts and appropriate longitudinal designs.

Keywords

HIV/AIDS; neoplasms; prisoners; prevalence

Introduction

Immunosuppression associated with HIV-infection and acquired immune deficiency syndrome (AIDS) has been consistently linked to an increased risk of Kaposi sarcoma (KS), non-Hodgkin's lymphoma (NHL), primary brain lymphoma, and invasive cervical cancer^{1–5}. These malignancies are therefore classified as AIDS-defining cancers. Additional cancers, most notably anal cancer, Hodgkin's disease, and leukaemia, have also demonstrated moderate associations with HIV infection in some populations^{3,4,6,7}. The link between immunosuppression and cancer is supported by findings that immune restoration achieved via highly active antiretroviral therapy (HAART) is associated with a decreased incidence of AIDS-defining cancers². In fact, it has been demonstrated that HAART improves tumour outcomes even without additional chemotherapy. Moreover, medical immunosuppression is associated with many of the same forms of cancer that occur in people with HIV infection⁷.

Improvements in AIDS therapy and the associated increase in survival among patients with AIDS will likely result in greater prevalence in HIV-associated cancers¹. It is increasingly important, therefore, to track the development of these cancers as treatments continue to improve.

Because prison inmates constitute one of the highest HIV/AIDS prevalent populations in the US^{8–11}, a substantial amount of research has been conducted on the pharmacotherapy patterns, AIDS-related survival, and the overall clinical profiles of HIV-infected inmates^{9,12–16}. Little information currently exists, however, on the association between HIV infection and cancer in the correctional setting. The purpose of the present study, therefore, was to compare the prevalence of cancers in HIV-infected and non-infected inmates in one of the nation's largest prison systems.

Methods

The cohort under study consisted of 336,668 inmates convicted of criminal offences and incarcerated in the Texas Department of Criminal Justice (TDCJ) prison system for any duration dating from 1 January 1999 through 31 December 2001. Texas houses one of the largest prison populations in the US and together with California houses almost one-fourth of all US prison inmates¹⁷.

All TDCJ inmates are required to have medical and mental health examinations at the time of intake. This evaluation lasts approximately 60 minutes and consists of a detailed medical and mental health history, a comprehensive physical examination, and a number of diagnostic procedures including a rapid plasma reagin (RPR), Mantoux TB skin test, and additional tests as indicated. Diagnoses of all medical conditions were made by physicians, physician assistants, or nurse practitioners at the time of each inmate's initial evaluation and/or subsequent medical encounters, and were classified according to International Classification of Disease (ICD-10) coding system. These data, along with sociodemographic information, are maintained in an institution-wide medical information system. This system is routinely updated to ensure that the information reflects the inmates' current health status.

Prevalence estimates were used to assess the proportion of inmates with each of the cancers under study. The present study assessed only those medical conditions that were present during the period of investigation. Prevalence of each of the aforementioned malignancies was estimated according to HIV infection status¹⁸. A total of eight cancers (three AIDS-defining and five non-AIDS defining) were selected for evaluation based on their reported association with HIV in previous published studies^{1,4,5}. Because most of the conditions under study were exceedingly rare, prevalence was calculated per 100,000 inmates. In order to assess differences in prevalence across the subgroups under study, the prevalence odds ratio and corresponding 95% confidence intervals were generated for each estimate. Logistic regression was then used to assess the age- and race-adjusted association of HIV infection status with the dichotomous outcome variables, presence of each of the cancers under study. Since females constituted a small proportion of the TDCJ inmate population (11.6%), inclusion of the covariate gender in the multivariate logistic regression analyses yielded unstable estimates. Gender was, therefore, left out of all multivariate models. Because gender was distributed similarly in the HIV-infected and uninfected subgroups, its potential confounding effect is probably reduced.

Results

Table 1 presents the distribution of demographic factors among TDCJ inmates according to HIV infection status. The vast majority of the study population was male (88.7%) and aged 30 to 49 years (57.6%). Of the total 336,668 inmates under study, 32.9% were white, 42.2% were

black, and 24.9% were Hispanic. Blacks and inmates aged 30 to 49 years were substantially over-represented among inmates infected with HIV. Hispanics, as well as inmates in the youngest and oldest age groups, were substantially under-represented among HIV-infected inmates.

