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Racial Disparities in Cancer Risk Among Men Who Have Sex with Men with HIV in the United States, 2001–2019

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Abstract

Background: Greater immunosuppression is associated with elevated risk of virus-associated cancers among people with HIV. We investigated racial and ethnic disparities in cancer risk among MSM with HIV (MSMWH).

Methods: Among MSMWH from 2001–2019 in the HIV/AIDS Cancer Match Study, we examined Kaposi sarcoma (KS), non-Hodgkin lymphoma (NHL), liver cancer, anal cancer, and Hodgkin lymphoma (HL). Within racial/ethnic groups, we estimated cancer rates relative to the general population with standardized incidence ratios (SIR). We calculated incidence rate ratios (IRR) comparing cancer risk between racial/ethnic groups among MSMWH using Poisson regression. We stratified these calculations according to prior AIDS diagnosis to assess whether differences persisted after accounting for AIDS.

Results: We evaluated 358,023 MSMWH followed for 3.2 million person-years. The SIRs for KS for Hispanic/Latino MSMWH (887 95%CI=833–943) and Black MSMWH (772; 95%CI=727–819) were higher than White MSMWH (417; 95%CI=392–443). Among MSMWH, risk of KS was higher for Hispanic/Latino and Black MSMWH compared to White MSMWH (IRR=1.40 and 1.24, respectively). We did not detect differences in IRRs when stratified by AIDS diagnosis. While the SIR for anal cancer was lower among Black MSMWH (24.1; 95%CI=22.3–26.0) compared to White MSMWH (38.4; 95%CI=36.3–40.6), incidence was not statistically different (IRR=0.98; 95%CI=0.89–1.08).

Conclusion: Incidence rates and relative risks for several virus-related cancers were greater for Hispanic/Latino and Black MSMWH than White MSMWH, even when examined exclusively among those with or without AIDS. These disparities in cancer risk point to inequities in access to HIV care and disease burden.

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INTRODUCTION:

As the population with HIV ages, cancer contributes to a growing proportion of mortality and morbidity, making disparities in cancer risk important to describe and address. People with HIV (PWH) who have not achieved viral suppression have higher risk of many cancers, especially those associated with viruses [1–5]. PWH with CD4+ T cell concentrations less than 200 per cubic millimeter of blood or who are diagnosed with specific illnesses associated with infections meet the criteria for a diagnosis of AIDS. Combination antiretroviral therapy (cART) to treat HIV can improve viral suppression, prevent progression to a diagnosis of AIDS, reduce cancer incidence and increase life expectancy for PWH [6–8]. However, major racial and ethnic disparities exist in HIV acquisition, access to cART, and viral suppression [9]. Differences in virus-associated cancer risk across racial and ethnic groups among PWH have been documented, though these disparities have not accounted for level of immunosuppression [10]. Disparities in severe immunosuppression likely contribute to differences in virus-associated cancer risk.

Men who have sex with men (MSM) are disproportionately affected by HIV, representing 71% of new HIV diagnoses in the US in 2021 [11]. In 2019, among all MSM with HIV (MSMWH), 85% knew their HIV status, 66% had been linked to an HIV healthcare provider within one month after learning they were positive, 50% had been retained in care, and 58% had reached viral suppression within 6 months of their diagnosis [9]. Additionally, new HIV diagnoses disproportionately occur among minoritized racial and ethnic groups. Of the new HIV infections in the US in 2021 among MSM, 36% were among Black individuals, while 33% were among Hispanic/Latino individuals [9]. In 2021, 53% of Black PWH and 54% of Hispanic/Latino PWH reached viral suppression compared to 64% of White PWH [9]. These disparities in HIV acquisition and viral suppression likely result from social inequities such as institutional/interpersonal racism, HIV stigma, discrimination, homophobia, poverty, and barriers to healthcare.

We investigated the most common virus-associated cancers among MSMWH for which risk is strongly associated with advanced HIV and described their risk according to race and ethnicity [3]. We compared risk in MSMWH to the general population of males within racial and ethnic groups and estimated differences in risk according to race and ethnicity among MSMWH. We further investigated how risk varied according to prior diagnosis of AIDS as a measure of greater immunosuppression, reflecting disparities in progression of HIV and immunosuppression.

