SKIN

ORIGINAL RESEARCH

# Influence of Disadvantaged Socioeconomic and Demographic Status on Overall Survival in Patients with Kaposi Sarcoma

Michelle S. Swedek, BS[1], Kamron K. Zand, MS[1], Peter T. Silberstein, MD[1], Victoria A. Vardell, MD[2]

[1] Creighton University School of Medicine, Omaha, NE, USA
[2] Department of Internal Medicine, University of Utah, Salt Lake City, UT, USA

## ABSTRACT

**Background**: Kaposi sarcoma (KS) is a cutaneous and mucous membrane tumor caused by human/Kaposi sarcoma herpesvirus 8 (HHV-8), typically seen in immunocompromised patients, including those with HIV/AIDS. Patients from traditionally underserved and underrepresented (URM) populations have disparate survival outcomes across malignancies, however the effects of socioeconomic and demographic factors on survival have not been described on a large scale in KS.
**Methods**: KS patients diagnosed from 2004-2017 were identified in the National Cancer Database (NCDB). Overall survival (OS) was analyzed using Kaplan Meier and adjusted Cox regression methods, and repeated in a propensity score matched cohort, where White patients were matched to Black patients 1:1 for demographic factors and comorbidities.
**Results**: For the 4,034 identified patients, advanced age, Black race, HIV-positive status, and Charlson-Deyo score ≥1 were independently associated with decreased OS. Survival benefit was seen with Spanish/Hispanic ethnicity, private insurance, residence in areas of high educational attainment, and treatment at academic centers. Black patients had median survival of 99 months (95% confidence interval [CI] 73-124 months) compared to White patients (140 months, 95% CI 122-158 months) ($p<0.001$). Following propensity score matching, Black patients continued to have poorer OS compared to White patients (119 months versus 136 months, $p=0.045$).
**Conclusion**: We describe the impact of socioeconomic factors and race on survival in KS, finding significantly reduced survival in Black patients, which persisted after controlling for covariates. These results highlight the need for directed efforts promoting equitable outcomes for underrepresented minorities.

## INTRODUCTION

Kaposi sarcoma (KS) is a soft tissue endothelial cell tumor caused by human herpesvirus-8/Kaposi's Sarcoma-associated herpesvirus (HHV-8). KS occurs in a variety of patient populations and has been differentiated into four categories based on etiology: (1) classic KS, (2) AIDS-related KS, (3) African endemic KS, and (4) iatrogenic KS.[1] Clinical features common to all subtypes of KS include purple, papular, non-blanching skin lesions of varying size. Less commonly, extracutaneous involvement of mucous membranes, gastrointestinal tract, and lymph

nodes may occur.[2] The classic form of KS typically arises in older men of Mediterranean and Eastern European descent on the lower extremities, as well as an endemic form predominantly in sub-Saharan Africa primarily causing lymph node involvement in pediatric patients.[3] In iatrogenic and HIV patients, it may present with skin, oral (palatal and gingival), and less commonly, visceral involvement.[4] Typically, iatrogenic and AIDS-related KS respond well to immune reconstitution and anti-retroviral therapy respectively, thus many patients present with breakthrough localized skin involvement.[5] Isolated skin lesions may be treated with excision, liquid nitrogen, or vincristine injection, while cytotoxic chemotherapy is the standard of treatment for systemic disease.[5,6]

KS is an AIDS-defining illness and the second-most common neoplasm associated with AIDS.[7] Among people with HIV (PWH) living in the United States from 2000-2015, KS rates were elevated 521-fold compared to the general population and have declined at an annual percentage change of −6%.[8] KS most often occurs in PWH with uncontrolled viral replication and decreased CD4 T cell levels.[9] Since the advent of highly active antiretroviral therapy (HAART), incidence of KS and other AIDS-related malignancies such as non-Hodgkin's Lymphoma have declined substantially while non-AIDS related malignancies have increased in patients with HIV.[10] However, new and recurrent forms of KS despite adequate viral suppression have been documented as an novel issue in PWH.[9]

Previous studies by *Royse et al.* examining the Surveillance, Epidemiology, and End-Results (SEER) database demonstrated that in men younger than 55 years, the annual percent change (APC) for KS incidence significantly decreased for white men between 2001 and 2013 (APC -4.52, p=0.02), whereas the APC for African American (AA) men demonstrated a non-significant decrease from 2000–2013 (APC -1.84, p=0.09).[11] Among AA men in the South, however, APC has significantly increased between 2000 and 2013 (+3.0, p=0.03).[11] Additionally, compared with white men diagnosed with KS during the same time period, AA men were also more likely to die from all causes and KS cancer-specific causes (aHR 1.52, 95% CI 1.34–1.72, aHR 1.49, 95% CI 1.30–1.72 respectively).[11] Therefore, despite recent advances in the treatment of PWH using HAART, KS continues to be one of the most common malignancies that occurs in PWH even in the presence of adequate viral suppression. Moreover, there appear to be geographic and racial disparities in both incidence and survival of KS in the US that require further analysis.

In an effort to better understand the current outcomes of KS patients on a national scale, we examined the National Cancer Database (NCDB) to study the epidemiology and demographics of KS patients, and how these factors impact overall survival (OS) on a national scale. As a large oncology database that compiles data from over 1,400 cancer programs and including about 75% of newly diagnosed cancers in the United States, it is the largest database of these cancers currently available.[12]

## METHODS

### Patient Selection

Patients diagnosed with KS (identified by ICD-O-3 histology code 9140) from 2004-2017 were collected from the NCDB. This included demographic, socioeconomic, and survival data for patients aged 18 and up.

After selecting for variables of interest (**Figure 1**), a total of 4,034 patients met study inclusion criteria. Data from the NCDB is deidentified, and as such this project was determined to be institutional review board (IRB) exempt give that it is not human subjects research. Analyses were performed using IBM SPSS Statistics for Mac, Version 27 (Armonk, NY: IBM Corp), with propensity score matching utilizing the PSM 2.0.1 and FUZZY 2.0.1 extensions with Python 3.8 module in SPSS.