Table 2 shows the prevalence per 100,000 for AIDS-defining and non-AIDS defining cancers in the TDCJ study population, as well as the prevalence by HIV infection status. Cervical cancer, the most prevalent of the three AIDS-defining cancers under study (58 per 100,000), occurred more frequently among female inmates infected with HIV (135 per 100,000) than among their uninfected counterparts (56 per 100,000). The prevalence rates of KS and NHL were higher in the HIV-infected group as well. KS occurred in 283 per 100,000 in the HIV-infected subgroup, compared to only one per 100,000 in the uninfected subgroup. Cervical cancer occurred in 135 per 100,000 of the HIV infected subgroup, but only 56 per 100,000 of uninfected inmates.

Of the five non-AIDS defining cancers examined, three cancers, anal cancer, colorectal cancer, and Hodgkin's disease, exhibited elevated occurrence in HIV-infected inmates. Anal cancer occurred in 61 per 100,000 HIV-infected inmates, but only two per 100,000 uninfected inmates. Likewise, colorectal cancer occurred in 41 per 100,000 HIV-infected inmates but only 27 per 100,000 uninfected inmates; and Hodgkin's disease occurred in 81 per 100,000 of those with HIV, but only 20 of their uninfected counterparts. The unadjusted and adjusted prevalence odds ratios and the associated 95% confidence intervals show a strong and statistically significant association between HIV infection status and the prevalence of KS, NHL, anal cancer, and Hodgkin's disease. For the outcomes, lung cancer and leukaemia, HIV-infected inmates were less likely to have prevalent lung cancer and leukaemia than were uninfected inmates. Neither of these findings was statistically significant.

Discussion

Immunodeficiency associated with HIV infection is reported to cause three types of cancer: KS, NHL, and cervical cancer^{1,4,5,7}. Other cancers, including anal cancer, colorectal cancer, and Hodgkin's disease, are reported to occur more frequently among HIV-infected individuals than their uninfected counterparts^{2,4-7}. The strength of the association between non-AIDS defining neoplasms and HIV infection, however, has varied considerably across different study samples. Therefore, it is important to develop a more complete understanding of the association between HIV infection and cancer, and, in particular, to learn about how this association is modified by the behavioural characteristics of the population under study. The elevated rates of cancer among persons with AIDS can be attributed to either immunosuppression because of HIV infection, or common risk behaviours shared by the specific cancer and HIV infection. In view of the large numbers of HIV-infected and socially disadvantaged individuals in correctional settings, incarcerated populations are a particularly important population in which to examine the association of HIV infection and cancer risk.

In general, the findings of the present study, particularly the elevated rates of KS, NHL, anal cancer, and Hodgkin's disease among HIV-infected inmates were consistent with previous reports of non-incarcerated populations¹⁻⁵. Several of these cancers, particularly KS, and lymphomas, are associated with viruses. KS, for example, has been consistently linked with the sexual transmission of the Kaposi's sarcoma-associated herpes virus (KSHV)⁵. KS occurs most frequently among gay men, and is rarely seen in people who acquire HIV parenterally, such as injection drug users, or people with haemophilia⁵. In fact, the rates of KS are reportedly 10 times higher in homosexual or bisexual men than among other HIV transmission groups¹⁹. Although it was not possible to assess the association of KS with sexual risk

behaviours in the Texas prison population, it is noteworthy that all 14 cases of KS reported in the TDCJ occurred in males.

We found a positive association between HIV infection and cervical cancer, although it was not statistically significant. Cervical cancer has a well-documented sexually-transmitted viral aetiology, human papillomavirus (HPV). In fact, HPV has been linked to cancer of the vagina, anus, and penis, as well²⁰. Again, informational limitations precluded our assessment of the extent to which sexual risk factors and HPV correlated with these malignancies. But given the elevated rates of sexual risk factors among inmate populations, such as prostitution, sex in exchange for drugs, and having multiple sexual partners, it will be important for future studies to evaluate the sexually transmitted viral aetiology of these cancers in this population.