METHODS:

Study Population

We utilized data from the HIV/AIDS Cancer Match Study (HACM), a data linkage study of HIV and cancer in 14 regions in the US: Texas (2001–2015), New York (2001–2019), Colorado (2001–2015), Louisiana (2001–2015), Florida (2001–2019), Georgia (2004–2012), Puerto Rico (2003–2017), North Carolina (2001–2014), Washington D.C. (2007–2015), Maryland (2008–2018), New Jersey (2001–2012), Connecticut (2002–2016), Massachusetts (2007–2016), and Michigan (2001–2015). We identified individuals 20 years and older for

whom the primary risk factor for HIV acquisition was recorded as MSM. We used the reported race and ethnicity variable from the HIV registry to categorize individuals as: non-Hispanic (NH) White, NH Black, or Hispanic/Latino. We excluded individuals of other racial identities due to the limited number of PWH and cancer diagnoses in these groups.

The HACM Study was approved by institutional review boards at participating registries and was exempt from review at the US National Institutes of Health. Consent of participants was not required for the use of data collected through public health surveillance.

Statistical Approach

We calculated incidence rates (IRs) for five cancers in MSMWH that are common and for which risk is elevated in people with HIV compared with the general population (i.e., Kaposi sarcoma [KS], non-Hodgkin lymphoma [NHL], anal cancer, Hodgkin lymphoma [HL], and liver cancer) by race and ethnicity, standardized to the age distribution of MSMWH in 2010. Follow-up started at the first of age 20 years, HIV report date or beginning of registry coverage, and ended at the earliest of age 85 years, end of registry coverage, or death. For analyses stratified by prior AIDS status, diagnosis of AIDS was treated as a time varying covariate. We include these estimates to emphasize the potential role of an AIDS diagnosis as a mediator in explaining observed racial and ethnic disparities in cancer risk for MSMWH.

To compare the differential impact of HIV on cancer risk within each race and ethnicity we estimated standardized incidence ratios (SIRs). SIRs were calculated to compare the observed counts of each cancer among MSMWH to the number of expected cancer cases based on rates from the general population of males in the US, stratified by race and ethnicity, age, region, and year. SIRs stratified by prior AIDS status were calculated to investigate how progression to AIDS affects cancer risk. For KS, expected rates were based on data collected by the Surveillance, Epidemiology, and End Results cancer registries before the HIV epidemic (1973–79) [12]. To further test for differences in SIRs between racial and ethnic groups after accounting for a prior diagnosis of AIDS we performed a global test for race and ethnicity in the adjusted model and report the corresponding global p-value [13, 14].

Incidence rate ratios (IRRs) were calculated using Poisson regression to compare risk of cancer among MSMWH between racial/ethnic groups, adjusted for age, region, and year. White MSMWH were used as the referent group because they contributed the most person-time allowing for greatest power to detect statistically significant differences in risk. Significance for IRRs were calculated using 95% CI. Goodness of fit tests were conducted on the residuals to assess appropriateness of the model and confirm that there was not concern for overdispersion.

Results

We evaluated 358,023 MSMWH with 3.2 million person-years of follow-up. White MSMWH contributed 43% of the follow-up time, followed by Black MWMWH with 30%, and Hispanic/Latino MSMWH with 27% (Table 1). Twenty percent of person-time

contributed by White MSMWH was younger than 40 years while roughly 40% of the person-time contributed by Black and Hispanic/Latino MSMWH was younger than 40 years. People who inject drugs (PWID) contributed 12% of person-time among Black MSMWH, 11% of Hispanic/Latino MSMWH, and 10% of White MSMWH. Across all races and ethnicities, MSMWH with a prior AIDS diagnosis contributed 55% of the total person-time; however, this overall estimate varied by age, and within each age group, the proportion of person-time contributed by those with a prior AIDS diagnosis was notably higher for Hispanic/Latino and Black MSMWH compared to White MSMWH (Table 2).

