Published in final edited form as:

Gynecol Oncol. 2018 November ; 151(2): 269–274. doi:10.1016/j.ygyno.2018.08.041.

Disparities in treatment and survival among elderly ovarian cancer patients

Jolyn S. Taylor^a, Weiguo He^b, Ross Harrison^a, Hui Zhao^b, Charlotte C. Sun^a, Karen H. Lu^a, Sharon H. Giordano^b, and Larissa A. Meyer^{a,*}

^aThe University of Texas MD Anderson Cancer Center, Department of Gynecologic Oncology and Reproductive Medicine, United States of America

^bThe University of Texas MD Anderson Cancer Center, Department of Health Services Research, United States of America

Abstract

Objective.—To determine correlation between race and receipt of optimal treatment for ovarian cancer and the impact of this on overall survival.

Methods.—Using SEER-linked Medicare database, women 66 and older diagnosed with advanced ovarian cancer between 2002 and 2011 were identified. Patients with unclear histology, diagnosed on autopsy and without Medicare Parts A and B were excluded. We used Chi-square test for categorical variables, F test for continuous variables, and multivariable logistic regression to identify characteristics associated with receipt of surgery and chemotherapy. Kaplan–Meier analysis was used to compare overall survival rates. Cox Proportional Hazards regression was performed to identify factors associated with 5-year survival.

Results.—9016 ovarian cancer patients were included. 2638 had primary chemotherapy, 4854 had primary surgery, and 1524 had no treatment. 7653 (84.9%) were white, 572 (6.3%) black, 479 (5.3%) Hispanic, and 312 (3.5%) were of other race/ethnicity. More white patients (57.2%) received both chemotherapy and surgery compared to black (39.9%), Hispanic (48.9%), or other (54.2%) ($p < .001$). Receipt of either only surgery or chemotherapy, or receipt of neither, resulted in higher risk of death when compared to receipt of both. On multivariable analysis, black (OR 0.58 [0.46–0.73]) and Hispanic (0.69 [0.54–0.88]) patients were less likely to receive both chemotherapy and surgery. Being of black race was significantly correlated with worse overall survival [HR 1.13 (1.03–1.23); $p = .02$].

*Corresponding author at: 1155 Pressler Blvd, Suite CPB6.3271/Unit 1362, Houston, TX 77230, United States of America. lmeyer@mdanderson.org (L.A. Meyer).

Author contribution

Jolyn Taylor - preparation of manuscript and analysis of data; Weiguo He - preparation of manuscript and analysis of data; Hui Zhao - preparation of manuscript and analysis of data; Charlotte Sun - preparation of manuscript and analysis of data; Karen Lu - preparation of manuscript and analysis of data; Sharon Giordano - preparation of manuscript and analysis of data; Larissa Meyer - conception and design, preparation of manuscript and analysis of data.

Conflict of interest

Larissa A. Meyer and Charlotte C. Sun have research support from AstraZeneca. Larissa A. Meyer received an honorarium from Clovis Oncology for participation in an advisory board. The remaining authors have no conflicts of interest to disclose.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ygyno.2018.08.041>.

Conclusions.—Non-white women are less likely to receive the standard of care treatment for ovarian cancer and more likely to die from their disease than white women.

Keywords

Racial disparities; Ovarian cancer; Ovarian cancer treatment disparities

1. Introduction

Ovarian cancer is the fifth leading cause of cancer-related death among women in the United States and is the deadliest gynecologic malignancy [1]. This year, approximately 22,400 women will be diagnosed and 14,080 will die from this disease [1]. Similar to international trends, white women in the United States are more likely to be diagnosed with ovarian cancer, but non-white women have a higher mortality rate from the disease [2].

Most women diagnosed with ovarian cancer will present with advanced stage, either stage III or IV, disease [3,4]. National guidelines recommend primary treatment of ovarian cancer to include surgical staging and cytoreduction as well as systemic chemotherapy, either as adjuvant treatment or neoadjuvant therapy before surgery [5]. Disparities have been shown to exist in receipt of appropriate treatment between white and non-white patients [2,6–10]. Previous studies have demonstrated disparities in receipt of both chemotherapy and surgery [8,9,11,12].

The primary objective of this analysis was to determine the degree of correlation between race and receipt of optimal treatment with both chemotherapy and surgery. Our secondary objectives included: to identify other social and clinical variables that predicted receipt of nonstandard treatment; to evaluate the impact of non-standard treatment on overall survival; and to determine if race was independently associated with any difference in overall survival.