Our finding that neither lung cancer nor leukaemia were elevated among HIV infected inmates was not particularly surprising given the inconsistent results reported for these outcomes in previous studies²⁻⁵. It is important to acknowledge that many of the rare outcomes under study yielded limited statistical power. Our assessment of leukaemia, in particular, was hindered by an absence of reported cases in the HIV-infected subgroup. Consistent with most prison populations, Texas inmates exhibited a small proportion (less than 3%) of inmates over the age of 60. Because cancer is highly concentrated in older age groups, the reduced sample size in the 60 and over age group limited statistical power to examine HIV and cancer associations. This was particularly problematic in examining rare cancers. To have sufficient numbers of cancer outcomes, it will be important for future prison epidemiology studies to develop ways to pool data across multiple state prison systems.

There are a number of factors that may have contributed to the elevated rates of cancer among HIV infected inmates. First, it is possible that individuals who engaged in HIV-associated risk behaviours, such as injection drug use and unsafe sexual practices, were more likely to have exhibited cancer-associated risk behaviours such as smoking, excessive alcohol consumption, and poor diet¹. Because information on these behaviours is not routinely collected in the prison system, it was not possible to assess their potential confounding role. Second, the elevated rates of cancers among HIV infected inmates may have been partly attributable to the increased medical attention this group received⁷. While all inmates undergo routine physical examinations when they are initially incarcerated, and are given annual evaluations subsequently, inmates receiving regular care for medical management of their HIV/AIDS, are likely to have more regular contact with medical staff, thus increasing their probability of having a new malignancy diagnosed. For inmates with a relatively short stay, this may increase the apparent frequency of occurrence of cancer.

While the present study provides important cross-sectional information on the association of HIV infection and cancer, well-designed prospective studies will help investigators more completely understand this research question. In particular, such studies would help elucidate the extent to which mediating factors such as health behaviours, or methodological issues such as ascertainment bias, contribute to the elevated cancer risk among HIV infected individuals. As advances in AIDS treatment continue to increase the overall survival time for people infected with HIV, the development of HIV-related malignancies will also increase¹. Determining the specific aetiological pathways that underlie the relationship between HIV and cancer, particularly in high risk groups such as prison inmate populations, will have far-reaching clinical and public health importance.