### Patient Characteristics

Baseline demographic, socioeconomic, and survival data was determined using NCDB codes for the entire cohort. These features were also compared between racial identities and ethnicity. Race is patient-identified and was reported as White, Black, Asian and Pacific Islander (AAPI), and other. The other group included smaller racial groups and those who did not identify according to the available categories. Spanish/Hispanic ethnicity was also patient-identified. Patients who were identified to be Spanish/Hispanic based on surname alone were excluded. The Charlson-Deyo comorbidity score was used to define the presence of comorbidities based on International Classification of Disease (ICD) codes for common medical conditions, and included values of 0, 1, 2, and ≥3. Higher scores are typically associated with greater mortality and morbidity.[13] The 2016 American Community Survey Data was used to determine income and education level quartiles of patient zip code of residence. Patient insurance status was defined as uninsured, privately insured, or government insured. Facility types were defined as nonacademic and academic facilities. Categorical variables were first compared by Chi-square and Fischer's exact test for significance. Age at diagnosis was compared between groups using one-way ANOVA with Dunnett's T3 post-hoc comparison. Statistical significance was defined as p value <0.05.

### Survival Analysis

Mean and median overall survival (OS) in months from diagnosis were calculated using Kaplan Meier analysis, and significance was evaluated using pairwise log-rank tests. A multivariate Cox proportional hazards model was used to determine the risk of death based on demographic and socioeconomic variables of interest.

### Propensity Score Matched Analysis

Using a multivariate logistic regression model that included age, sex, ethnicity, median education and income level of zip code, insurance status, facility location, facility type, HIV status, and Charlson-Deyo comorbidity score, a propensity score was determined by the conditional probability of a patient identifying as Black. These factors were chosen by their significant variation between race groups and theoretical impact on survival. White patients were then matched 1:1 to Black patients using this propensity score, with preference for exact matches and a match tolerance of 0.01. Following matching, Kaplan Meier survival analysis for median overall survival was repeated.

## RESULTS

### Patient Characteristics

Of the 4,034 KS patients identified, 69.5% were White (n=2,804), 26.1% were Black (n=1,054), and 2.6% were AAPI (n=104). 1.8% of patients had race categorized as other (n=72). 17.2% of patients identified as Spanish/Hispanic ethnicity (n=694). Additional demographics by patient race and

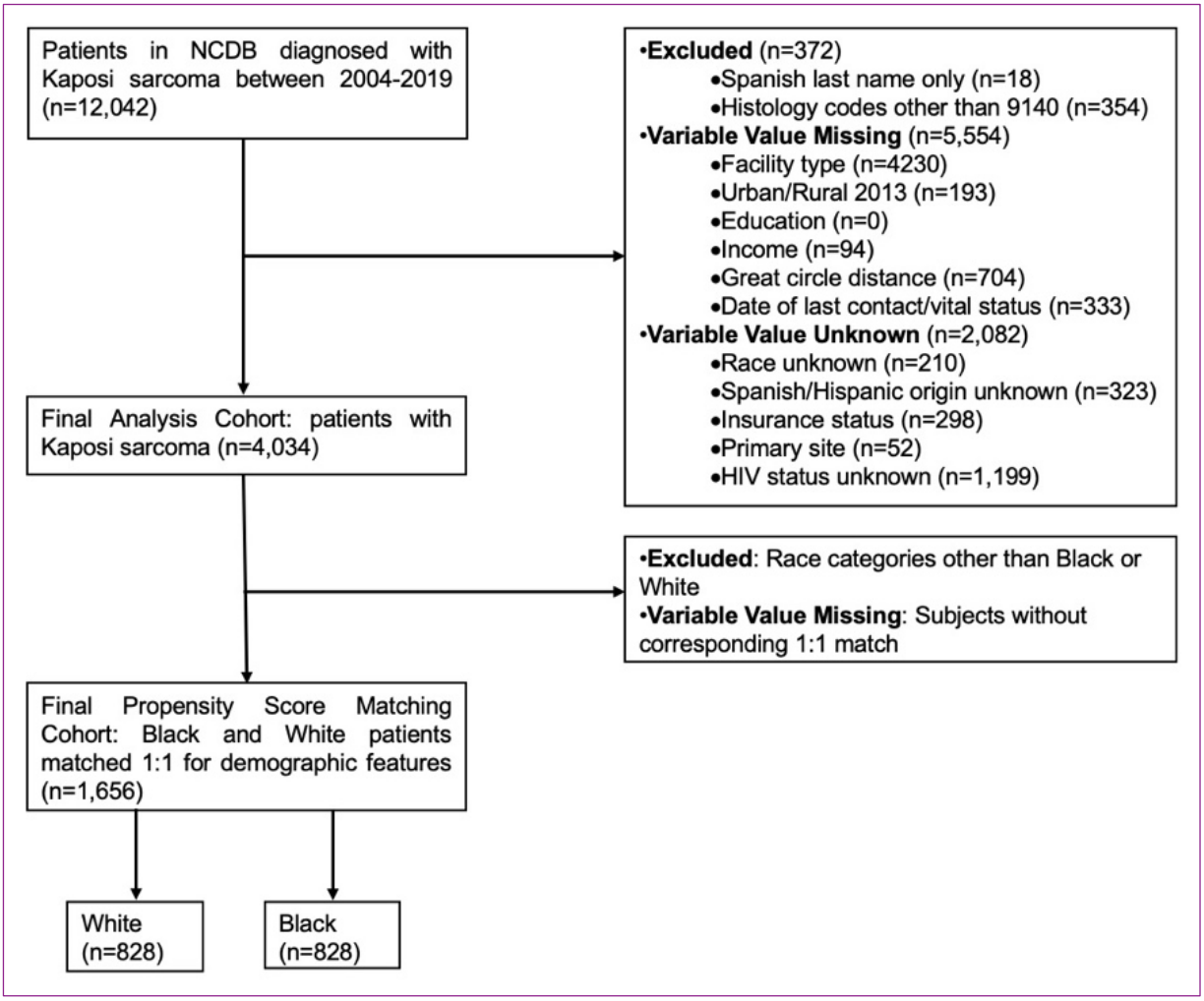


**Figure 1**. Selection of study patient population and exclusion criteria

ethnicity are described in **Tables 1 and 2**, respectively.