Standardized Incidence Ratios

SIRs were notably higher for KS among Hispanic/Latino and Black MSMWH (887 and 772, respectively) compared to White MSMWH (417) (Figure 1). A similar pattern was observed for NHL, with higher SIRs among Hispanic/Latino and Black MSMWH (5.5 and 4.8, respectively) than White MSMWH (3.1). White MSMWH had a higher SIR for anal cancer (38.4) compared to Hispanic/Latino (30.8) and Black MSMWH (24.1). HL risk was more elevated for Hispanic/Latino MSMWH compared to the general population (11.5) and elevated similarly for Black and White MSMWH (7.7 and 6.4, respectively). The highest SIR for liver cancer was among White MSMWH (2.27) followed by Black MSMWH (1.78) and Hispanic/Latino MSMWH (1.49).

Even after adjusting for a prior diagnosis of AIDS, there were statistically significant differences in SIRs between racial and ethnic groups based on the global p-value (Table 3). Within racial/ethnic groups, every SIR for those with a prior AIDS diagnosis was greater than for those who had not progressed to AIDS, except for liver cancer. For liver cancer, there were no significant differences in AIDS stratified SIRs among Hispanic/Latino or Black MSMWH, but the SIR for White MSMWH with a prior AIDS diagnosis was significantly higher than White MSMWH who had not progressed to AIDS (2.78 compared to 1.40).

Age-Standardized Incidence Rates and Incidence Rate Ratios

Among Hispanic/Latino and Black MSMWH, KS was the most common cancer (115 and 110 per 100,000 person-years, respectively) followed by NHL (111 and 98.8, respectively) (Table 4). In contrast, NHL was the most common cancer among White MSMWH (106) followed by anal cancer (87.4), then KS (75.0).

Compared to White MSMWH, rates were higher among Hispanic/Latino MSMWH for KS (IRR 1.40; 95%CI=1.28–1.54), NHL (1.22; 95%CI=1.12–1.32), HL (1.79; 95%CI=1.52–2.11) and liver cancer (1.42; 95%CI=1.17–1.72). Risk of anal cancer was 32% lower for Hispanic/Latino compared to White MSMWH (0.68; 95%CI=0.60–0.76) (Table 4). Compared to White MSMWH, Black MSMWH had significantly higher rates of KS (IRR 1.24; 95%CI=1.13–1.36), HL (1.44; 95%CI=1.22–1.70), and liver cancer (1.54; 95%CI=1.29–1.84), but similar rates of both NHL and anal cancer. There was no evidence of differences in IRRs by immunosuppression status.

DISCUSSION:

In the US during 2001–2019, Black and Hispanic/Latino MSMWH had significantly greater risk of cancers associated with advanced HIV compared to White MSMWH. We showed risks of KS and NHL (i.e., AIDS-defining cancers) were substantially elevated by as much as 40% in Hispanic/Latino MSMWH compared to White MSMWH, possibly reflecting disparities in access to HIV care. Such disparities have been documented and we emphasize their importance when presenting the consistently greater proportion of individuals with a diagnosis of AIDS among Hispanic/Latino and Black MSMWH compared to White MSMWH across all age groups. The relevance of a diagnosis of AIDS to risk of cancer in this population is further displayed in estimates of incidence and relative risk stratified by prior AIDS diagnosis. Furthermore, the distinct estimates of SIRs and IRRs lend context to the epidemiologic landscape of malignancies in PWH. For example, although the highest risk of anal cancer compared to the general population was observed for White MSMWH, incidence rates were similar to rates among Black MSMWH. These comparisons in risk of cancer lend insight into the disproportionate burden of HIV for minoritized racial/ethnic groups of MSM in the US.

We provided estimates stratified by AIDS status to assess whether racial and ethnic disparities remained among those who had or had not progressed to a diagnosis of AIDS. Within each racial/ethnic group, there were no significant differences in IRRs when disaggregated by AIDS status. This means that among MSMWH, differences in cancer risk by race and ethnicity persisted regardless of whether MSMWH had ever experienced the immunosuppression associated with an AIDS diagnosis. These findings could indicate disparities regarding severity of immunosuppression, recovery of immune function, or access to HIV care prior to progressing to AIDS, and more severe or prolonged immunosuppression among those with AIDS.