2. Materials and methods

2.1. Data

The Surveillance, Epidemiology, and End Results registry (SEER)-linked Medicare database was used in this retrospective population-based study. SEER is a population-based registry administered by the National Cancer Institute (NCI), which covers approximately 28% of the US population. Medicare claims provide health care services covered by Medicare. The linked database is a unique source of information which can be used for health services research. The linkage of SEER and Medicare claims is performed by the NCI and the Centers for Medicare and Medicaid Services [13]. Institutional Review Board approval was obtained prior to proceeding with this analysis.

2.2. Patient and tumor characteristics and treatment identification

Variables for sociodemographic status and tumor characteristics were collected from SEER. Education, poverty level, and income variables from the 2000 census tract data were used as surrogates of the socioeconomic status of patients. Comorbidity was estimated using

Klabunde-modified Charlson comorbidity score using claims in the 12 months prior to the diagnosis of ovarian cancer [14,15]. The receipt of surgery and chemotherapy was identified in Medicare claims data by using a combination of ICD-9 diagnosis codes, Common Procedural Terminology (CPT) codes, Healthcare Common Procedure Coding System (HCPCS) codes, and revenue center codes (Supplemental Table 1). The day of diagnosis for all patients was assigned the 15th of the month as SEER only reports the month and year of diagnosis.

Cohort selection is detailed in Supplemental Table 2, using SEER-Medicare data from 2002 to 2011, women older than 66 who were diagnosed with stage II or greater ovarian cancer were included for analysis. Patients with unclear histology, those diagnosed on autopsy, and those without Medicare Parts A and B continuously for twelve months before diagnosis were excluded.

2.3. Statistical analysis

Chi-square test for categorical variables or F test for continuous variables was used to compare patients' characteristics distributions. We used multivariable logistic regression to identify patient characteristics associated with receipt of surgery and chemotherapy. Kaplan-Meier analysis was used to compare the overall survival rates between treatment groups. Cox Proportional Hazards regression was performed to identify clinical or demographic prognostic factors associated with 5-year survival. To test the regression model for social and clinical variables associated with receipt of standard versus non-standard treatment, a Hosmer-Lemeshow goodness of fit test was performed. The variables included in the model were age, stage, histology, race, marital status, educational attainment, and comorbidity score. A p-value of 0.05 was considered to be significant. When applicable, all statistical tests performed were two-sided. SAS version 9.3 (SAS Institute, Cary, NC) was used to perform the statistical analysis.

3. Results

Between 2002 and 2011, there were 9016 patients with ovarian cancer identified who met inclusion criteria (Table 1). The majority of the patients were white, not married, resided in a large metropolitan area, had serous histology, and were stage III at diagnosis. Among all ovarian cancer patients, 7653 (84.9%) were white, 572 (6.3%) black, 479 (5.3%) Hispanic, and 312 (3.5%) were of other race or ethnicity.

A total of 5005 patients received standard treatment for ovarian cancer defined as receipt of both surgery and chemotherapy. Of our cohort, 53.8% (4854/9016) were initially treated with surgery, 29.3% (2638/9016) were initially treated with chemotherapy, and 16.9% (1524/9016) underwent no treatment. Of the patients initially treated with neoadjuvant chemotherapy, 39.8% (1050/2638) subsequently underwent interval surgery although the majority (60.2% [1588/2638]) did not. Of those who underwent primary surgical cytoreduction, 81.5% (3955/4854) went on to receive postoperative chemotherapy and 18.5% (899/4854) did not. Among this patient population, a higher percentage of white patient (57.2%) received both chemotherapy and surgery compared to black (39.9%), Hispanic (48.9%), or other (54.2%) ($p < .001$). There were no differences by race or

ethnicity found with regard to length of time between undergoing surgery and initiating chemotherapy or between completing neoadjuvant chemotherapy and undergoing surgery.

On multivariable analysis, non-white race remained significantly correlated with not receiving both chemotherapy and surgery (Table 2). The Hosmer Lemeshow goodness of fit test produced a p value of .17, suggesting that the regression model fit the data adequately. Compared to those patients of white race, black (OR 0.58 [0.46–0.73]), and Hispanic (0.69 [0.54–0.88]) patients were less likely to receive both chemotherapy and surgery. Other factors associated with not receiving both chemotherapy and surgery included being of older age, being unmarried, having a greater burden of comorbidities, having a lower educational level, being of more advanced stage, and having mucinous histology. Non-white women were observed to have a greater burden of comorbidities among women receiving both standard and non-standard treatment (Table 3). Among women who received standard treatment, a greater proportion of non-white women were observed to have modified Charlson comorbidity scores of ≥ 2 (black 17.1%; Hispanic 11.5%; other 12.4%, white 9.1%; Chi Square Test: $p < .0001$). The same was observed in women receiving nonstandard treatment (black 30.5%; Hispanic 29.4%; other 25.9%, white 20.9%; Chi Square Test: $p < .0001$). The median modified Charlson comorbidity score for black women was 1 whereas the median score was 0 for all other groups. Non-white patients who received both standard and non-standard treatment tended to be younger than white patients (Table 4).