Compared to White patients, Black patients were younger at diagnosis (mean age 58 versus 51 years old, p<0.001), with 75.3% of Black patients diagnosed before age 55 compared to 53.5% of White patients (p<0.001). Other racial and ethnic groups presented at a similar age compared to White patients (**Tables 1 and 2**). Black patients (37.7%) were more likely to have Charlson-Deyo scores of 3 and above compared to White (29.5%) and AAPI patients (34.6%) (p=0.001). 82.7% of Black patients were HIV-positive compared to 62.7% of White and 61.5% of AAPI patients (p<0.001). Compared to White patients (9.2%), 12.8% of Black patients and 13.5% of AAPI patients were uninsured (p<0.001). Hispanic patients were more likely to be uninsured (16.7%) compared to non-Hispanic patients (9.1%) (p<0.001). Black and Hispanic patients resided in lower income areas, with 39.5% and 31.0%, respectively, living in zip codes with an average income below the 25$^{th}$ percentile, compared to 18.7% of White and 11.5% of AAPI patients (p<0.001). A greater percentage of Black (37.9%) and Hispanic (57.8%) patients resided in zip codes where 17.6% or more of residents did not attain a high school degree, compared to 27.4% of White patients (p<0.001).

## Survival Analysis

OS for all race groups was analyzed using Kaplan-Meier curves. (**Figure 2**) The median OS for all KS patients was 133 months (95% confidence interval [CI] 119-148 months). Black patients had a shorter median OS of 99 months (95% CI 73-124 months) compared to White patients with a median OS of 140 months (95% CI 122-158 months) (p<0.001). All other minority groups trended towards improved OS compared to White patients. The AAPI, Other, and Hispanic cohorts did not reach median survival during the follow-up period (p=0.584, 0.473, and 0.001, respectively).

To assess for the independent contribution of socioeconomic and demographic variables, multivariate Cox regression was performed for age, sex, race, ethnicity, Charlson-Deyo score, education, income, insurance, location, facility type, and HIV status (**Table 3**). Age greater than 70 years old was associated with reduced OS compared to patients aged 40-54 years old (hazard ratio [HR] 2.06, 95% CI 1.67-2.55, p<0.001). Black race was independently associated with reduced OS compared to White race (HR 1.31, 95% CI 1.16-1.47, p<0.001). No statistically significant difference was seen in survival for other racial groups. Hispanic ethnicity was associated with improved survival compared to non-Hispanic ethnicity (HR 0.80, 95% CI 0.69-0.93, p=0.003). Residence in areas with high educational attainment was associated with improved survival, with a survival benefit seen for patients residing in areas with no greater than 10.8% of residents not graduating high school (HR 0.83, 95% CI 0.71-0.98, p=0.026). Having private insurance was associated with improved survival (HR 0.74, 95% CI 0.62-0.89, p=0.002); however, no statistically significant difference was seen in survival with government insurance compared to having no insurance. Improved survival was associated with academic centers (HR 0.76, 95% CI 0.68-0.83, p<0.001). Positive HIV status portended a poorer prognosis (HR 1.93, 95% CI 1.61-2.32, p<0.001), as did any Charlson-Deyo score greater than 0 (HR 1.49, 95% CI 1.26-1.76, p<0.001). Sex, income, and facility location did not independently have any statistically significant effect on survival.

