3-2018

Demographic, Presentation, and Treatment Factors and Racial Disparities in Ovarian Cancer Hospitalization Outcomes

Tomi F. Akinyemiju
University of Kentucky, tomiakin@uky.edu

Gurudatta Naik
University of Alabama at Birmingham

Kemi Ogunsina
University of Alabama at Birmingham

Daniel T. Dibaba
University of Kentucky, daniel.dibaba@uky.edu

Neomi Vin-Raviv
University of Northern Colorado

HHS Public Access

Author manuscript

Cancer Causes Control. Author manuscript; available in PMC 2019 March 01.

Published in final edited form as:

Cancer Causes Control. 2018 March ; 29(3): 333–342. doi:10.1007/s10552-018-1010-7.

Demographic, Presentation and Treatment Factors and Racial Disparities in Ovarian Cancer Hospitalization Outcomes

Tomi F Akinyemiju[1,2,3,*], **Gurudatta Naik**[1,2], **Kemi Ogunsina**[1], **Daniel T. Dibaba**[3], and **Neomi Vin-Raviv**[4,5]

[1]University of Alabama at Birmingham, Department of Epidemiology, Birmingham, AL

[2]University of Alabama at Birmingham, Comprehensive Cancer Center, Birmingham, AL

[3]University of Kentucky, Department of Epidemiology, Lexington, KY

[4]University of Northern Colorado Cancer Rehabilitation Institute, Greeley, CO

[5]Colorado State University, School of Social Work, College of Health and Human Sciences, Fort Collins, CO

Abstract

Background—This study examines whether racial disparities in hospitalization outcomes persist between African-American and White women with ovarian cancer after matching on demographic, presentation and treatment factors.

Methods—Using data from the Nationwide Inpatient Sample database, 5,164 African-American ovarian cancer patients were sequentially matched with White patients on demographic (e.g. age, income), presentation (e.g. stage, comorbidities) and treatment (e.g. surgery, radiation) factors. Racial differences in-hospital length of stay, post-operative complications and in-hospital mortality were evaluated using conditional logistic regression models.

Results—White ovarian cancer patients had relatively higher odds of post-operative complications when matched on demographics (OR=1.35, 95% CI: 1.05, 1.74), and presentation (OR=1.28, 95% CI: 1.00, 1.65) but not when additionally matched on treatment (OR=1.03, 95% CI: 0.78, 1.35). African-American patients had longer in-hospital length of stay (6.96 ± 7.21 days) compared with White patients when matched on demographics (6.37 ± 7.07 days), presentation (6.48 ± 7.16 days) and treatment (6.53±7.59 days). Compared with African-American patients, White patients experienced lower odds of in-hospital mortality when matched on demographics (OR = 0.78, 95% CI: 0.66, 0.92), but this disparity was no longer significant when additionally matched on presentation (OR=0.88, 95% CI: 0.75, 1.04) and treatment (OR=0.95, 95% CI: 0.81, 1.12).

Conclusion—Racial disparities in ovarian cancer hospitalization outcomes persisted after adjusting for demographic and presentation factors, however these differences were eliminated after additionally accounting for treatment factors. More studies are needed to determine the

[*]**Corresponding Author** Dr. Tomi Akinyemiju, Department of Epidemiology, University of Kentucky College of Public Health, Lexington, KY 40526, tomiakin@uky.edu.

factors driving racial differences in ovarian cancer treatment in otherwise similar patient populations.

Introduction

Ovarian cancer remains one of the most lethal gynecologic cancers in the United States, with an estimated 22,280 new cases diagnosed and 14,240 deaths in 2016[1]. Although African-American patients have lower incidence of ovarian cancer compared with White patients, they experience significantly higher mortality rates [2, 3], a trend that has worsened in the past several decades [4]. Several factors have been reported to contribute to racial disparities in ovarian cancer outcomes, including sociodemographic factors, access to healthcare, comorbidities and biological differences [5–10]. African-American patients are also more likely to be diagnosed at later stages [11, 12], present with more aggressive tumors [13] and have a poorer response to treatment [4]. Once diagnosed, African-American patients are less likely to receive standard care or evidence-based treatment, which includes primary cytoreductive surgery and chemotherapy in line with the National Comprehensive Cancer Network (NCCN) guidelines [14–16]. These differences contribute to poorer survival outcomes in African-American patients [17–20]. Lack of access to guideline-adherent care is likely a major contributing factor to ovarian cancer disparities, as studies examining patients in equal access settings have observed similar health outcomes [21–23].

Few studies to date have systematically and simultaneously evaluated multiple contributors to racial disparities in ovarian cancer outcomes. Here, we examined if racial disparities persist among hospitalized ovarian cancer patients after sequentially matching on demographics, presentation and treatment variables [24]. Moreover, we examined whether racial differences were larger among older (65 years+) compared with younger patients, and pre-compared with post-Affordable Care Act implementation.

Methods and Materials

Data Source

We analyzed data from the Healthcare Cost Utilization Project National Inpatient Sample (HCUP-NIS) for the years 2007-2011. The NIS is a national database of inpatient discharge data maintained by the Agency for Healthcare Research and Quality. The NIS database includes records on about 39 million all-payer inpatient visits across 10,000 hospitals in the US [26]. The database includes detailed information on patient admissions, including diagnoses and procedures (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] codes), as well as patient socio-demographic information and hospital characteristics. More details on HCUP-NIS database can be obtained at http://www.hcupus.ahrq.gov/nisoverview.jsp [26]. The study population comprised of ovarian cancer (ICD-9 code: 183.0) patients who were African-American and ages 40 years or older matched with White patients on demographics, presentation and treatment characteristics.