In terms of oncologic outcomes, receipt of chemotherapy and surgery was associated with improved overall survival. Fig. 1 depicts the 5-year overall survival by treatment group. Women treated with both chemotherapy and surgery had the best 5-year survival rate (28.4%). Those who received neither treatment modality had the lowest 5-year survival (0.6%). Median length of overall survival for those patients who received both chemotherapy and surgery was 36.3 months, for those who received chemotherapy alone 10.0 months, for those who received surgery only 2.0 months and for those who received no treatment 1.2 months.

Table 5 reviews those factors found to be significantly associated with the survival outcome. Receipt of either only surgery or chemotherapy, or receipt of neither, resulted in higher risk of death when compared to receipt of both chemotherapy and surgery. Likewise, being of older age, having greater comorbidities, more advanced stage, larger tumor size, and higher grade tumor histology were associated with worse survival outcomes. Compared to serous histology, those patients with tumors of endometrioid histology had better survival and those with mucinous histology had worse survival. After controlling for all other factors, including receipt of adequate treatment with chemotherapy and surgery, being of black race remained significantly correlated with worse overall survival compared to white patients [HR 1.13 (1.03, 1.23); $p = .02$].

4. Discussion

Internationally and within the United States, there are disparities in receipt of optimal oncologic care and mortality between white and nonwhite women diagnosed with ovarian cancer [2,7–9,12,16–18]. Compared to white patients, black ovarian cancer patients have

been shown to be more likely to have dose reductions, treatment delays, early discontinuation of chemotherapy and worse survival [6]. These disparities have been suggested to originate from differences in underlying comorbidities, presentation at more advanced stages, and unequal access to treatment [2,7–10,18–20]. The “weathering” hypothesis has also been offered as a potential explanation for health disparities observed, particularly among the black population. The weathering framework argues that at least part of the health outcome disparity observed in black populations is a result of the cumulative physical and mental toll that results from socioeconomic marginalization that occurs over a lifetime [22–25]. In our analysis, we found that, after controlling for relevant factors such as year, age, stage, histology, comorbidities, socioeconomic status, and geographic region of residence, being of non-white race remained associated with not receiving the standard of care treatment for ovarian cancer, which includes a combination of chemotherapy and surgery.

Additional factors associated with receiving less than the accepted standard of care included being of older age, having worse overall health, presenting with advanced disease, having lower educational levels, and being unmarried. Being of older age, worse health, and having more advanced disease could all result in a patient being physically unable to receive the standard of care treatment with both chemotherapy and surgery. This same reasoning could explain why these factors were also associated with worse overall survival. Patients of lower educational levels and without the social support of a spouse may have greater difficulty navigating the healthcare system, leading to receipt of suboptimal care. Difficulty navigating a complex healthcare system may result in less than optimal treatment even with otherwise equal access to high-quality care [6].

Our analysis also found that, irrespective of the type and adequacy of the treatment received, patients of black race were more likely to die from their disease than white patients. Prior investigations using data from the 1980s through the 1990s found that black women with ovarian cancer were less likely to undergo surgical resection of their cancer and experienced shorter overall survival compared to white patients [12,17]. Our current analysis included more recent data related to patient care over the next decade from the previous studies yet found disappointingly similar results. For example, Chan et al. examined the SEER dataset for the years 1988 to 2001 found that black women had a higher risk of disease-related death as well as differences in the type of oncologic care received [10]. Our current analysis looking at the subsequent 10 years reveals an unfortunate persistence of these findings. This study also compliments the more recent findings of Bandera et al., who observed outcome and treatment disparities in black women using a large regional healthcare database. Their analysis was able to include granular data on treatment specifics. Our analysis would suggest that their findings may be generalizable on a national scale. Despite some published studies reporting little or no racial or ethnic disparities in ovarian cancer care or survival, the majority of published evidence raises the concern that there are on-going racial and ethnic disparities in ovarian cancer care [26–29]. Our analysis found that being of black race was not only associated with being less likely to receive standard of care treatment for ovarian cancer, which is strongly associated with worse overall survival, but we also found that being of black race was independently associated with worse overall survival even after controlling for the type of treatment received. Though the hazard ratio was larger with

regard to the type of treatment received, both treatment received and race were found to be significant factors affecting overall survival.