**Table 1**. Demographic and socioeconomic features of KS by race.

| | | Total | | Race | | | | | | | | P value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | White | | Black | | AAPI | | Other | | |
| | | N | % | N | % | N | % | N | % | N | % | |
| | | 4034 | - | 2804 | 69.50% | 1054 | 26.10% | 104 | 2.60% | 72 | 1.80% | - |
| Age | 40-54 years old | 2395 | 59.4% | 1501 | 53.5% | 794 | 75.3% | 60 | 57.7% | 40 | 55.6% | <0.001 |
| | 55-69 years old | 795 | 19.7% | 584 | 20.8% | 177 | 16.8% | 21 | 20.2% | 13 | 18.1% | |
| | 70-84 years old | 581 | 14.4% | 477 | 17.0% | 70 | 6.6% | 19 | 18.3% | 15 | 20.8% | |
| | ≥85 years old | 263 | 6.5% | 242 | 8.6% | 13 | 1.2% | 4 | 3.8% | 4 | 5.6% | |
| Sex | Male | 3549 | 88.0% | 2471 | 88.1% | 917 | 87.0% | 97 | 93.3% | 64 | 88.9% | 0.282 |
| | Female | 485 | 12.0% | 333 | 11.9% | 137 | 13.0% | 7 | 6.7% | 8 | 11.1% | |
| Ethnicity | Not Spanish/Hispanic | 3340 | 82.8% | 2170 | 77.4% | 1026 | 97.3% | 101 | 97.1% | 43 | 59.7% | <0.001 |
| | Spanish/Hispanic | 694 | 17.2% | 634 | 22.6% | 28 | 2.7% | 3 | 2.9% | 29 | 40.3% | |
| % of Patient Zip Code without High School Diploma | ≥17.6% | 1221 | 30.3% | 768 | 27.4% | 399 | 37.9% | 32 | 30.8% | 22 | 30.6% | <0.001 |
| | 10.9% - 17.5% | 1033 | 25.6% | 649 | 23.1% | 342 | 32.4% | 24 | 23.1% | 18 | 25.0% | |
| | 6.3% - 10.8% | 932 | 23.1% | 688 | 24.5% | 208 | 19.7% | 20 | 19.2% | 16 | 22.2% | |
| | ≤6.3% | 848 | 21.0% | 699 | 24.9% | 105 | 10.0% | 28 | 26.9% | 16 | 22.2% | |
| Median Income of Patient Zip Code | <$40,227 | 970 | 24.0% | 524 | 18.7% | 416 | 39.5% | 12 | 11.5% | 18 | 25.0% | <0.001 |
| | $40,227 - $50,353 | 822 | 20.4% | 564 | 20.1% | 232 | 22.0% | 17 | 16.3% | 9 | 12.5% | |
| | $50,354 - $63,332 | 833 | 20.6% | 632 | 22.5% | 159 | 15.1% | 26 | 25.0% | 16 | 22.2% | |
| | >$63,333 | 1409 | 34.9% | 1084 | 38.7% | 247 | 23.4% | 49 | 47.1% | 29 | 40.3% | |
| Insurance | Not Insured | 420 | 10.4% | 259 | 9.2% | 135 | 12.8% | 14 | 13.5% | 12 | 16.7% | <0.001 |
| | Private Insurance | 1505 | 37.3% | 1089 | 38.8% | 347 | 32.9% | 40 | 38.5% | 29 | 40.3% | |
| | Government Insurance | 2109 | 52.3% | 1456 | 51.9% | 572 | 54.3% | 50 | 48.1% | 31 | 43.1% | |
| Facility Type | Nonacademic Centers | 1709 | 42.4% | 1251 | 44.6% | 392 | 37.2% | 42 | 40.4% | 24 | 33.3% | <0.001 |
| | Academic Centers | 2325 | 57.6% | 1553 | 55.4% | 662 | 62.8% | 62 | 59.6% | 48 | 66.7% | |
| Location | East Coast | 2008 | 49.8% | 1277 | 45.5% | 659 | 62.5% | 34 | 32.7% | 38 | 52.8% | <0.001 |
| | Central | 1101 | 27.3% | 766 | 27.3% | 301 | 28.6% | 12 | 11.5% | 22 | 30.6% | |
| | West Coast | 925 | 22.9% | 761 | 27.1% | 94 | 8.9% | 58 | 55.8% | 12 | 16.7% | |
| Charlson-Deyo Score | 0 | 2385 | 59.1% | 1707 | 60.9% | 578 | 54.8% | 55 | 52.9% | 45 | 62.5% | 0.001 |
| | 1 | 297 | 7.4% | 218 | 7.8% | 63 | 6.0% | 11 | 10.6% | 5 | 6.9% | |
| | 2 | 71 | 1.8% | 51 | 1.8% | 16 | 1.5% | 2 | 1.9% | 2 | 2.8% | |
| | ≥3 | 1281 | 31.8% | 828 | 29.5% | 397 | 37.7% | 36 | 34.6% | 20 | 27.8% | |
| HIV Status | HIV-negative | 1303 | 32.3% | 1045 | 37.3% | 182 | 17.3% | 40 | 38.5% | 36 | 50.0% | <0.001 |
| | HIV-positive | 2731 | 67.7% | 1759 | 62.7% | 872 | 82.7% | 64 | 61.5% | 36 | 50.0% | |

**Table 2**. Demographic and socioeconomic features of KS by ethnicity.

| | | Total | | Ethnicity | | | | P value |
|---|---|---|---|---|---|---|---|---|
| | | | | Not Spanish/Hispanic | | Spanish/Hispanic | | |
| | | N | % | N | % | N | % | |
| | | 4034 | - | 3340 | 82.8% | 694 | 17.2% | - |
| Age | 40-54 years old | 2395 | 59.4% | 1973 | 59.1% | 422 | 60.8% | 0.452 |
| | 55-69 years old | 795 | 19.7% | 657 | 19.7% | 138 | 19.9% | |
| | 70-84 years old | 581 | 14.4% | 483 | 14.5% | 98 | 14.1% | |
| | ≥85 years old | 263 | 6.5% | 227 | 6.8% | 36 | 5.2% | |
| Sex | Male | 3549 | 88.0% | 2930 | 87.7% | 619 | 89.2% | 0.279 |
| | Female | 485 | 12.0% | 410 | 12.3% | 75 | 10.8% | |
| % of Patient Zip Code without High School Diploma | ≥17.6% | 1221 | 30.3% | 820 | 24.6% | 401 | 57.8% | <0.001 |
| | 10.9% - 17.5% | 1033 | 25.6% | 903 | 27.0% | 130 | 18.7% | |
| | 6.3% - 10.8% | 932 | 23.1% | 838 | 25.1% | 94 | 13.5% | |
| | ≤6.3% | 848 | 21.0% | 779 | 23.3% | 69 | 9.9% | |
| Median Income of Patient Zip Code | <$40,227 | 970 | 24.0% | 755 | 22.6% | 215 | 31.0% | <0.001 |
| | $40,227 - $50,353 | 822 | 20.4% | 662 | 19.8% | 160 | 23.1% | |
| | $50,354 - $63,332 | 833 | 20.6% | 678 | 20.3% | 155 | 22.3% | |
| | >$63,333 | 1409 | 34.9% | 1245 | 37.3% | 164 | 23.6% | |
| Insurance | Not Insured | 420 | 10.4% | 304 | 9.1% | 116 | 16.7% | <0.001 |
| | Private Insurance | 1505 | 37.3% | 1312 | 39.3% | 193 | 27.8% | |
| | Government Insurance | 2109 | 52.3% | 1724 | 51.6% | 385 | 55.5% | |
| Facility Type | Nonacademic Centers | 1709 | 42.4% | 1463 | 43.8% | 246 | 35.4% | <0.001 |
| | Academic Centers | 2325 | 57.6% | 1877 | 56.2% | 448 | 64.6% | |
| Location | East Coast | 2008 | 49.8% | 1702 | 51.0% | 306 | 44.1% | <0.001 |
| | Central | 1101 | 27.3% | 934 | 28.0% | 167 | 24.1% | |
| | West Coast | 925 | 22.9% | 704 | 21.1% | 221 | 31.8% | |
| Charlson-Deyo Score | 0 | 2385 | 59.1% | 1987 | 59.5% | 398 | 57.3% | 0.146 |
| | 1 | 297 | 7.4% | 242 | 7.2% | 55 | 7.9% | |
| | 2 | 71 | 1.8% | 52 | 1.6% | 19 | 2.7% | |
| | ≥3 | 1281 | 31.8% | 1059 | 31.7% | 222 | 32.0% | |
| HIV Status | HIV-negative | 1303 | 32.3% | 1078 | 32.3% | 225 | 32.4% | 0.941 |
| | HIV-positive | 2731 | 67.7% | 2262 | 67.7% | 469 | 67.6% | |