Demographic Characteristics—Patient demographic variables used in matching included age, residential region, health insurance, and median income of household in a residential area. Age was recorded in years; residential region was derived from number of

people staying in counties and categorized as - 1) Large Metropolitan counties (≥ 1 million population), 2) Small Metropolitan counties (population between 50,000 and 999,999), 3) Micropolitan counties (population between 10,000 and 49,999) and 4) Non-metropolitan and non-micropolitan counties. Median income in a household for a residential area was categorized as – 1) Lowest Quartile (≤ $25,000 per year), 2) Second Quartile (between $25,001 and $34,999 per year), 3) Third Quartile (between $35,000 and $44,999 per year) and 4) Highest Quartile (≥ $45,000).

Presentation Characteristics—These include data on stage at diagnosis and comorbidity index at admission. The NIS does not include staging information on individual cancer diagnosis, therefore a proxy ovarian cancer stage variable was defined and cases characterized as metastatic, non-metastatic and in-situ (not including carcinoma in-situ ICD-9 codes). A Modified Deyo Comorbidity Index [27] was created to estimate individual burden of multiple comorbidities such as cerebrovascular disease, congestive heart failure, diabetes mellitus, dementia, myocardial infarction, rheumatic diseases, peptic ulcer disease, liver disease, renal disease and HIV/AIDs. Comorbid conditions were identified using ICD-9 codes, and each assigned a value of one (1) for each condition if present. The scores were summed up for each individual to obtain a comorbidity index score.

Treatment Characteristics—Ovarian cancer is predominantly treated by surgery, while radiation therapy and chemotherapy are given to prevent or mitigate spread of disease from primary site [28]. Using ICD-9 codes, we identified all patients who received surgery (open or laparoscopic), radiation and/or chemotherapy. Although hysterectomies are also performed for non-cancer etiologies, we only included patients that had removal of ovaries along with hysterectomies to avoid including treatment outcomes for non-cancer related surgeries.

Study Outcomes—Four inpatient outcomes were evaluated – 1) Length Of Stay (LOS), defined as the total number of days hospitalized, with same day discharge being counted as one day; 2) Post-operative complications after surgical treatment for ovarian cancer, including systemic inflammatory response syndrome/septic shock, puncture wounds, disruption of operative wound, traumatic injury during operation, infections, foreign body left inside the body, non-healing wounds and other unspecified complications identified by appropriate ICD-9 codes; 3) In-hospital mortality, defined as deaths during hospitalization due to any reason; and 4) patient discharge disposition-a patient-centered quality measure, comparing individuals recovering at home with those with more protracted recovery periods in a nursing home or other facility (28). Codes for Discharge disposition were obtained from NIS dataset [26] and included: 1) Routine discharge (discharge to the patient’s home with no health care assistance); 2) discharge to a skilled nursing facility; 3) expired and; 4) Other classified as discharged due to any other short-term hospital, intermediate care facility, any other facility or discharged against medical advice.

Statistical analyses—To evaluate whether racial differences in study outcomes persisted after adjusting for demographic, presentation and treatment variables, we conducted a series of multivariate matched analyses similar to approaches used in recent studies [25, 29, 30].

African-American ovarian cancer patients that met our inclusion criteria were included in the study, and first, compared with White ovarian cancer patients in crude analysis. Next, a propensity score was generated using logistic regression analysis with race as the outcome (African-American vs. White) and each set of matching variables as predictors (e.g. for demographic matching, predictors were age, region, health insurance and income). Propensity scores for each matched analysis (i.e. demographics, presentation and treatment) are balanced between groups using greedy matching by selecting one White patient representing the best match based on propensity score with an African-American patient, without replacement. This approach is typically used in observational studies to mimic randomized studies where randomization enables unbiased estimation of treatment effects. By evaluating differences in hospitalization outcomes comparing matched African-American and White patients, the possibility of bias due to differences in the matched variables among African-Americans and Whites is minimized. To evaluate between-group balance of matched variables after matching, we conducted Wilcoxon signed-rank test on matched continuous variables and McNemar's test on matched categorical variables. The signed rank *P-value* > 0.05 indicates no significant differences in the means of matched continuous variables between the two groups, and the McNemar's test k-statistic value > 0.50 was considered adequate for matching categorical variables.

Three consecutive models were generated to compare outcomes among African-American and White patients matched on demographics only, demographics and presentation, and demographics, presentation and treatment respectively. Conditional logistic regression analysis was used to account for the matched study design and evaluate racial differences in in-hospital mortality, t-tests were used to evaluate differences in length of stay and the Pooled or Satterthwaite *P-value*s were reported depending on equality of variances, while linear regression models were used to adjust for study covariates. Odds ratios (for post-operative complications and in-hospital mortality) and ß coefficient estimates (for hospital length of stay) and 95% confidence intervals were presented. Multinomial logistic regression was used to evaluate disparities in discharge disposition, using 'discharge to home' as the reference category. All analyses were conducted using SAS 9.3 (SAS Institute, Cary, NC).

Ethical Consideration

This study was considered exempt by the Institutional Review Board at the University of Alabama at Birmingham, as the HCUP-NIS database is a publicly available and de-identified data source.

Results

There were 49,761 women ages 40 years or older with a primary diagnosis of ovarian cancer represented in the dataset. African-American patients comprised about 10% (n=5,164) of these patients while the rest were White (90%, n=44,597). About 47% of patients presented with metastatic cancer, and 23% received surgery for treatment of ovarian cancer, while 11% of patients received chemotherapy. Table 1 shows the descriptive characteristics of 5,164 White patients matched with 5,164 African-American patients. The matched variables were statistically balanced between African-American and White patients (Appendix 1), except

number of comorbidities at presentation, which remained significantly higher on average among African-Americans compared with Whites (*P*=0.03). After matching on demographics, 48% of African-American patients presented with metastatic cancer compared with 46% of Whites (*P*= 0.02). However, there were no racial differences in stage when additionally matched on presentation and treatment. About 17% of African-American patients received surgery compared with 24% of White patients (*P*= <0.0001); this difference persisted even when additionally matched on presentation (17% vs 25%, *P*= < 0.0001), but disappeared when additionally matched on treatment (17% vs. 18%, *P*= 0.835). Further, African-American patients had higher mean number of comorbidities compared with Whites (Mean ± SD: 0.48 ± 0.74 vs. 0.38 ± 0.67), however this difference disappeared when additionally matched on presentation characteristics. About 17% of African-American patients had Medicaid insurance coverage compared with 8% of White patients when matched on demographics, 8% when further matched on presentation and 8% when further matched on treatment.