Kaposi Sarcoma, Non-Hodgkin Lymphoma, And Hodgkin Lymphoma

KS is caused by an infection of Kaposi sarcoma herpesvirus-8 (KSHV). Some cases of NHL and HL are caused by Epstein-Barr virus (EBV) among PWH. These viruses have a greater carcinogenicity in immunocompromised persons. KSHV prevalence is higher among MSM than in the general US population and, when adjusting for HIV status, there are no known differences in prevalence by race or ethnicity [15–18]. Studies of geographic and racial disparities over time in KS incidence among young men have reported annual improvements for White men and less significant improvements, even declines in the South US, among Black young men [19, 20]. Our data showed similar disparities in KS incidence with higher rates for Hispanic/Latino and Black MSMWH compared to White MSMWH. Hispanic/Latino and Black MSMWH had higher relative risks of KS compared to the general population, approximately twice that of White MSMWH. Further, relative risk of KS was greater among those with a prior AIDS diagnosis, consistent with an association with severe immunosuppression [15]. Prior research established that Black PWH have twice the mortality rate from HIV-associated KS compared to White and Hispanic/Latino PWH, even after controlling for covariates like HIV viral load and ART adherence, suggesting that

our research does not capture the extent of disparities in outcomes like mortality from KS diagnoses among MSMWH [21].

Prior studies have established that MSMWH have a 30% higher risk of NHL compared to heterosexual men with HIV and this risk increases with greater severity of immunosuppression [22]. Additionally, risk for HL is 5 to 15 times higher among PWH compared to the general population [23]. Hispanic/Latino and Black MSMWH had higher SIRs than White MSMWH for both NHL and HL. EBV seroprevalence is higher among Black and Hispanic/Latino individuals, compared to White individuals in the US. [24, 25]. Racial disparities in prevalence of EBV among MSMWH have not been identified but likely reflect those observed in the general population. For each racial/ethnic group, MSMWH with a prior AIDS diagnosis had a higher relative risk of NHL than those who had not progressed to AIDS, emphasizing the importance of adherence to HIV treatment to maintaining viral suppression. Our research supports that preventing AIDS could reduce some racial disparities in risk of KS among MSMWH, but even after accounting for disparities in the risk of HIV progression, there are residual disparities in cancer risk. Access and adherence to cART due to systemic barriers could contribute to differences in morbidity and mortality from KS since those with HIV who receive cART had a much lower incidence of KS compared to those who do not [16].

Anal Cancer

In 2015, incidence of anal cancer among MSMWH was 9 times higher than in MSM without HIV, who still had a higher incidence than the general population [26]. Additionally, high risk anal HPV, which has a higher seroprevalence among Black MSM compared to White MSM, causes a higher proportion of anal cancer among Black and Hispanic/Latino PWH [27–29]. Our findings are consistent with these disparities since Black MSMWH had a lower SIR for anal cancer than White MSMWH even though the IRR was not statistically different. The contrast in these observed estimates could be driven by a higher number of expected anal cancers among Black men, which are estimated based on incidence rates in the general population. It is likely that the anal cancer SIR for Black MSMWH is an underestimation of the true relative risk, because 57% of anal cancer cases among Black men in the U.S. occur among those with HIV, thus the general population estimate is highly influenced by HIV, similar to what has previously been observed for KS [12].

Recent guidelines proposed for anal cancer screening identify PWH as a priority population that experience significant benefits from screening [30]. Because these screenings are not yet standard clinical practice, it is possible White MSM have had higher anal cancer screening rates, which have resulted in higher rates of early-stage, prevalent disease in comparison with other racial and ethnic groups [31]. One meta-analysis suggested White individuals in the US have the highest coverage of HPV vaccination, but non-White individuals are more likely to initiate the vaccination process with their provider, suggesting a closing in racial disparities in vaccination coverage [32, 33]. Although the HPV vaccine was too recently introduced to affect anal cancer rates today, HPV vaccination is highly effective in reducing the risk of anal cancer among MSMWH and should be better implemented in this group [34].