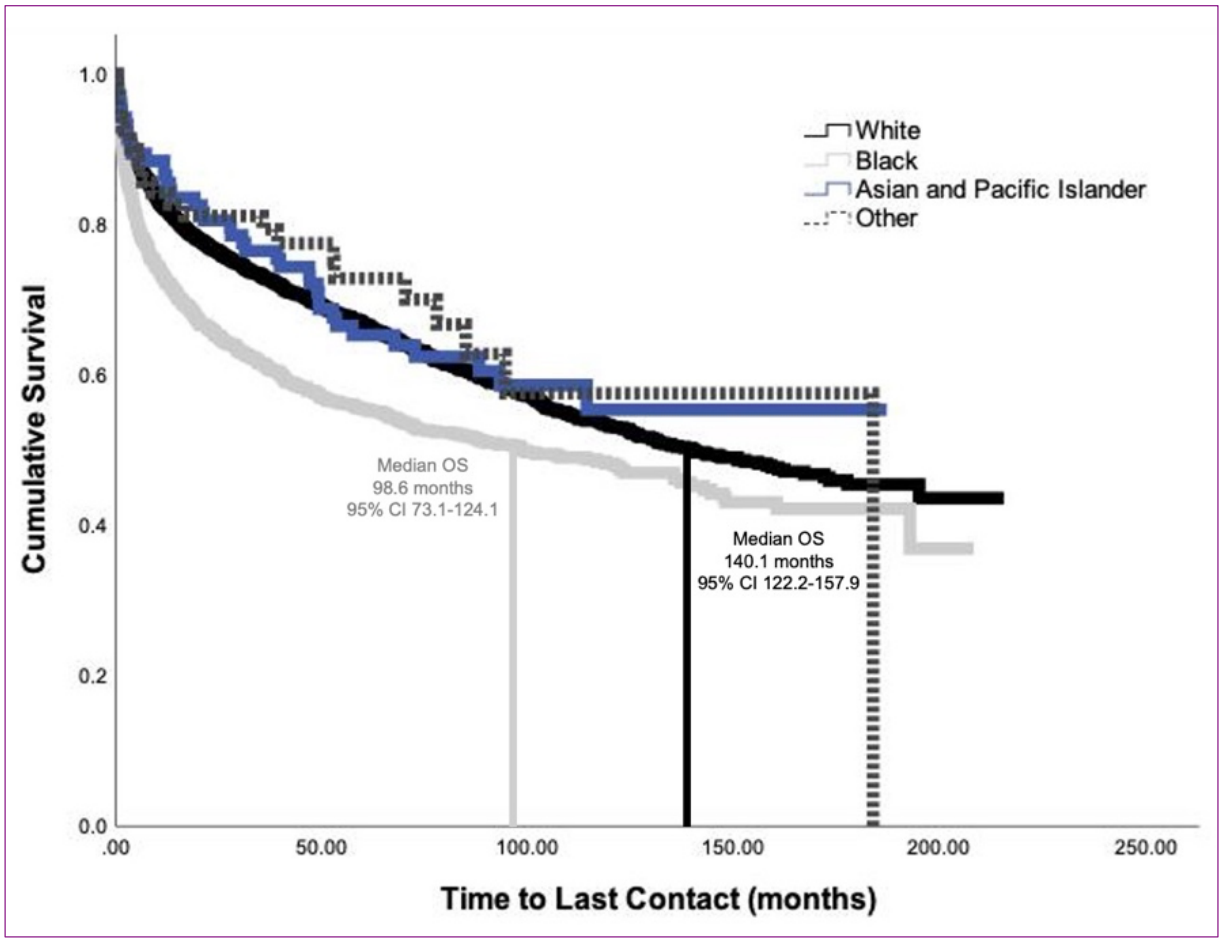


**Figure 2**. Kaplan Meier curves comparing survival between race groups. Median survival for White and Black patients are noted.

### Propensity Score Matching

After 1:1 propensity score matching of White to Black patients for key demographic covariates, 1,656 patients were identified. Within this matched cohort, Kaplan-Meier analysis was run again to compare OS between White and Black patients. (**Figure 3**) In the propensity score matched cohort, White patients had significantly improved median OS of 136 months (95% CI 110-163 months) compared to Black patients with median OS of 119 months (95% CI 89-149 months) (p=0.045).

## DISCUSSION

To our knowledge, our study is the first to describe the impact of key demographic and socioeconomic factors on survival in KS on a large national scale. Similar to prior studies, we found that Black patients were diagnosed at younger ages and had poorer survival outcomes compared to White patients, and that patients living with HIV have reduced OS.[14,15,16] On a national level, it is well-established that URM individuals are more likely to have lower socioeconomic status, experience poorer healthcare outcomes regardless of SES, and be disproportionately affected by HIV.[17,18] Our study builds on these past findings with the addition of multivariate statistical analysis, comprehensive socioeconomic factors, and propensity score matching to help determine what features have the most significant impact on these outcomes.