Table 2 describes racial differences in hospitalization outcomes among matched African-American and White patients. Compared with African-American patients, White patients experienced higher odds of post-operative complications when matched on demographic factors (OR=1.35, 95% CI=1.05, 1.74), but this difference became non-significant when additionally matched on presentation (OR=1.28, 95% CI: 1.00, 1.65) and treatment (OR=1.03, 0.78, 1.35). White patients also experienced significantly shorter hospital length of stay compared with African-American patients when matched on demographics (β= −0.60, *P*=<0.001), presentation (β= −0.46, *P*=<0.001) and treatment (β= −0.43, *P*=0.003). Compared with African-American patients, White patients experienced significantly lower odds of in-hospital mortality when matched on demographics (OR=0.78, 95% CI: 0.66, 0.92), however no racial difference remained when additionally matched on presentation (OR=0.88, 95% CI: 0.75, 1.04), and treatment (OR=0.95, 95% CI: 0.81, 1.12). White patients were less likely to be discharged to other intermediate facilities or discharged against advice compared with African-American ovarian cancer patients after matching on demographics, presentation and treatment variables (OR= 0.89, 95% CI: 0.80, 0.98), but there was no statistically significant difference in being discharged to skilled nursing homes (OR=1.01, 95% CI: 0.92, 1.11).

Table 3 presents the results of age-stratified analyses. Among patients less than 65 years at hospitalization, there were no significant differences in hospitalization outcomes between African-American patients and White patients matched on demographic, presentation and treatment characteristics. However, among patients ages 65 years and older, average LOS was significantly lower among White patients even after adjusting for demographics, presentation and treatment (β= −0.63, *P*=0.003). In addition, White patients experienced significantly lower odds of in-hospital mortality when matched on demographics and presentation (OR= 0.77, 95% CI: 0.62, 0.96), but not after additionally matching on treatment (OR = 0.81, 95% CI: 0.65, 1.00). We conducted stratified analysis comparing patients admitted pre-2010 (Affordable Care Act implementation start year) and post-2010 (Table 4). There were no statistically significant differences in post-operative complications and in-hospital mortality comparing White and African-American patients in models sequentially matched on demographics, presentation and treatment pre-2010. However,

post-2010, White patients had statistically significant higher odds of post-operative complications compared with African-American patients in models sequentially matched on demographics (OR=1.69, 95%CI: 1.12, 2.56), presentation (OR=1.62, 95%CI: 1.08, 2.44), but not after matching on treatment (OR=1.39, 95%CI: 0.91, 2.13). White patients also experienced lower odds of in-hospital mortality compared with African-American patients after matching on demographics (OR=0.73, 95% CI: 0.57, 0.92), presentation (OR=0.79, 95% CI: 0.63, 0.99), and treatment (OR=0.76, 95% CI: 0.60, 0.96).

Discussion

This study examined whether racial disparities in hospitalization outcomes persist after adjusting for differences in demographics, presentation and treatment among patients with ovarian cancer. We accounted for known prognostic factors that influence ovarian cancer survival and may contribute to disparities between African-American and White patients, specifically age, income, insurance, residential area, stage at diagnosis, comorbidities and receipt of treatment. After matching on demographic variables, African-Americans experienced longer hospital length of stay, and had higher odds of post-surgical complications and in-hospital mortality compared with Whites. However, after additionally adjusting for presentation and treatment variables, racial differences in mortality and post-surgical complication were no longer significant, although length of stay remained significantly shorter among White patients.

Several factors may contribute to persistent disparities in hospitalization outcomes observed in the current study. First, we observed that African-American patients had a significantly higher comorbidity index even after matching on multiple conditions as part of the Deyo Comorbidity Index, and comorbidities are highly correlated with poorer health outcomes following surgical or medical treatment of ovarian cancer patients [31, 32]. It is possible that other conditions not included in the measure of comorbidities may be differentially distributed by race, contributing to inadequate matching among African-American and White patients. The higher burden of comorbidities and higher proportion of metastatic disease among African-American patients may explain why length of stay remained significantly higher in African-American patients compared with White patients. However, future studies will be needed to determine why White patients were more likely to receive surgery compared with African-American patients even though all patients were admitted, and theoretically had already accessed care. Primary data will be needed to determine whether these differences are due to due to patient preferences, financial factors such as insurance status and/or negative perceptions of the benefit of surgery [33, 34].

Insurance differences persisted between African-American and White patients even after matching, and this may have been an important factor in the disparities observed in hospitalization outcomes. After matching on demographics, about 17% of African-American patients were on Medicaid, while 30% had private insurance, compared with 8% of White patients on Medicaid, and 39% with private insurance. Insurance status has been shown to influence health outcomes for other cancer types [35], and this may be due to treatment delays, quality of treatment, as well as access to preventive care prior to diagnosis that may influence the underlying health status of patients during admission [36–41]. Interestingly, we

observed that the racial disparities in length of stay and in-hospital mortality were only observed among older patients (ages 65 years and older) but not younger patients. Although we expected racial differences to be larger in the younger age groups due to larger variations in insurance coverage (since adults are eligible for Medicare insurance after age 65), our findings may be due to age differences in the course of disease, such that older patients may have had disease for a long time with deteriorating effects on their health and poorer response to treatment. Overall, older patients in this study (48%) tended to present with metastatic cancer compared with younger patients (45%), and had a greater burden of comorbidities (mean=0.46, SD=0.73) compared with younger patients (mean=0.29, SD=0.59). However, younger African-Americans patients were more likely to present with metastatic ovarian cancer (50%) than older African-American patients (47%) and older White patients (48%). Further studies are required to fully explore this finding, however it is possible that there were no racial disparities observed among younger patients after matching because the matched variables better captured the range of demographic, presentation and treatment differences by race in this age-group.