Liver Cancer

Rates of hepatocellular carcinoma (HCC), the most common histologic subtype of liver cancer, have largely plateaued in the general U.S. population, yet this decline has not been evenly distributed by race or ethnicity with White individuals having the lowest incidence rates between 2001–2019 [35, 36]. PWH have a higher burden and increased risk of HCC compared to those without HIV, due to higher prevalence of coinfection with hepatitis B virus (HBV), hepatitis C virus (HCV), behavioral risk factors, and immunosuppression [37]. Other work suggests that among MSMWH who acquired HCV sexually, higher viral load of HIV was associated with lower odds of spontaneous clearance of HCV [38]. Our findings are consistent with this suggestion that disparities in severe immunosuppression are associated with disparities in cancer risk.

Compared to White MSMWH, liver cancer incidence was significantly greater for Black MSMWH regardless of AIDS status, and for Hispanic/Latino MSMWH who had not progressed to an AIDS diagnosis. Prevention is paramount to reduce liver cancer risk. An effective HBV vaccine exists, yet vaccination rates among MSM are low, especially among older age groups and Black and Hispanic/Latino men [39–41]. With curative HCV treatment available, there are still disparities in access, especially among Medicaid enrollees who are disproportionately Black or Hispanic/Latino, resulting in disparities in HCC incidence [36, 42, 43]. Addressing disparities in HBV vaccination, access to HCV curative treatment, and increased access to earlier HIV treatment among Black and Hispanic/Latino MSMWH should be prioritized to reduce disparities in liver cancer among MSMWH.

Limitations

We interpreted a prior diagnosis of AIDS as a proxy for greater immunosuppression, indicating several barriers to receiving adequate healthcare, including receiving a timely HIV diagnosis and reaching sustained viral suppression. Conversely, our comparator of people who had not progressed to AIDS is imperfect and may incorrectly assume one has sustained viral suppression when they have instead never received a recorded AIDS diagnosis. In theory, this could disproportionately impact those of minoritized groups and the differential misclassification of those without a diagnosis of AIDS. A diagnosis of AIDS is a single event which does not capture whether an individual later restores immune function. Immunosuppression is likely more sustained and severe for those who experience greater barriers to receiving care. More accurate determinations of immunosuppression could have been assessed if we had access to data on adherence to cART and longitudinal CD4 counts, but these data were unavailable. Future research should utilize these metrics. Also, we were unable to estimate cancer risk in racial and ethnic groups that provided too small samples or were not harmoniously ascertained between cancer registries and HIV surveillance. Thus, we were unable to include other racial/ethnic groups, but this information is vital in understanding disparities.

Conclusion

Cancers that are associated with a diagnosis of AIDS continue to contribute to morbidity and mortality in the aging population of people with HIV. However, improvements in HIV prevention and care can markedly reduce the incidence of certain cancers. Disparities

in cancer risk may serve as an important proxy for disparities in HIV care. Elevated incidence of HIV among Black and Hispanic/Latino MSM contributes to racial inequities in cancer risk, especially for virus-associated cancers as examined in this study. Equitable access to cART will reduce racial and ethnic disparities for KS and NHL, which are strongly associated with greater immunosuppression. We further emphasize the importance of monitoring the trends in both the absolute and relative risk of these cancers within racial and ethnic groups as a potential proxy for assessing disparities in HIV care.

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Data availability

Interested investigators can access data from individual state (or region) linkages by obtaining approval directly from the HIV and cancer registries in those states. In addition, collaboration between outside investigators and the NCI is possible. Data analyses can be done by NCI staff or, in some circumstances, NCI may be able to release tabulated data. Contact Qianlai Luo (qianlai.luo@nih.gov) for data requests.