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References

1. Cooksley C, Hwang L, Waller D, Ford A. HIV-related malignancies: community-based study using linkage of cancer registry and HIV registry data. *Int J STD AIDS* 1999;10:795–802. [PubMed: 10639060]
2. Hermans P. Opportunistic AIDS-associated malignancies in HIV-infected patients. *Biomed Pharmacother* 2000;54:32–40. [PubMed: 10721460]
3. Morten F, Biggar R, Engels E, Goedert J. Association of cancer with AIDS-related immunosuppression in adults. *JAMA* 285:1736–45. 200. [PubMed: 11277828]
4. Petruckevitch A, Del Amo J, Phillips A, Stephenson J, Johnson A, De Cock K. Risk of cancer in patients with HIV disease. *Int J STD AIDS* 1999;10:38–42. [PubMed: 10215128]
5. Weiss R. Viruses, cancer, and AIDS. *FEMS Immunol Med Microbiol* 1999;26:227–32. [PubMed: 10575133]
6. Goedert J, Cote T, Virgo P, et al. Spectrum of AIDS-associated malignant disorders. *Lancet* 1998;351:1833–9. [PubMed: 9652666]
7. Grulich A, Wan X, Law M, Coates M, Kaldor J. Risk of cancer in people with AIDS. *AIDS* 1999;13:839–43. [PubMed: 10357384]
8. Baillargeon J, Black SA, Pulvino J, Dunn K. The disease profile of Texas prison inmates. *Ann Epidemiol* 2000;10:74–80. [PubMed: 10691060]
9. Braithwaite, R.; Hammet, T.; Mayberry, R. *Prison and AIDS: A Public Health Challenge*. Joney-Bass Publishers; San Francisco: 1996.
10. Hoxie N, Chen M, Prieve A. HIV seroprevalence among male prison inmates in the Wisconsin Correctional System. *Wis Med J* 1998;97:28–31.
11. Spaulding A, Stephenson B, Macalino G, Ruby W, Clarke J, Flanigan T. Human immunodeficiency virus in correctional facilities: a review. *HIV/AIDS* 2002;35:305–12.
12. Baillargeon J, Borucki M, Zepeda S, Jenson HB, Leach CT. Antiretroviral prescribing patterns in the Texas prison system. *Clin Infect Dis* 2000;31:1476–81. [PubMed: 11096015]
13. Baillargeon J, Borucki M, Williamson J, Dunn K. Determinants of HIV-related survival among Texas prison inmates. *AIDS Patient Care STDs* 1999;13:355–61. [PubMed: 10842856]
14. Baillargeon J, Borucki M, Grady J. Immunologic predictors of HIV-related survival among Texas prison inmates. *AIDS Patient Care STDs* 1999;14:183–8. [PubMed: 10806636]
15. Griffin M, Ryan J, Briscoe V. Effects of incarceration on HIV-infected individuals. *J Nat Med Assoc* 1996;88:639–44.
16. Wu H, Baillargeon J, Grady J, Black SA, Dunn K. HIV seroprevalence among newly incarcerated inmates in the Texas correctional system. *Ann Epidemiol* 2001;11:342–6. [PubMed: 11399449]
17. Beck A, Karberg J, Harrison P. U.S. Department of Justice, Bureau of Justice Statistics. *Prison and jail inmates at midyear 2001*. 2002
18. Kleinbaum, K.; Kuper, L.; Morgenstern, H. *Epidemiologic Research*. Van Nostrand; Boston: 1982.
19. Beral V, Bull D, Darby S, et al. Risk of Kaposi's sarcoma and sexual practices associated with faecal contact in homosexual or bisexual men with AIDS. *Lancet* 1992;339:632–5. [PubMed: 1347337]
20. Bosch F, Munoz N. The viral etiology of cervical cancer. *Virus Res* 2002;89:183–90. [PubMed: 12445658]

Table 1

Sociodemographic characteristics of Texas prison inmates

HIV infectious status	Overall (n=336,668)		Infected (n=4,910)		Not infected (n=331,758)	
	n	%	n	%	n	%
Sex						
Female	38,206	11.4	772	15.7	37,434	11.3
Male	298,462	88.6	4138	84.3	294,324	88.7
Race						
Black	142,207	42.2	3228	65.7	138,979	41.9
Hispanic	83,849	24.9	457	9.3	83,392	25.1
White	110,612	32.9	1225	25.0	109,387	33.0
Age (years)						
18–29	115,853	34.4	722	14.7	115,131	34.8
30–49	194,036	57.6	3865	78.7	190,171	57.3
50+	26,779	7.9	323	6.6	26,456	7.9

Table 2

Rates of neoplasms among Texas prison inmates according to HIV infection status

	Overall (n=336,668) n/100,000	Infected (n=4,910) n/100,000	Not infected (n=331,758) n/100,000	Unadjusted odds ratio/ 95% CI	Adjusted odds ratios/95% CI**
<i>AIDS-defining cancers</i>					
Cervical cancer*	58	129	56	2.3 (0.3–17.2)	2.0 (0.3–15.2)
Kaposi sarcoma	4	265	1	880.7 (115.2–6733.7)	862.5 (109.3–999.9)
Non-Hodgkin's lymphoma	21	224	17	12.8 (6.7–24.5)	11.7 (6.0–22.6)
<i>Non-AIDS-defining cancers</i>					
Anal cancer	2	61	1	50.7 (11.3–226.6)	43.7 (9.3–206.6)
Colorectal cancer	23	41	27	1.5 (0.4–6.0)	1.4 (0.3–6.0)
Hodgkin's disease	21	81	20	4.1 (1.5–11.3)	4.1 (1.5–11.4)
Lung cancer	27	20	27	0.7 (0.1–5.4)	0.7 (1.0–5.3)
Leukaemia***	13	0	13		

* = Calculated using a females only denominators (36,425; 740; and 35,685 respectively)

** = Adjusted for age and race using logistic regression

*** = Odds ratio undefined due to insufficient number of cancer cases