Post-discharge care after an inpatient hospital admission is a major challenge for patients with cancer, and studies demonstrate that discharge to skilled nursing facilities are associated with worse clinical outcomes including postoperative complications, more frequent readmissions, and increased mortality [42–44]. Our results showed that African-American patients were less likely to receive routine discharge to home following a hospitalization compared with White patients, and recent studies have indicated that African-American patients have higher odds of hospital readmissions following a discharge for a surgical procedure compared with Whites [45]. There may be racial differences in social support and coping mechanisms leading to the higher likelihood of non-routine discharge for African-American patients, however the Nationwide Inpatient Sample does not include information on post-discharge settings. Future studies examining post-discharge health outcomes by race, including re-admissions and quality of life will help shed light on post-treatment factors important for ovarian cancer survival.

We also observed that racial disparities in hospitalization outcomes were most pronounced after, but not before, the implementation of the Affordable Care Act in 2010. It is possible that while health insurance may have improved one aspect of access to care post-2010, i.e. financial burden and out of pocket expenses, there are likely racial differences in other dimensions such as availability and accessibility of high volume providers, potentially explaining racial differences observed post ACA. Recent studies have shown that high volume hospitals have better ovarian cancer survival rates compared with low volume hospitals [46], and that treatment at NCI Designated Comprehensive Cancer Centers is associated with better adherence to treatment related guidelines, and lower ovarian cancer related mortality compared with non-NCI designated centers. Future studies examining multiple components of access to care simultaneously will be needed to better highlight barriers to the receipt of high quality ovarian cancer care among African-Americans and Whites.

There are several limitations relevant to this analysis. First, cancer stage information was based on ICD-9 codes, and as such there is a possibility of misclassification of disease stage

in matched analysis. Length of stay represents a measure of overall health during hospitalization, and may have been influenced by receipt of other procedures or treatment not necessarily restricted to the primary admission for ovarian cancer alone. Information on individual level socioeconomic factors such as education and income were not available in the dataset to better adjust for potential confounding by these factors, however we utilized data on individual level insurance status and area socioeconomic status. The analysis was restricted to African-American and White patients who had been admitted to the hospital and therefore theoretically had already accessed healthcare. Therefore, results may not be generalizable to the overall US population with varying levels of healthcare access. The strength of this analysis include the large sample size which enabled analysis of a relatively rare cancer outcome, and examination of race- and age-differences in outcomes. The use of clinical diagnostic codes to identify ovarian cancer cases and administrative claims data to identify receipt of treatment also enhanced the quality of the analysis by further minimizing misclassification bias. Data from the Nationwide Inpatient Sample also represents inpatient stays and discharges from US hospitals in 46 states in 2011, covering 97% of the US population, and significantly enhancing the generalizability of study results.

Conclusion

After sequentially matching on demographics, presentation, and treatment characteristics, African American ovarian cancer patients did not have higher in-hospital mortality, although they tended to have longer average lengths of stay in the hospital. Racial differences in discharge disposition also persisted. These may be due to residual racial differences in clinical factors such as burden of comorbidities and metastatic disease, and/or racial differences in utilization of quality ovarian cancer treatment due to differences in access to quality healthcare. Future studies with a combination of primary patient reported data, detailed treatment information, as well as hospital and provider characteristics will be needed to further elucidate the causes of disparate ovarian cancer outcomes.

Appendix 1

Matching balance test result using signed rank test for continuous variables and McNemar's test for categorical variables

	Demographic matched	**Presentation matched**	**Treatment matched**
Age	0.5021 *(P-value)*	0.0874 *(P-value)*	0.7041 *(P-value)*
Income	0.9249 (K statistic)	0.7914 (K statistic)	0.7318 (K statistic)
Region	0.9063 (K statistic)	0.7116 (K statistic)	0.6526 (K statistic)
Comorbidities		0.0315 *(P-value)*	0.0039 *(P-value)*
Stage		0.6075 (K statistic)	0.5696 (K statistic)
Surgery			0.4822 (K statistic)

K statistic is from McNemar's test.