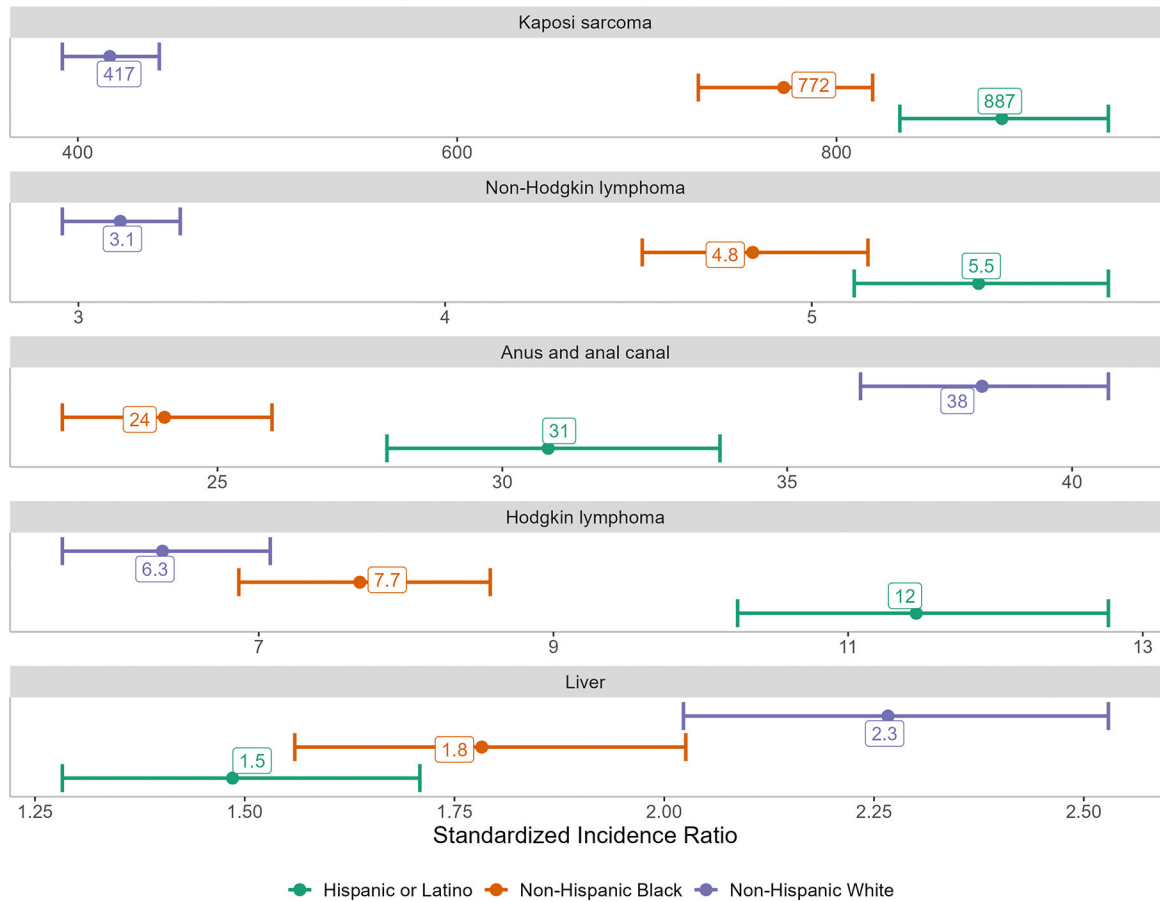
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Standardized Incidence Ratio by Race and Ethnicity

**Figure 1.**

Standardized incidence ratio of cancers by racial and ethnic group among men who have sex with men with HIV in the United States, 2001–2019.

Table 1.

Person-years for those whose primary risk factor for HIV acquisition are men who have sex with men (MSM) in HIV/AIDS Cancer Match Study, 2001–2019.