Our analysis offers indirect evidence to support the “weathering” hypothesis. To consider weathering in an oncologic context, the accumulated health comorbidities that result from weathering could lead disparity in both the treatment offered as well as tolerance to treatment received, both of which could lead to adverse outcomes in terms of survival. We observed that non-white patients had a greater burden of comorbidities entering treatment compared with whites. Additionally, the median age of black women who received non-standard therapy was 4 years younger than white women who received non-standard care, despite the difference in median age at diagnosis being only 1 year. Taken together, these may indirectly suggest that black women entered treatment in a worse state of health – or at least a provider-perceived worse state of health – than their similarly aged white counterparts. While an individual patient’s receipt of standard or non-standard care is certainly multifactorial, these observations could suggest that the weathering hypothesis explains part of the outcome disparities observed.

The findings of our analysis underscore the importance and the value of guideline-consistent cancer care [5]. The median overall survival in patients who received the standard of care was substantially improved compared to those who did not. Receipt of non-NCCN guideline-consistent care has previously been shown to be an independent predictor of diminished overall survival in women with ovarian cancer [21]. Additionally, non-NCCN guideline-consistent care has been associated with greater overall costs for the treatment of women with ovarian cancer [30]. Guideline-consistent care provides the definition of value in healthcare with both improved outcomes and lower costs. Adherence to these guidelines may be one strategy to overcome the disparities faced by non-white women with ovarian cancer [5]. Patients with poorer performance status may still be considered for treatment with neoadjuvant chemotherapy [31].

An inherent limitation of the current analysis is reliance on the validity of the cancer registry records. Though the cancer registry is verified and monitored for accuracy, any data entry process has the possibility for error. Other limitations, which affect most registry and claims data analyses, are the inability to determine the causation behind why a patient did not receive both chemotherapy and surgery as well as the capability to only analyze those variables available through the dataset [32]. Due to this inability to account for the causation, there is the possibility of confounding leading to bias in the results. The authors also acknowledge the difficulty of fully controlling for socioeconomic factors as related to race or ethnicity and the possible confounding that may occur. In addition, for the current analysis, the number and type of subsequent therapies that patients received following initial treatment were not accounted for and therefore could not be controlled for in this analysis. Given the significant proportion of patients that did not undergo surgery, it is possible that some may have a misdiagnosed primary cancer (e.g. uterine rather than ovarian). We are unable to ascertain to what extent this applies to this cohort, how this may have affected the outcomes assess, or if there were racial difference related to this. While administrative data sets tend to accurately identify people who identify as white or black, they tend to be less

accurate for patients with other backgrounds [33]. Finally, the authors recognize that selection bias is a limitation of most retrospective investigations.

A strength of this analysis was that the data included for analysis were drawn from a large sample size allowing for a robust statistical analysis. In addition, when assessing the impact of race on overall survival, the statistical model used controlled for the type of treatment received in order to avoid potential confounding. The patients included in this analysis came from the diverse treatment area included within SEER, potentially allowing for the results to be generalized on a broader scale than a smaller, single-institution investigation.

In conclusion, non-white women were less likely to receive the standard of care treatment for ovarian cancer and were more likely to die from their disease than white women. Treatment with both chemotherapy and surgery was associated with improved overall survival compared to either chemotherapy or surgery alone. Further investigation is needed in order to better understand the etiologies of these disparities in receipt of standard of care treatment of ovarian cancer among white and non-white women. In the interim, individual providers should seek to develop competency in health equity to recognize the pervasive nature of health inequalities and to make efforts to provide the same high quality standard of care to all patients [34]. With additional understanding of the causation behind these disparities, whether due to difficulty navigating the healthcare system, social barriers to receiving care or other, as yet unknown factors, hopefully progress can be made toward improving the survival disadvantage currently experienced by non-white patients facing ovarian cancer.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Financial support

This research was also supported in part by the National Institutes of Health through MD Anderson Cancer Center's Support Grant CA016672. Dr. Meyer was supported by the following grants: National Institutes of Health K07 CA201013 and Cancer Prevention Research Institute of Texas (CPRIT) RP140020. Dr. Taylor and Dr. Harrison were funded by the National Institutes of Health T32 CA101642 grant. The funding source had no direct role in preparing or reviewing this study nor this manuscript.

References

- [1]. Siegel RL, Miller KD, Jemal A, Cancer Statistics, 2017, *CA Cancer J. Clin* 67 (2017) 7–30. [PubMed: 28055103]
- [2]. Chornokur G, Amankwah EK, Schildkraut JM, et al., Global ovarian cancer health disparities, *Gynecol. Oncol* 129 (2013) 258–264. [PubMed: 23266352]
- [3]. LAG Y.J. Ries, in: Keel GE, Eisner MP, Lin YD, Horner M-J (Eds.), *SEER Survival Monograph: Cancer Survival Among Adults: U.S. SEER Program, 1988–2001, Patient and Tumor Characteristics*. National Cancer Institute, SEER Program, NIH Pub. No. 07–6215, Bethesda, MD, 2007.
- [4]. LAG E.M.K.C. Ries, Hankey BF, Miller BA, Clegg L, Edwards BK (Eds.), *SEER Cancer Statistics Review, 1973–1998*, National Cancer Institute, Bethesda, MD, 2001.