References

1. Siegel Rebecca L, Miller Kimberly D, Jemal Ahmedin. Cancer Statistics, 2016. CA: A Cancer Journal for Clinicians. 2016; 66(1):7–30. Web. 16 Apr. 2017. [PubMed: 26742998]
2. Farley J, Risinger JI, Rose GS, Maxwell GL. Racial disparities in blacks with gynecologic cancers. Cancer. 2007; 110(2):234–43. DOI: 10.1002/cncr.22797. [PubMed: 17559136]
3. Chan JK, Zhang M, Hu JM, Shin JY, Osann K, Kapp DS. Racial disparities in surgical treatment and survival of epithelial ovarian cancer in United States. Journal of surgical oncology. 2008; 97(2): 103–7. DOI: 10.1002/jso.20932 [PubMed: 17979133]
4. Terplan M, Schluterman N, McNamara EJ, Tracy JK, Temkin SM. Have racial disparities in ovarian cancer increased over time? An analysis of SEER data Gynecologic oncology. 2012; 125(1):19–24. DOI: 10.1016/j.ygyno.2011.11.025 [PubMed: 22108636]
5. Brewer KC, Peterson CE, Davis FG, Hoskins K, Pauls H, Joslin CE. The influence of neighborhood socioeconomic status and race on survival from ovarian cancer: a population-based analysis of Cook County, Illinois. Annals of epidemiology. 2015; 25(8):556–63. DOI: 10.1016/j.annepidem. 2015.03.021. [PubMed: 25986734]
6. Terplan M, Smith EJ, Temkin SM. Race in ovarian cancer treatment and survival: a systematic review with meta-analysis. Cancer causes & control : CCC. 2009; 20(7):1139–50. DOI: 10.1007/ s10552-009-9322-2. [PubMed: 19288217]
7. Harlan LC, Clegg LX, Trimble EL. Trends in surgery and chemotherapy for women diagnosed with ovarian cancer in the United States. J Clin Oncol. 2003; 21(18):3488–94. DOI: 10.1200/jco. 2003.01.061. [PubMed: 12972525]
8. Randall TC, Armstrong K. Health Care Disparities in Hereditary Ovarian Cancer: Are We Reaching the Underserved Population? Current treatment options in oncology. 2016; 17(8):39.doi: 10.1007/ s11864-016-0417-1 [PubMed: 27315065]
9. Bristow RE, Powell MA, Al-Hammadi N, et al. Disparities in ovarian cancer care quality and survival according to race and socioeconomic status. Journal of the National Cancer Institute. 2013; 105(11):823–32. DOI: 10.1093/jnci/djt065. [PubMed: 23539755]
10. Terplan M, Temkin S, Tergas A, Lengyel E. Does equal treatment yield equal outcomes? The impact of race on survival in epithelial ovarian cancer. Gynecologic oncology. 2008; 111(2):173–8. DOI: 10.1016/j.ygyno.2008.08.013 [PubMed: 18823649]
11. Morris CR, Sands MT, Smith LH. Ovarian cancer: predictors of earlystage diagnosis. Cancer Causes Control. 2010; 21:1203–11. DOI: 10.1007/s10552-010-9547-0 [PubMed: 20364367]
12. National Cancer Institute. SEER Stat Fact Sheets: Ovary Cancer. 2015. Available from: http:// seer.cancer.gov/statfacts/html/ovary.html
13. Peterson C, Rauscher G, Johnson T, Kirschner C, Barrett R, Kim S, et al. The association between neighborhood socioeconomic status and ovarian cancer tumor characteristics. Cancer Causes Control. 2014; 25(5):633–7. [PubMed: 24532025]
14. Bristow RE, Zahurak ML, Ibeanu OA. Racial disparities in ovarian cancer surgical care: a population-based analysis. Gynecol Oncol. 2011; 121:364–8. DOI: 10.1016/j.ygyno.2010.12.347 [PubMed: 21288564]
15. Parham G, Phillips JL, Hicks ML, Andrews N, Jones WB, Shingleton HM, et al. Te National Cancer Data Base report on malignant epithelial ovarian carcinoma in African-American women. Cancer. 1997; 80:816–26. doi: 10.1002/(SICI)1097-0142(19970815)80:4<816::AID-CNCR21>3.3.CO;2-W. [PubMed: 9264366]
16. Goff BA, Matthews BJ, Larson EH, Andrilla CHA, Wynn M, Lishner DM, et al. Predictors of comprehensive surgical treatment in patients with ovarian cancer. Cancer. 2007; 109:2031–42. DOI: 10.1002/cncr.22604 [PubMed: 17420977]
17. Bristow RE, Chang J, Ziogas A, Campos B, Chavez LR, Anton-Culver H. Sociodemographic disparities in advanced ovarian cancer survival and adherence to treatment guidelines. Obstet Gynecol. 2015; 125:833–42. DOI: 10.1097/AOG.0000000000000643. [PubMed: 25751200]
18. Long B, Chang J, Ziogas A, Tewari KS, Anton-Culver H, Bristow RE. Impact of race, socioeconomic status, and the health care system on the treatment of advanced-stage ovarian cancer in California. Am J Obstet Gynecol. 2015; 212:e1–9. DOI: 10.1016/j.ajog.2014.10.1104