Characteristic	Hispanic or Latino	Non-Hispanic Black	Non-Hispanic White
Total person-years	862,158 (26.9%)	973,521 (30.4%)	1,369,951 (42.7%)
Age			
20–29	100,676 (11.7%)	181,209 (18.6%)	63,305 (4.6%)
30–39	225,226 (26.1%)	255,486 (26.2%)	241,028 (17.6%)
40–49	289,180 (33.5%)	291,849 (30.0%)	488,401 (35.7%)
50–59	182,310 (21.1%)	185,257 (19.0%)	405,749 (29.6%)
60–69	53,101 (6.2%)	50,385 (5.2%)	141,038 (10.3%)
70+	11,665 (1.4%)	9,336 (1.0%)	30,430 (2.2%)
Year			
2001–2004	84,638 (9.8%)	107,263 (11.0%)	180,451 (13.2%)
2005–2008	138,710 (16.1%)	176,220 (18.1%)	261,575 (19.1%)
2009–2012	198,600 (23.0%)	264,275 (27.1%)	349,944 (25.5%)
2013–2016	243,882 (28.3%)	256,082 (26.3%)	358,593 (26.2%)
2017–2019	196,328 (22.8%)	169,682 (17.4%)	219,388 (16.0%)
Prior AIDS Diagnosis			
No	377,614 (43.8%)	432,859 (44.5%)	607,959 (44.4%)
Yes	484,544 (56.2%)	540,662 (55.5%)	761,992 (55.6%)
MSM Who Inject Drugs*			
No	754,888 (88.6%)	845,386 (87.6%)	1,191,069 (89.9%)
Yes	97,563 (11.4%)	119,509 (12.4%)	133,220 (10.1%)

* Massachusetts is not included in this variable because of data use restrictions.

Table 2.

Proportion of person-time within racial and ethnic group contributed by men who have sex with men with HIV with a prior AIDS diagnosis by age group in the HIV/AIDS Cancer Match Study, 2001–2019

Age Group	Hispanic or Latino		Non-Hispanic Black		Non-Hispanic White	
	Total person-years	Person-years with prior AIDS diagnosis (percent of total)	Total person-years	Person-years with prior AIDS diagnosis (percent of total)	Total person-years	Person-years with prior AIDS diagnosis (percent of total)
20–29	100,676	26,508 (26.3%)	181,209	52,844 (29.2%)	63,305	12,976 (20.5%)
30–39	225,226	103,777 (46.1%)	255,486	127,497 (49.9%)	241,028	103,397 (42.9%)
40–49	289,180	178,569 (61.8%)	291,849	188,126 (64.5%)	488,401	280,945 (57.5%)
50–59	182,310	127,032 (69.7%)	185,257	128,951 (69.6%)	405,749	252,538 (62.2%)
60–69	53,101	39,753 (74.9%)	50,385	36,314 (72.1%)	141,038	91,785 (65.1%)
70+	11,665	8,905 (76.3%)	9,336	6,930 (74.2%)	30,430	20,351 (66.9%)

Table 3.

Standardized incidence ratios of each cancer by race and ethnicity, comparing observed cases divided by expected cases from general population in the US, stratified by immunosuppression status *

Cancer	Immunosuppression Status	Hispanic or Latino		Non-Hispanic Black		Non-Hispanic White		p-value
		Observed Cases	SIR	Observed Cases	SIR	Observed Cases	SIR	
Kaposi Sarcoma	Overall	1,001	887 (833, 943)	1,085	772 (727, 819)	1,023	417 (392, 443)	0.007
	No Prior AIDS diagnosis	271	755 (669, 849)	230	518 (454, 588)	304	333 (297, 372)	
	Prior AIDS Diagnosis	730	949 (881, 1,019)	855	889 (831, 950)	719	466 (433, 501)	
Non-Hodgkin Lymphoma	Overall	952	5.46 (5.12, 5.81)	950	4.84 (4.54, 5.15)	1,442	3.11 (2.96, 3.28)	<0.001
	No Prior AIDS diagnosis	246	4.13 (3.64, 4.67)	246	3.57 (3.15, 4.04)	418	2.38 (2.16, 2.61)	
	Prior AIDS Diagnosis	706	6.14 (5.70, 6.60)	704	5.52 (5.12, 5.94)	1,024	3.57 (3.35, 3.79)	
Anal	Overall	427	30.8 (28.0, 33.8)	658	24.1 (22.2, 26.0)	1,199	38.4 (36.3, 40.6)	<0.001
	No Prior AIDS diagnosis	52	11.5 (8.64, 14.9)	101	10.5 (8.58, 12.7)	226	18.9 (16.5, 21.4)	
	Prior AIDS Diagnosis	375	40.2 (36.2, 44.4)	557	31.4 (28.9, 34.1)	973	50.6 (47.5, 53.9)	
Hodgkin lymphoma	Overall	319	11.5 (10.3, 12.8)	312	7.69 (6.86, 8.57)	311	6.35 (5.67, 7.08)	<0.001
	No Prior AIDS diagnosis	79	6.86 (5.46, 8.49)	77	4.31 (3.42, 5.35)	87	3.89 (3.13, 4.77)	
	Prior AIDS Diagnosis	240	14.7 (12.9, 16.6)	235	10.3 (9.07, 11.7)	224	8.40 (7.35, 9.55)	
Liver	Overall	187	1.49 (1.28, 1.71)	225	1.78 (1.56, 2.03)	308	2.27 (2.02, 2.53)	<0.001
	No Prior AIDS diagnosis	47	1.29 (0.95, 1.69)	63	1.65 (1.28, 2.09)	70	1.40 (1.09, 1.75)	
	Prior AIDS Diagnosis	140	1.57 (1.32, 1.84)	162	1.84 (1.57, 2.14)	238	2.78 (2.44, 3.14)	