- [5]. Armstrong DPS, Alvarez R, et al.: NCCN Guidelines Index Ovarian Cancer (ed Version 2.2018), National Comprehensive Cancer Network, Inc.
- [6]. Bandera EV, Lee VS, Rodriguez-Rodriguez L, et al., Racial/Ethnic Disparities in Ovarian Cancer Treatment and Survival, *Clin. Cancer Res* 22 (2016) 5909–5914. [PubMed: 27521449]
- [7]. Terplan M, Smith EJ, Temkin SM, Race in ovarian cancer treatment and survival: a systematic review with meta-analysis, *Cancer Causes Control* 20 (2009) 1139–1150. [PubMed: 19288217]
- [8]. Harlan LC, Clegg LX, Trimble EL, Trends in Surgery and Chemotherapy for Women Diagnosed With Ovarian Cancer in the United States, *J. Clin. Oncol* 21 (2003) 3488–3494. [PubMed: 12972525]
- [9]. Parham GPJ, Hicks ML, Andrews N, Jones WB, Shingleton HM, Menck HR, The National Cancer Data Base report on malignant epithelial ovarian carcinoma in African-American women, *Cancer* 80 (8 15 1997) 816–826. [PubMed: 9264366]
- [10]. Chan JK, Zhang M, Hu JM, et al., Racial disparities in surgical treatment and survival of epithelial ovarian cancer in United States, *J. Surg. Oncol* 97 (2008) 103–107. [PubMed: 17979133]
- [11]. Bristow RE, Chang J, Ziogas A, et al., Spatial analysis of adherence to treatment guidelines for advanced-stage ovarian cancer and the impact of race and socioeconomic status, *Gynecol. Oncol* 134 (2014) 60–67. [PubMed: 24680770]
- [12]. Barnholtz-Sloan JS, Tainsky MA, Abrams J, et al., Ethnic differences in survival among women with ovarian carcinoma, *Cancer* 94 (2002) 1886–1893. [PubMed: 11920552]
- [13]. Warren J, Klabunde C, Schrag D, et al., Overview of the SEER-Medicare Data: Content, Research Applications, and Generalizability to the United States Elderly Population, *Med. Care* 40 (2002) 3–18.
- [14]. Klabunde C, Potosky A, Legler J, et al., Development of a comorbidity index using physician claims data, *J. Clin. Epidemiol* 53 (2000) 1258–1267. [PubMed: 11146273]
- [15]. Klabunde C, Harlan L, Warren J, Data sources for measuring comorbidity: a comparison of hospital records and medicare claims for cancer patients, *Med. Care* 44 (2006) 921–928. [PubMed: 17001263]
- [16]. McGuire V, Jessor CA, Whittemore AS, Survival among U.S. Women with Invasive Epithelial Ovarian Cancer, *Gynecol. Oncol* 84 (2002) 399–403. [PubMed: 11855877]
- [17]. Kim S, Dolecek TA, Davis FG, Racial differences in stage at diagnosis and survival from epithelial ovarian cancer: A fundamental cause of disease approach, *Soc. Sci. Med* 71 (2010) 274–281. [PubMed: 20483517]
- [18]. Wright JD, Doan T, McBride R, et al., Variability in chemotherapy delivery for elderly women with advanced stage ovarian cancer and its impact on survival, *Br. J. Cancer* 98 (2008) 1197–1203. [PubMed: 18349836]
- [19]. Morris CR, Sands MT, Smith LH, Ovarian cancer: predictors of early-stage diagnosis, *Cancer Causes Control* 21 (2010) 1203–1211. [PubMed: 20364367]
- [20]. Merrill RM, Anderson AE, Merrill JG, Racial/ethnic differences in the use of surgery for ovarian cancer in the United States, *Adv. Med. Sci* 55 (2010) 93–98. [PubMed: 20513643]
- [21]. Bristow RE, Powell MA, Al-Hammadi N, et al., Disparities in ovarian cancer care quality and survival according to race and socioeconomic status, *J. Natl. Cancer Inst* 105 (2013) 823–832. [PubMed: 23539755]
- [22]. Geronimus AT, Understanding and eliminating racial inequalities in women's health in the United States: the role of the weathering conceptual framework, *J. Am. Med. Womens Assoc* (1972) 56 (2001) 133–136 (149–50).
- [23]. Geronimus AT, Hicken M, Keene D, et al., “Weathering” and age patterns of allostatic load scores among blacks and whites in the United States, *Am. J. Public Health* 96 (2006) 826–833. [PubMed: 16380565]
- [24]. Geronimus AT, The weathering hypothesis and the health of African-American women and infants: evidence and speculations, *Ethn. Dis* 2 (1992) 207–221. [PubMed: 1467758]
- [25]. Cunningham TJ, Croft JB, Liu Y, et al., Vital Signs: Racial Disparities in Age-Specific Mortality Among Blacks or African Americans - United States, 1999–2015, *MMWR Morb. Mortal. Wkly Rep* 66 (2017) 444–456. [PubMed: 28472021]