We found significant variation in population characteristics between KS patients of White and URM background. Black patients were more likely to be underinsured and reside in area of significantly lower education and income levels. Moreover, they were more likely to be affected by multiple comorbidities and be diagnosed with HIV. On multivariate analysis, Black race was independently associated with reduced OS, which persisted when controlled for covariates including age, sex, ethnicity, median education and income level of zip code, insurance status, facility location, facility type, HIV status, and Charlson-Deyo comorbidity score. This may be due to comorbidities that are not accounted for by the Charlson-Deyo Comorbidity Index, or additional economic and social factors not represented in the available codes, including structural racism and other surrogate markers of healthcare access. Another reason for lagging survival in Black patients living with HIV could be disparities in access to HAART. Furthermore, prior research has shown that racial and ethnic minorities, including Black patients, have decreased ART adherence, which could be attributed to historical discrimination and racism experienced by these patients causing mistrust of the medical system and increased treatment-associated psychological distress.[19,20] Multivariate analysis indicated that in addition to Black race, the features of advanced age, HIV-positive status, and Charlson-Deyo score greater than 0 were each independently associated with decreased survival, while Spanish/Hispanic ethnicity, private insurance, residence in areas of high educational attainment, and treatment at academic centers were associated with improved survival. Past work has indicated that comorbidities such as diabetes may promote susceptibility to developing KS, which may explain the detrimental effect of higher Charlson-Deyo score on KS survival.[21] Several studies have noted that despite poorer socioeconomic factors, including residence in areas with reduced educational attainment and income, improved OS has been seen in Spanish/Hispanic patients compared to non-Spanish/Hispanic patients

**Table 3**. Cox regression for demographic and socioeconomic factors of all KS patients.

| | | Hazard Ratio (95% CI) | P-value |
|---|---|---|---|
| Sex | Male | Reference | |
| | Female | 1.07 (0.93-1.24) | 0.352 |
| Age | 40-54 years old | Reference | |
| | 55-69 years old | 1.06 (0.92-1.23) | 0.425 |
| | 70-84 years old | 2.06 (1.67-2.55) | <0.001 |
| | ≥85 years old | 3.72 (2.92-4.74) | <0.001 |
| Race | White | Reference | |
| | Black | 1.31 (1.16-1.47) | <0.001 |
| | Asian and Pacific Islander | 0.92 (0.67-1.28) | 0.626 |
| | Other | 0.98 (0.64-1.49) | 0.907 |
| Ethnicity | Not Spanish/Hispanic | Reference | |
| | Spanish/Hispanic | 0.80 (0.69-0.93) | 0.003 |
| % of Patient Zip Code without High School Diploma | ≥17.6% | Reference | |
| | 10.9% - 17.5% | 0.90 (0.79-1.04) | 0.152 |
| | 6.3% - 10.8% | 0.83 (0.71-0.98) | 0.026 |
| | ≤6.3% | 0.77 (0.64-0.93) | 0.007 |
| Median Income of Patient Zip Code | <$40,227 | Reference | |
| | 40,227 - $50,353 | 0.87 (0.75-1.01) | 0.065 |
| | $50,354 - $63,332 | 0.98 (0.83-1.15) | 0.793 |
| | >$63,333 | 0.90 (0.76-1.08) | 0.252 |
| Insurance | Not Insured | Reference | |
| | Private Insurance | 0.74 (0.62-0.89) | 0.002 |
| | Government Insurance | 1.18 (0.99-1.41) | 0.061 |
| Location | East Coast | Reference | |
| | Central | 1.08 (0.96-1.21) | 0.208 |
| | West Coast | 1.08 (0.95-1.23) | 0.225 |
| HIV Status | HIV-negative | Reference | |
| | HIV-positive | 1.93 (1.61-2.32) | <0.001 |
| Charlson-Deyo Score | 0 | Reference | |
| | 1 | 1.49 (1.26-1.76) | <0.001 |
| | 2 | 1.68 (1.23-2.31) | 0.001 |
| | ≥3 | 1.32 (1.18-1.48) | <0.001 |
| Facility Type | Non-academic Centers | Reference | |
| | Academic Centers | 0.76 (0.68-0.83) | <0.001 |