* We adjusted for age, region, year, race and ethnicity, and prior AIDS diagnosis to calculate standardized incidence ratios.

Table 4.

Age-standardized incidence rates of cancer[†] (per 100,000 person-years) and incidence rate ratios[‡] comparing rates to referent Non-Hispanic White, by race and ethnicity among men who have sex with men with HIV, stratified by prior AIDS diagnosis.

Cancer	Immunosuppression status	Age-Standardized Incidence Rates			Incidence Rate Ratios	
		Hispanic or Latino	Non-Hispanic Black	Non-Hispanic White	Hispanic or Latino	Non-Hispanic Black
Kaposi sarcoma	Overall	115	110	75.0	1.40 (1.28, 1.54)**	1.24 (1.13, 1.36)**
	No Prior AIDS diagnosis	68.7	47.8	49.6	1.45 (1.21, 1.72)**	1.04 (0.86, 1.24)
	Prior AIDS Diagnosis	182	191	110	1.30 (1.16, 1.45)**	1.18 (1.06, 1.32)**
Non-Hodgkin lymphoma	Overall	111	98.8	106	1.22 (1.12, 1.34)**	1.04 (0.95, 1.13)
	No Prior AIDS diagnosis	72.1	65.0	70.9	1.14 (0.96, 1.35)	1.02 (0.87, 1.21)
	Prior AIDS Diagnosis	150	132	139	1.22 (1.10, 1.35)**	0.99 (0.89, 1.09)
Anal	Overall	50.3	68.8	87.4	0.68 (0.60, 0.76)**	0.98 (0.89, 1.08)
	No Prior AIDS diagnosis	16.5	28.2	41.1	0.54 (0.38, 0.74)**	1.01 (0.78, 1.28)
	Prior AIDS Diagnosis	72.4	96.5	121	0.66 (0.58, 0.75)**	0.90 (0.81, 1.01)
Hodgkin lymphoma	Overall	37.5	32.6	22.8	1.79 (1.52, 2.11)**	1.44 (1.22, 1.70)**
	No Prior AIDS diagnosis	19.7	16.9	14.3	1.49 (1.07, 2.08)*	1.17 (0.84, 1.63)
	Prior AIDS Diagnosis	51.0	44.5	30.2	1.80 (1.49, 2.18)**	1.44 (1.19, 1.74)**
Liver	Overall	20.3	22.4	22.1	1.42 (1.17, 1.72)**	1.54 (1.29, 1.84)**
	No Prior AIDS diagnosis	16.6	19.8	13.3	2.08 (1.40, 3.07)**	2.16 (1.51, 3.07)**
	Prior AIDS Diagnosis	22.7	24.0	28.0	1.23 (0.99, 1.52)	1.33 (1.08, 1.63)**

[†] Rates were standardized to the 2010 age distribution of men who have sex with men with HIV in the HIV/AIDS Cancer Match Study.

[‡] Poisson regression model controlled for registry, age, and calendar year

* Denotes significance < 0.05

** Denotes significance <0.01