- [26]. Cress RD, O'Malley CD, Leiserowitz GS, et al., Patterns of Chemotherapy Use for Women With Ovarian Cancer: A Population-Based Study, *J. Clin. Oncol* 21 (2003) 1530–1535. [PubMed: 12697877]
- [27]. Jordan S, Steer C, DeFazio A, et al., Patterns of chemotherapy treatment for women with invasive epithelial ovarian cancer – A population-based study, *Gynecol. Oncol* 129 (2013) 310–317. [PubMed: 23403164]
- [28]. Mahdi H, Jernigan A, Lockhart D, et al., Racial Disparity in 30-Day Morbidity and Mortality After Surgery for Ovarian Cancer, *Int. J. Gynecol. Cancer* 25 (1) (2015) 55–62.
- [29]. Du XL, Sun CC, Milam MR, et al., Ethnic differences in socioeconomic status, diagnosis, treatment, and survival among older women with epithelial ovarian cancer, *Int. J. Gynecol. Cancer* 18 (2008) 660–669. [PubMed: 17892451]
- [30]. Urban RR, He H, Alfonso-Cristancho R, et al., The Cost of Initial Care for Medicare Patients With Advanced Ovarian Cancer, *J. Natl. Compr. Cancer Netw* 14 (2016) 429–437.
- [31]. Takaya H, Nakai H, Murakami K, et al., Efficacy of weekly administration of paclitaxel and carboplatin for advanced ovarian cancer patients with poor performance status, *Int. J. Clin. Oncol* 23 (2018) 698–706. [PubMed: 29572761]
- [32]. Reeder-Hayes KE, Troester MA, Meyer AM, Reducing Racial Disparities in Breast Cancer Care: The Role of 'Big Data', *Oncology (Williston Park)* 31 (10) (2017) 756–762. [PubMed: 29083467]
- [33]. Waldo DR, Accuracy and Bias of Race/Ethnicity Codes in the Medicare Enrollment Database, *Health Care Financ. Rev* 26 (2004) 61–72. [PubMed: 25371985]
- [34]. Temkin SM, Rimel BJ, Bruegl AS, et al., A contemporary framework of health equity applied to gynecologic cancer care: A Society of Gynecologic Oncology evidenced-based review, *Gynecol. Oncol* 149 (2018) 70–77. [PubMed: 29605053]

HIGHLIGHTS

- Racial disparities exist among women receiving treatment for ovarian cancer.
- Non-white women are less likely to receive both surgery and chemotherapy to treat ovarian cancer than white women.
- Non-white women are more likely to die from ovarian cancer than white women.

Fig. 1.
Five-year overall survival.

Table 1

Patient characteristics.

Characteristics ^a	Treatment group			p-Value	Total, n (%)
	Chemotherapy only, n (%)	Chemotherapy and surgery, n (%)	No chemotherapy or surgery, n (%)		
Patients					
Age at diagnosis (years)					
66–70	248 (15.6)	1623 (32.4)	156 (10.2)	<.0001 ^b	2138 (23.7)
71–75	288 (18.1)	1440 (28.8)	180 (11.8)		2083 (23.1)
76–80	400 (25.2)	1213 (24.2)	324(21.3)		2145 (23.8)
80+	652 (41.1)	729 (14.6)	864 (56.7)		2650 (29.4)
Mean (SD)	78.4± 6.7	74.1 ± 5.6	81.4 ± 7.4	<.0001 ^c	76.6 ± 6.9
Year of diagnosis					
2002	186 (11.7)	552 (11.0)	139 (9.1)	0.10 ^b	985 (10.9)
2003	169 (10.6)	574(11.5)	162 (10.6)		1012 (11.2)
2004	158 (9.9)	518 (10.3)	161 (10.6)		951 (10.5)
2005	146 (9.2)	522 (10.4)	170 (11.2)		917 (10.2)
2006	176 (11.1)	544 (10.9)	148 (9.7)		973 (10.8)
2007	157 (9.9)	455 (9.1)	164(10.8)		857 (9.5)
2008	156 (9.8)	517 (10.3)	148 (9.7)		920 (10.2)
2009	147 (9.3)	469 (9.4)	134 (8.8)		815 (9.0)
2010	151 (9.5)	430 (8.6)	157 (10.3)		809 (9.0)
2011	142 (8.9)	424 (8.5)	141 (9.3)		777 (8.6)
Comorbidity index					
0	869 (54.7)	3515 (70.2)	747 (49.0)	<.0001 ^b	5638 (62.5)
1	412 (25.9)	1037 (20.7)	390 (25.6)		2066 (22.9)
2	307 (19.3)	453 (9.1)	387 (25.4)		1312 (14.6)
Marital status at diagnosis					
Married	549 (34.6)	2454 (49.0)	397 (26.0)	<.0001 ^b	3690 (40.9)
Unknown	49 (3.1)	149 (3.0)	64 (4.2)		300 (3.3)