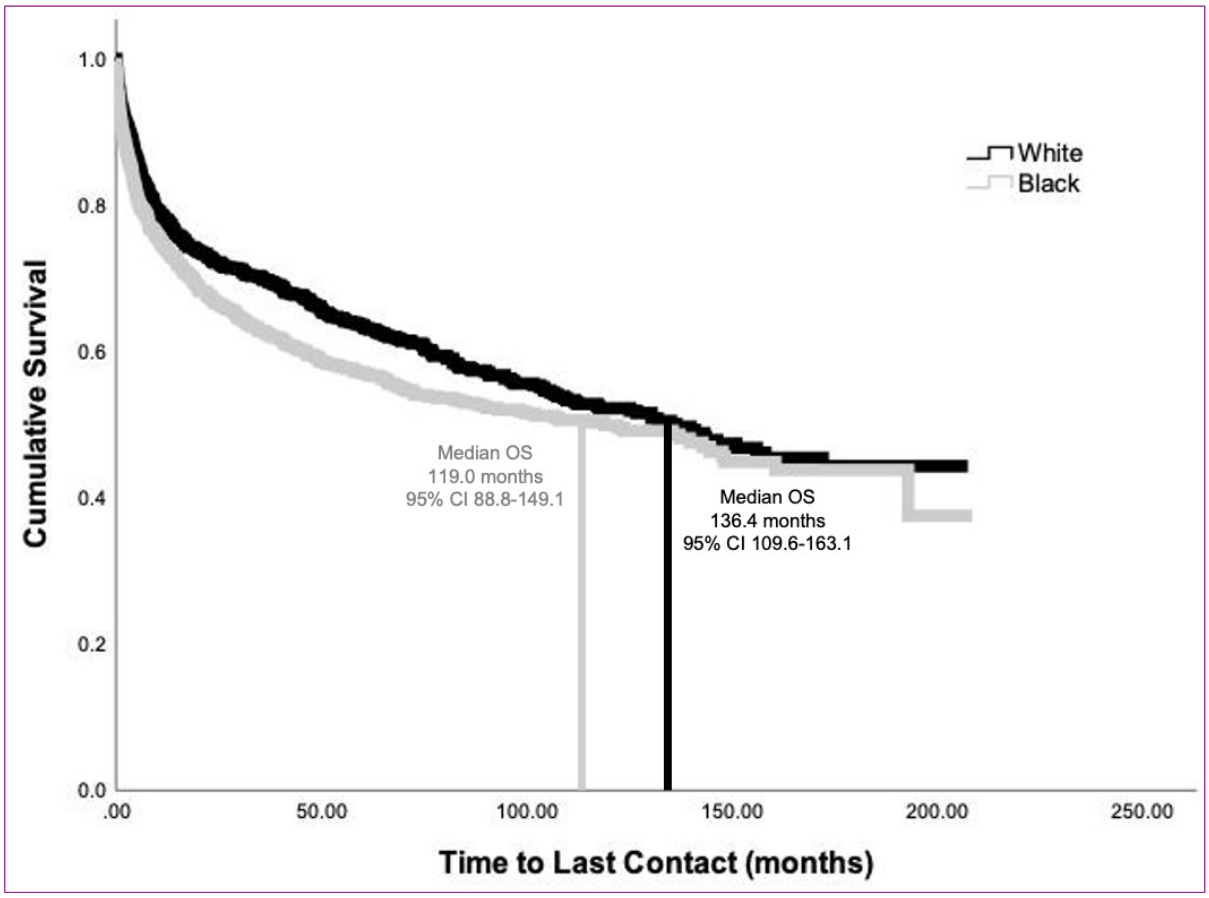


**Figure 3**. Kaplan Meier curves comparing median survival between Black and White patients in 1:1 propensity score matching model.

in several malignancies, although the reason for this is not well-understood.[22]

Private insurance is known to confer a survival benefit across cancers, which our study replicated; however, our study revealed no survival benefit of having government insurance compared to having no insurance at all.[23] Prior studies have shown that patients who are uninsured or have Medicaid insurance experienced worse survival across a variety of malignancies.[24] Greater study is needed to understand why survival continues to lag for cancer patients using government insurance. Improved KS survival was noted with increased education, a trend which has been described in other cancers and attributed to a variety of causes, including stronger psychosocial support and earlier stage at diagnosis.[25] Treatment at an academic center also was associated with improved survival, which has been demonstrated by similar work across malignancies. It is hypothesized that access to specialized therapies and enhanced care logistics at academic medical centers could be contributors to improved survival.[26,27]

There are several limitations to this study. The NCDB is limited to Commission on Cancer accredited facilities, which covers approximately 75% of new cancer cases in the U.S. Thus, a significant fraction of hospitals may be underrepresented in this data due to selection bias, particularly against rural critical access hospitals. Moreover, the NCDB is a hospital-based registry, so generalizability on a population-level is more limited. Racial and ethnic identity in the NCDB is self-identified and are provided as broad categories, therefore racial and ethnic identities may not be fully described by the available categories. While powerful due to its size, the NCDB also has limited information on treatment and disease-specific features and/or outcomes.

## CONCLUSION

In summary, our study reveals the impact of key socioeconomic and demographic factors on survival in KS in the NCDB. Notably, we highlight significant racial disparities with poor survival outcomes in Black patients with KS, which persisted even after controlling for socioeconomic features and other surrogate markers of healthcare access in a 1:1 propensity-score matched model. While we propose unaccounted comorbidities and decreased access to HAART in the setting of discrimination and systemic racism as potential reasons for these survival disparities, more study is warranted to investigate why Black patients in KS continue to have poorer outcomes. Other socioeconomic and URM groups were also noted to have disparate insurance status, highlighting the importance of healthcare access in this population. We call for greater efforts in promoting access to healthcare and providing equitable medical care to all KS patients.

**Acknowledgements:** We would like to thank the National Cancer Database.

**Conflict of Interest Disclosures:** None

**Funding:** None

**Corresponding Author:**
Michelle S Swedek
Creighton University School of Medicine, 2500 California Plaza, Omaha, NE 68178-0408
(402) 280-2700
Email: MichelleSwedek@creighton.edu

**References:**

1. Armstrong AW, Lam KH, Chase EP. Epidemiology of classic and AIDS-related Kaposi's sarcoma in the USA: incidence, survival, and geographical distribution from 1975 to 2005. Epidemiol Infect [Internet]. 2013 Jan 12 [cited 2023 Mar 26];141(1):200–6. Available from:

https://www.cambridge.org/core/product/identifier/S0950268812000325/type/journal_article
2. Buonaguro FM, Tornesello ML, Buonaguro L, Satriano RA, Ruocco E, Castello G, et al. Kaposi's sarcoma: Aetiopathogenesis, histology and clinical features. Journal of the European Academy of Dermatology and Venereology. 2003 Mar 13;17(2):138–54.
3. Mesri EA, Cesarman E, Boshoff C. Kaposi's sarcoma and its associated herpesvirus. Vol. 10, Nature Reviews Cancer. 2010. p. 707–19.
4. Cesarman E, Damania B, Krown SE, Martin J, Bower M, Whitby D. Kaposi sarcoma. Nat Rev Dis Primers. 2019 Dec 1;5(1).
5. Schneider JW, Dittmer DP. Diagnosis and Treatment of Kaposi Sarcoma. Vol. 18, American Journal of Clinical Dermatology. Springer International Publishing; 2017. p. 529–39.
6. Régnier-Rosencher E, Guillot B, Dupin N. Treatments for classic Kaposi sarcoma: A systematic review of the literature. Vol. 68, Journal of the American Academy of Dermatology. Mosby Inc.; 2013. p. 313–31.
7. Rihana N, Nanjappa S, Sullivan C, Velez AP, Tienchai N, Greene JN. Malignancy Trends in HIV-Infected Patients Over the Past 10 Years in a Single-Center Retrospective Observational Study in the United States. Cancer Control. 2018 Jan 1;25(1).
8. Peprah S, Engels EA, Horner MJ, Monterosso A, Hall HI, Johnson AS, et al. Kaposi sarcoma incidence, burden, and prevalence in United States people with HIV, 2000-2015. Vol. 30, Cancer Epidemiology Biomarkers and Prevention. American Association for Cancer Research Inc.; 2021. p. 1627–33.
9. Palich R, Makinson A, Veyri M, Guihot A, Valantin MA, Brégigeon-Ronot S, et al. Kaposi's sarcoma in virally suppressed people living with hiv: An emerging condition. Vol. 13, Cancers. MDPI; 2021.
10. Cobucci RNO, Lima PH, de Souza PC, Costa VV, Cornetta M da C de M, Fernandes JV, et al. Assessing the impact of HAART on the incidence of defining and non-defining AIDS cancers among patients with HIV/AIDS: A systematic review. Vol. 8, Journal of Infection and Public Health. Elsevier Ltd; 2015. p. 1–10.
11. 11. Royse KE, El Chaer F, Amirian ES, Hartman C, Krown SE, Uldrick TS, et al. Disparities in Kaposi sarcoma incidence and survival in the United States: 2000-2013. PLoS One. 2017 Aug 1;12(8).
12. National Cancer Database (NCDB). Society of General Internal Medicine.
13. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. J Chronic Dis. 1987 Jan 1;40(5):373–83.
14. Ragi SD, Moseley I, Ouellette S, Rao B. Epidemiology and Survival of Kaposi's Sarcoma by Race in the United States: A Surveillance, Epidemiology, and End Results Database Analysis. Clin Cosmet Investig Dermatol. 2022;15:1681–5.
15. Kumar V, Soni P, Garg M, Hashmi AT, Chandra A. Racial disparities in incidence & survival of Kaposi's sarcoma in the United States. Indian Journal of Medical Research. 2019 Mar 1;149(3):354–63.
16. Desai AD, Lipner SR. Overall improved survival for Kaposi Sarcoma patients and lagging survival for HIV-infected KS patients in a National Cancer Database Analysis 2004-2018. J Am Acad Dermatol. 2023 Jan;
17. Williams DR, Priest N, Anderson NB. Understanding associations among race, socioeconomic status, and health: Patterns and prospects. Vol. 35, Health Psychology. American Psychological Association Inc.; 2016. p. 407–11.
18. Y. Omar Whiteside, Stacy M. Cohen, Heather Bradley, Jacek Skarbinski, H. Irene Hall, Amy Lansky. Morbidity and Mortality Weekly Report Centers for Disease Control and Prevention MMWR Editorial and Production Staff MMWR Editorial Board. Vol. 7, MMWR. 2014.
19. Simoni JM, Huh D, Wilson IB, Shen J, Goggin K, Reynolds NR, et al. Racial/ethnic disparities in ART adherence in the United States: Findings from the MACH14 study. J Acquir Immune Defic Syndr (1988). 2012 Aug 15;60(5):466–72.
20. Thrasher AD, Earp JAL, Golin CE, Zimmer CR. Discrimination, Distrust, and Racial/Ethnic Disparities in Antiretroviral Therapy Adherence Among a National Sample of HIV-Infected Patients [Internet]. EPIDEMIOLOGY AND SOCIAL SCIENCE. 2008. Available from: http://journals.lww.com/jaids
21. Chang PJ, Yang YH, Chen PC, Chen LW, Wang SS, Shih YJ, et al. Diabetes and risk of Kaposi's sarcoma: effects of high glucose on reactivation and infection of Kaposi's sarcoma-associated herpesvirus [Internet]. Vol. 8. 2017. Available from: www.impactjournals.com/oncotarget
22. Taylor Z, Kjelstrom S, Buckley M, Cahn DB, Hospital BM, Mawr B. Overall survival and associations of insurance status amongst Hispanic men with high-risk prostate cancer: A National Cancer Database Study [Internet].

Available from: https://ssrn.com/abstract=4271086
23. Pan HY, Walker G V., Grant SR, Allen PK, Jiang J, Guadagnolo BA, et al. Insurance status and racial disparities in cancer-specific mortality in the United States: A population-based analysis. Cancer Epidemiology Biomarkers and Prevention. 2017 Jun 1;26(6):869–75.
24. Walker G V., Grant SR, Guadagnolo BA, Hoffman KE, Smith BD, Koshy M, et al. Disparities in stage at diagnosis, treatment, and survival in nonelderly adult patients with cancer according to insurance status. Journal of Clinical Oncology. 2014 Oct 1;32(28):3118–25.
25. Hussain SK, Lenner P, Sundquist J, Hemminki K. Influence of education level on cancer survival in Sweden. Annals of Oncology. 2008 Jan;19(1):156–62.
26. Singh SRK, Malapati SJ, Kumar R, Willner C, Wang D. NCDB analysis of melanoma 2004–2015: Epidemiology and outcomes by subtype, sociodemographic factors impacting clinical presentation, and real-world survival benefit of immunotherapy approval. Cancers (Basel). 2021 Mar 2;13(6):1–16.
27. Vardell VA, Ermann DA, Tantravahi SK, Haaland B, McClune B, Godara A, et al. Impact of academic medical center access on outcomes in multiple myeloma. Am J Hematol [Internet]. 2023 Jan 1 [cited 2023 Apr 12];98(1):41–8. Available from: https://onlinelibrary.wiley.com/doi/full/10.1002/ajh.26759