19. Hodeib M, Chang J, Liu F, Ziogas A, Dilley S, Randall LM, et al. Socioeconomic status as a predictor of adherence to treatment guidelines for early-stage ovarian cancer. Gynecol Oncol. 2015; 138:121–7. DOI: 10.1016/j.ygyno.2015.04.011 [PubMed: 25913132]
20. Howell EA, Egorova N, Hayes MP, Wisnivesky J, Franco R, Bickell N. Racial disparities in the treatment of advanced epithelial ovarian cancer. Obstet Gynecol. 2013; 122:1025–32. DOI: 10.1097/AOG.0b013e3182a92011 [PubMed: 24104782]
21. Collins Y, Holcomb K, Chapman-Davis E, Khabele D, Farley JH. Gynecologic cancer disparities: a report from the Health Disparities Taskforce of the Society of Gynecologic oncology. Gynecol Oncol. 2014; 133:353–61. DOI: 10.1016/j.ygyno.2013.12.039 [PubMed: 24406291]
22. Winter WE III, Maxwell GL, Tian C, Carlson JW, Ozols RF, Rose PG, et al. Prognostic factors for stage III epithelial ovarian cancer: a *Gynecologic oncology* Group Study. J Clin Oncol. 2007; 25:3621–7. DOI: 10.1200/JCO.2006.10.2517 [PubMed: 17704411]
23. Farley JH, Tian C, Rose GS, Brown CL, Birrer M, Maxwell GL. Race does not impact outcome for advanced ovarian cancer patients treated with cisplatin/paclitaxel: an analysis of Gynecologic oncology Group trials. Cancer. 2009; 115:4210–7. DOI: 10.1002/cncr.24482 [PubMed: 19536873]
24. NCI Surveiilance EaERp. Cancer of the Ovary - cancer stat facts Secondary Cancer of the Ovary - cancer stat facts. 2017. https://seer.cancer.gov/statfacts/html/ovary.html
25. Silber Jeffrey H, , et al. Racial Disparities In Colon Cancer Survival. Annals of Internal Medicine. 2014; 161(12):845.doi: 10.7326/M14-0900 [PubMed: 25506853]
26. AHRQ (Agency for Healthcare Research and Quality) R M. HCUP Databases. Healthcare Cost and Utilization Project (HCUP). AHRQ (Agency for Healthcare Research and Quality); 2011. February 6, 2017
27. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. J Clin Epidemiol. 1992 Jun; 45(6):613–9. [PubMed: 1607900]
28. NCCN Clinical Practice Guidelines In Oncology. Nccn.org. 2017. N.p.https://www.nccn.org/professionals/physician_gls/f_guidelines.asp#ovarian 21 Mar. 2017
29. Naik GurudattaAkinyemiju Tomi. Disparities In Hospitalization Outcomes Among African-American And White Prostate Cancer Patients. Cancer Epidemiology. 2017; 46:73–79. Epub 2017 Jan 3. DOI: 10.1016/j.canep.2016.12.001 [PubMed: 28056390]
30. Silber JH, Rosenbaum PR, Clark AS, Giantonio BJ, Ross RN, Teng Y, et al. Characteristics associated with differences in survival among black and white women with breast cancer. JAMA. 2013; 310(4):389–97. [PubMed: 23917289]
31. Urban RR, He H, Alfonso R, Hardesty MM, Gray HJ, Goff BA. Ovarian cancer outcomes: Predictors of early death. Gynecologic oncology. 2016; 140(3):474–80. DOI: 10.1016/j.ygyno.2015.12.021 [PubMed: 26743531]
32. Suidan RS, Leitao MM Jr, Zivanovic O, et al. Predictive value of the Age-Adjusted Charlson Comorbidity Index on perioperative complications and survival in patients undergoing primary debulking surgery for advanced epithelial ovarian cancer. Gynecologic oncology. 2015; 138(2): 246–51. DOI: 10.1016/j.ygyno.2015.05.034. [PubMed: 26037900]
33. Elit L, Charles C, Gold I, et al. Women's perceptions about treatment decision making for ovarian cancer. Gynecologic oncology. 2003; 88(2):89–95. [PubMed: 12586585]
34. John EM, Whittemore AS, Harris R, Itnyre J. Characteristics relating to ovarian cancer risk: collaborative analysis of seven U.S. case-control studies. Epithelial ovarian cancer in black women. Collaborative Ovarian Cancer Group. Journal of the National Cancer Institute. 1993; 85(2):142–7. [PubMed: 8418303]
35. Pan HY, Walker GV, Grant SR, et al. Insurance Status and Racial Disparities in Cancer-Specific Mortality in the United States: A Population-Based Analysis. Cancer epidemiology, biomarkers & prevention: a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology. :2017.
36. Halpern Michael T, , et al. Association Of Insurance Status And Ethnicity With Cancer Stage At Diagnosis For 12 Cancer Sites: A Retrospective Analysis. Obstetrical & Gynecological Survey. 2008; 63(6):380–381.

37. Murphy Caitlin C, , et al. Race And Insurance Differences In The Receipt Of Adjuvant Chemotherapy Among Patients With Stage III Colon Cancer. Journal of Clinical Oncology. 2015; 33(23):2530–2536. [PubMed: 26150445]

38. Hoehn Richard S, , et al. Does Race Affect Management And Survival In Hepatocellular Carcinoma In The United States? Surgery. 2015; 158(5):1244–1251. [PubMed: 25958069]

39. Fedewa SA, et al. Insurance Status And Racial Differences In Uterine Cancer Survival: A Study Of Patients In The National Cancer Database. Gynecologic oncology. 2011; 122(1):63–68. [PubMed: 21463888]

40. Costa Luciano J, Brill Ilene K, Brown Elizabeth E. Impact Of Marital Status, Insurance Status, Income, And Race/Ethnicity On The Survival Of Younger Patients Diagnosed With Multiple Myeloma In The United States. Cancer. 2016; 122(20):3183–3190. [PubMed: 27548407]

41. Gerhard Robert Steven, et al. Treatment Of Men With High-Risk Prostate Cancer Based On Race, Insurance Coverage, And Access To Advanced Technology. Urologic Oncology: Seminars and Original Investigations. 2017; pii: S1078-1439(16)30411-2. doi: 10.1016/j.urolonc.2016.12.004

42. Cholankeril G, et al. Skilled Nursing Facility Placement In Hospitalized Elderly Patients With Colon Cancer. European Journal of surgical oncology (EJSO). 2016; 42(11):1660–1666. [PubMed: 27387271]

43. AlHilli Mariam M, , et al. Risk-Scoring Model For Prediction Of Non-Home Discharge In Epithelial Ovarian Cancer Patients. Journal of the American College of Surgeons. 2013; 217(3): 507–515. [PubMed: 23816386]

44. Balentine Courtney J, , et al. Association Of High-Volume Hospitals With Greater Likelihood Of Discharge To Home Following Colorectal Surgery. JAMA Surgery. 2014; 149(3):244. [PubMed: 24430092]

45. Tsai Thomas C, Orav E JohnJoynt Karen E. Disparities In Surgical 30-Day Readmission Rates For Medicare Beneficiaries By Race And Site Of Care. Annals of Surgery. 2014; 259(6):1086–1090. [PubMed: 24441810]

46. Wright JD, Chen L, Hou JY, Burke WM, Tergas AI, Ananth CV, Neugut AI, Hershman DL. Association of Hospital Volume and Quality of Care With Survival for Ovarian Cancer. Obstet Gynecol. 2017 Sep; 130(3):545–553. DOI: 10.1097/AOG.0000000000002164 [PubMed: 28796677]

Table 1

Patient Characteristics Comparing African-American and White Ovarian Cancer Patients, Nationwide Inpatient Sample, 2007-2011*