Characteristics ^a	Treatment group			p-Value	Total, n (%)
	Chemotherapy only, n (%)	Chemotherapy and surgery, n (%)	No chemotherapy or surgery, n (%)		
Not married	990 (62.3)	2402 (48.0)	1063 (69.8)		5026 (55.7)
Race/ethnicity				<.0001 ^b	
African American, non-Hispanic	134 (8.4)	228 (4.6)	157 (10.3)		572 (6.3)
Hispanic	97 (6.1)	234 (4.7)	100 (6.6)		479 (5.3)
Other/unknown	55 (3.5)	169 (3.4)	56 (3.7)		312 (3.5)
White, non-Hispanic Region	1302 (82.0)	4374 (87.4)	1211 (79.5)		7653 (84.9)
Region				<.0001 ^b	
Midwest	235 (14.8)	533 (10.6)	247 (16.2)		1122 (12.4)
Northeast	378 (23.8)	1084(21.7)	307 (20.1)		1968 (21.8)
South	362 (22.8)	1251 (25.0)	377 (24.7)		2251 (25.0)
West	613 (38.6)	2137 (42.7)	593 (38.9)		3675 (40.8)
Area of residence				0.0027 ^b	
Large metropolitan	906 (57.1)	2685 (53.6)	815 (53.5)		4865 (54.0)
Metropolitan	458 (28.8)	1488 (29.7)	437 (28.7)		2639 (29.3)
Urban	86 (5.4)	322 (6.4)	84 (5.5)		552 (6.1)
Less urban	104 (6.5)	416 (8.3)	151 (9.9)		770 (8.5)
Rural	34(2.1)	94 (1.9)	37 (2.4)		190 (2.1)
Census tract percent below poverty (Census 2000), mean (SD)	11.0± 9.4	10.1 ± 8.6	12.0 ± 9.9		10.7 ± 9.1
Census tract median income (Census 2000), mean (SD) (US\$)	51,206.4 ± 24,456.5	53,112.7 ± 24,805.4	48,357.0 ± 23,493.6		51,452.1 ±
Census tract percent non-high school graduates (Census 2000), mean (SD)	18.5 ± 12.6	16.8 ± 12.0	19.7 ± 13.1		17.9 ± 12.4
<i>Tumor</i>				<.0001 ^c	
Histology groupings				<.0001 ^b	
Clear cell and endometrioid	27 (1.7)	406 (8.1)	22 (1.5)		545 (6.1)
Mucinous	45 (2.8)	97 (1.9)	64 (4.2)		275 (3.1)
Other adenocarcinomas	1083 (68.2)	857 (17.1)	1101 (72.2)		3219 (35.7)
Serous	433 (27.3)	3645 (72.8)	337 (22.1)		4977 (55.2)

Characteristics ^a	Treatment group			p-Value	Total, n (%)
	Chemotherapy only, n (%)	Chemotherapy and surgery, n (%)	No chemotherapy or surgery, n (%)		
AJCC stage				<.0001 ^b	
Stage II	44 (2.8)	482 (9.6)	48 (3.1)		688 (7.6)
Stage III	465 (29.3)	2884 (57.6)	336 (22.0)		4094 (45.4)
Stage IV	872 (54.9)	1443 (28.8)	869 (57.0)		3494 (38.8)
Unstaged	207 (13.0)	196 (3.9)	271 (17.8)		740 (8.2)

^aNot all values add up to 100% secondary to missing values and rounding.

^bp-values are determined using Chi-squared comparing differences among four treatment groups.

^cp-values are using Fiest comparing means among four treatment groups.

Table 2

Multivariable analysis of factors associated with receipt of surgery and chemotherapy.