	African-Americans	Whites-Demographics	Whites-Demographics and Presentation	Whites-Demographics, Presentation and Treatment	All Whites-Unmatched
	N=5164	N=5164	N=5164	N=5164	N =44597
Age at admission- year, Mean (SD)	62.98(12.15)	63.03 (12.01)	63.11 (11.99)	63.20 (12.00)	65.59 (12.03)#
Residential Income, N (%)					
First Quartile-Lowest	2398 (46.44)	2442 (47.29)	2441 (47.27)	2410 (46.67)	8184 (18.35)#
Second Quartile	1021 (19.77)	1024 (19.83)	1038 (20.10)	1023 (19.81)	10443 (23.42)
Third Quartile	880 (17.04)	893 (17.29)	864 (16.73)	888 (17.20)	11039 (24.75)
Fourth Quartile-Highest	668 (12.94)	685 (13.27)	692 (13.40)	699 (13.54)	14026 (31.45
Number of Co-morbidities, Mean (SD)	0.48 (0.74)	0.38 (0.67)#	0.46 (0.73)	0.45 (0.72)#	0.37 (0.66)#
Stage, N (%)					
Non-Metastatic	2660 (51.51)	2778 (53.80)#	2657 (51.45)	2641 (51.14)	23916 (53.63)#
Metastatic	2504 (48.49)	2386 (46.20)	2507 (48.55)	2523 (48.86)	20681 (46.37)
Discharge Disposition, N (%)					
Routine Discharge	2440 (47.25)	2687 (52.03)	2639 (51.10)	2541 (49.21)	21698 (48.65)
Skilled Nursing Facility	1233 (23.88)	1233 (23.88)	1239 (23.99)	1265 (24.50)	10999 (24.66)
Expired	282 (5.46)	220 (4.26)	232 (4.49)	254 (4.92)	1856 (4.16)
Other	1209 (23.41)	1024 (19.93)	1054 (20.41)	1104 (21.38)	10044 (22.52)
Surgery, N (%)					
Yes	892 (17.27)	1251 (24.23)#	1268 (24.55)#	919 (17.80)	10348 (23.20)#
No	4272 (82.73)	3913 (75.77)	3896 (75.45)	4245 (82.20)	34249 (76.80)
Radiation Therapy, N (%)					
Yes	31 (0.60)	29 (0.56)	25 (0.48)	23 (0.45)	179 (0.40)
No	5133 (99.40)	5135 (99.44)	5139 (99.52)	5141 (99.55)	44418 (99.60)
Chemotherapy, N (%)					
Yes	586 (11.35)	519 (10.05)#	519 (10.05)#	560 (10.84)	4841 (10.85)
No	4578 (88.65)	4645 (89.95)	4645 (89.95)	4604 (89.16)	39756 (89.15)

	African-Americans	Whites-Demographics	Whites-Demographics and Presentation	Whites-Demographics, Presentation and Treatment	All Whites-Unmatched
Insurance Type, N (%)					
Medicaid	858 (16.62)	416 (8.06)#	410 (7.94)#	428 (8.29)#	2088 (4.68)#
Medicare	2379 (46.07)	2379 (46.07)	2372 (45.93)	2390 (46.28)	23225 (52.08)
Other	380 (7.36)	316 (6.12)	323 (6.25)	310 (6.00)	1911 (4.28)
Private	1547 (29.96)	2053 (39.76)	2059 (39.87)	2036 (39.43)	17270 (38.72)
Residential Region, N (%)					
Large Metro (>1mil residents)	3539 (68.53)	3605 (69.81)	3592 (69.56)	3639 (70.47)	23557 (52.82)#
Small Metro (<1 mil residents)	990 (19.17)	995 (19.27)	1045 (20.24)	987 (19.11)	11771 (26.39)
Micropolitan (Adjacent to metro)	296 (5.73)	293 (5.67)	282 (5.46)	284 (5.50)	4672 (10.48)
Non-metro and non-micropolitan	206 (3.99)	210 (4.07)	175 (3.39)	178 (3.45)	2943 (6.60)

*Percentages may not add up to 100% due to rounding.

Sample includes all African-American patients diagnosed with ovarian cancer in the dataset and Whites matched on: 1) demographic variables (age, geographical region, and residential income), 2) demographics + presentation variables (additionally stage and comorbidities), and 3) demographics, presentation and treatment variables (additionally receipt of surgery, chemotherapy, and radiation). All whites represent White patients diagnosed with ovarian cancer in the dataset.

#*P-value* < 0.05, statistically significant difference between African-American patients and White patients

Table 2

Racial Differences in Ovarian Cancer Outcomes Following Hospitalization For Matched Groups[¶]

	African-Americans	White-Demographics[¶]	Whites-Demographics and Presentation[§]	Whites-Demographics, Presentation and Treatment[Y]	All Whites-Unmatched[Φ]
	N=5164	N=5164	N=5164	N=5164	N =44597
Post-operative complications N (%)					
No	5052 (97.83)	5022 (97.25)	5012 (97.06)	5051 (97.83)	43473 (97.48)
Yes	112 (2.17)	142 (2.75)	152 (2.94)	112 (2.17)	1124 (2.52)
OR (95% CI)		**1.35 (1.05, 1.74)**	1.28 (1.00, 1.65)	1.03 (0.78, 1.35)	1.17 (0.96, 1.42)
P-value		0.019	**0.051**	0.835	0.1249
Length of Stay -days					
Mean (SD)	6.96 (7.2)	6.37 (7.07)	6.48 (7.16)	6.53 (7.59)	6.22 (6.66)
β-Estimate		(−0.60)	(−0.46)	(−0.43)	(−0.74)
P-value		**<0.0001**	**0.0007**	**0.0031**	**<0.001**
Died during Hospitalization N (%)					
No	4831 (93.59)	4904 (95.04)	4893 (94.81)	4864 (94.25)	42346 (94.99)
Yes	331 (6.41)	256 (4.96)	268 (5.19)	297 (5.75)	2234 (5.01)
OR (95% CI)		**0.78 (0.66, 0.92)**	0.88 (0.75, 1.04)	0.95 (0.81, 1.12)	**0.77 (0.68, 0.87)**
P-value		0.003	0.134	0.567	<0.0001
Discharge Disposition					
Skilled facility		0.94(0.85, 1.03)*	1.00(0.91, 1.10)	1.01(0.92, 1.11)	1.00(0.93, 1.08)
Other		**0.79(0.71, 0.87)**	**0.81(0.73, 0.89)**	**0.89(0.80, 0.98)**	0.93(0.87, 1.01)
Routine		**Ref**	**Ref**	**Ref**	**Ref**
P-value		<0.0001	<0.0001	0.066	**<0.0001**

Each outcome was modeled separately comparing White patients to African-American patients consecutively matched on

[¶] demographic variables (age, year of diagnosis, residential income and insurance);

[§] demographic + presentation (disease stage and number of comorbidities);

[Y] demographic +presentation + treatment (surgery, chemotherapy and radiation);

[Φ] comparing all White patients to all African-American patients.