Characteristics	Odds ratio	95% CI	p-Value
Age at diagnosis (years)			<.0001
66–70	1.00	(Referent)	
71–75	0.72	(0.62, 0.84)	
76–80	0.44	(0.38, 0.51)	
81	0.13	(0.11, 0.16)	
Marital status			<.0001
Married	1.00	(Referent)	
Unmarried	0.76	(0.68, 0.84)	
Unknown	0.85	(0.63, 1.15)	
Race			<.0001
White (non-Hispanic)	1.00	(Referent)	
African American (non-Hispanic)	0.56	(0.45, 0.70)	
Hispanic	0.68	(0.54, 0.86)	
Other/unknown	0.75	(0.56, 0.99)	
Comorbidity index			<.0001
0	1.00	(Referent)	
1	0.70	(0.62, 0.79)	
2	0.42	(0.36, 0.48)	
% who did not graduate from high school (Census 2000)			<.0001
1st quartile (lowest)	0.87	(0.75, 1.01)	
2nd quartile	0.80	(0.69, 0.93)	
3rd quartile	0.67	(0.58, 0.79)	
4th quartile (highest)	0.87	(0.75, 1.01)	
AJCC stage			<.0001
II	1.00	(Referent)	
III	0.83	(0.68, 1.03)	
IV	0.30	(0.25, 0.38)	
Unstaged	0.21	(0.16, 0.28)	

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Characteristics	Odds ratio	95% CI	p-Value
Histology groupings			<.0001
Serous	1.00	(Referent)	
Mucinous	0.30	(0.22, 0.41)	
Endometrioid	0.89	(0.67, 1.19)	
Clear cell	0.83	(0.56, 1.24)	
Other adenocarcinomas	0.26	(0.23, 0.29)	

Table 3

Klabunde-modified Charlson comorbidity stratified by race and treatment received.

Race	Standard treatment				Non-standard treatment				Total cohort			
	Modified Charlson score				Modified Charlson score				Modified Charlson score			
	0	1	2		0	1	2		Mean	Median		
	N	%	N	%	N	%	N	%	N	%	N	%
Black	130	57.0	59	25.9	39	17.1	145	42.2	94	27.3	105	30.5
Hispanic	141	60.3	66	28.2	27	11.5	118	48.2	55	22.4	72	29.4
Other	110	65.1	38	22.5	21	12.4	59	41.3	47	32.9	37	25.9
White	3071	70.2	906	20.7	397	9.1	1740	53.1	854	26.0	685	20.9
	Chi Square Test: p < .0001				Chi Square Test: p < .0001				Chi Square Test: p < .0001			

Table 4

Patient age stratified by race and treatment received.

	<u>Standard treatment</u>			<u>Non-standard treatment</u>			<u>Total cohort</u>		
	Median age, years	IQR		Median age, years	IQR		Median age, years	IQR	
Black	72.0	69.0	77.0	77.0	72.0	83.0	75.0	70.0	81.0
Hispanic	72.0	69.0	76.0	78.0	72.0	84.0	74.0	70.0	80.0
Other	73.0	69.0	77.0	78.0	73.0	83.0	75.0	70.0	79.0
White	74.0	70.0	78.0	81.0	75.0	85.0	76.0	71.0	82.0
	p < .0001			p < .0001			p < .0001		

IQR = interquartile range.

Table 5

Multivariable analysis of factors associated with overall survival.

Characteristics	Hazard ratio	95% CI ^b	p-Value ^a
Treatment group			<.0001
Chemotherapy and surgery	1.00	(Referent)	
Surgery only	4.74	(4.37, 5.14)	
Chemotherapy only	1.96	(1.82,2.11)	
No treatment	7.09	(6.55,7.68)	
Age at diagnosis (years)			<.0001
66–70	1.00	(Referent)	
71–75	1.09	(1.02,1.17)	
76–80	1.14	(1.07,1.22)	
81	1.29	(1.20,1.39)	
Race			.02
White, non-Hispanic	1.00	(Referent)	
Black, non-Hispanic	1.13	(1.03,1.23)	
Hispanic	0.96	(0.87,1.06)	
Other/unknown	0.91	(0.80,1.03)	
Marital status			<.0001
Married	1.00	(Referent)	
Unmarried	1.09	(1.04,1.14)	
Unknown	0.86	(0.77 1.05)	
Comorbidity index			<.0001
0	1.00	(Referent)	
1	1.14	(1.08,1.20)	
2	1.35	(1.26,1.44)	
AJCC stage			<.0001
Stage II	1.00	(Referent)	
Stage III	2.25	(2.03, 2.50)	
Stage IV	2.75	(2.47, 3.07)	
Unstaged	2.03	(1.79, 2.30)	
Histology groupings			<.0001
Serous	1.00	(Referent)	
Mucinous	1.32	(1.16,1.51)	
Endometrioid	0.82	(0.73, 0.93)	
Clear cell	0.91	(0.76,1.10)	
Other adenocarcinomas	1.13	(1.07,1.19)	

^a p-Values are based on Wald chi-squared test.^b Indicates confidence interval.