‡Values are Odds ratio and 95% CIs from multinomial logistic regression

Abbreviations: CI, confidence interval; Ref, reference; SD, standard deviation; Routine, routine home discharge; Other, other types of discharge such as to intermediate short stay facilities and discharge against medical advice; Skilled-facility, skiiled nursing facility.

Table 3

Racial Differences in Ovarian Cancer Outcomes Following Hospitalization For Matched Groups, Stratified By Age-Group

	African-Americans	White-Demographics	Whites-Demographics and Presentation	Whites-Demographics, Presentation and Treatment	All Whites-Unmatched
Patients <65 years					
	N=2907	**N=2907**	**N=2907**	**N=2907**	**N =21184**
Post-operative complications					
OR, 95% CI	Ref	1.30 (0.94, 1.80)	1.20 (0.86, 1.67)	1.09 (0.78, 1.53)	1.24 (0.96, 1.60)
P-value		0.1181	0.2761	0.6055	0.1019
Length of Stay					
β-Estimate	Ref	−0.34	−0.34	−0.34	**−0.76**
P-value		0.0601	0.0655	0.0795	**<0.0001**
Died during Hospitalization					
OR, 95% CI	Ref	0.99 (0.77, 1.23)	1.06 (0.83, 1.35)	1.05 (0.82, 1.34)	**0.82(0.68, 0.99)**
P-value		0.9076	0.6548	0.7023	**0.0406**
Patients 65 years+					
	N=2257	**N=2257**	**N=2257**	**N=2257**	**N =23413**
Post-operative complications					
OR, 95% CI	Ref	1.24 (0.84, 1.84)	1.11 (0.74, 1.66)	0.80 (0.52, 1.24)	1.12 (0.82, 1.51)
P-value		0.2756	0.6083	0.3215	0.4819
Length of Stay					
β-Estimate	Ref	**−0.69**	−0.41	**−0.63**	**−0.87**
P-value		**0.0018**	0.0737	**0.0035**	**<0.0001**
Died during Hospitalization					
OR, 95% CI	Ref	**0.70 (0.56, 0.87)**	**0.77 (0.62, 0.96)**	**0.81 (0.65, 1.00)**	**0.68 (0.58, 0.79)**
P-value		**0.0014**	**0.0178**	**0.0490**	**<0.0001**

Sample includes all African-American patients diagnosed with ovarian cancer in the dataset and Whites matched on: 1) demographic variables (age, geographical region, and residential income), 2) demographics + presentation variables (additionally stage and comorbidities), and 3) demographics, presentation and treatment variables (additionally receipt of surgery, chemotherapy, and radiation). All Whites represent White patients diagnosed with ovarian cancer in the dataset. Patients stratified based on age at admission

Table 4

Racial Differences in Ovarian Cancer Outcomes Following Hospitalization for Matched Groups, Stratified by Pre-2010 And Post-2010

	African-Americans	White-Demographics	Whites-Demographics and Presentation	Whites-Demographics, Presentation and Treatment	All Whites-Unmatched
Pre-2010					
	N=2711	**N=2711**	**N=2711**	**N=2711**	**N= 29576**
Post-operative complications					
OR, 95% CI	Ref	1.04(0.75, 1.45)	1.20 (0.87, 1.65)	0.99(0.71, 1.38)	1.03(0.81, 1.32)
P-value		0.801	0.260	0.932	0.796
Length of Stay					
β-Estimate	Ref	−0.25	0.04	0.09	**−0.59**
P-value		0.206	0.852	0.64	**<0.0001**
Died during hospitalization					
OR, 95% CI	Ref	0.92(0.73, 1.15)	0.99(0.79, 1.24)	1.07(0.86, 1.34)	0.87(0.73, 1.03)
P-value		0.448	0.908	0.532	0.098
Post-2010					
	N=2453	**N=2453**	**N=2453**	**N=2453**	**N=18621**
Post-operative complications					
OR, 95% CI	Ref	**1.69(1.12, 2.56)**	**1.62(1.08, 2.44)**	1.39(0.91, 2.13)	1.37(0.98, 1.90)
P-value		**0.012**	**0.021**	0.133	0.066
Length of Stay					
β-Estimate	Ref	**−0.56**	**−0.64**	**−0.68**	**−0.94**
P-value		**0.009**	**0.003**	**0.001**	**<0.0001**
Died during hospitalization					
OR, 95% CI	Ref	**0.73(0.57, 0.92)**	**0.79(0.63,0.995)**	**0.76(0.60, 0.96)**	**0.67(0.56, 0.79)**
P-value		**0.009**	**0.046**	**0.020**	**<0.0001**

Sample includes all African-American patients diagnosed with ovarian cancer in the dataset and Whites matched on: 1) demographic variables (age, geographical region, and residential income), 2) demographics + presentation variables (additionally stage and comorbidities), and 3) demographics, presentation and treatment variables (additionally receipt of surgery, chemotherapy, and radiation). All Whites represent White patients diagnosed with ovarian cancer in the dataset. Patients stratified based on year of admission.