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Systematic Review

SYSTEMATIC REVIEW

Race, Socioeconomic Status, and Health-Care Access Disparities in Ovarian Cancer Treatment and Mortality: Systematic Review and Meta-Analysis

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Abstract

Background: Ovarian cancer remains a leading cause of death from gynecological malignancies. Race, socioeconomic status (SES), and access to health care are important predictors of quality treatment and survival. We provide a systematic review and meta-analysis on the role of these predictors on disparities in ovarian cancer treatment and mortality.
Methods: Using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, we searched PubMed, EMBASE, and Scopus for relevant articles published between January 2000 and March 2017. We selected studies published in the United States that evaluated the role of race, SES, or health-care access on disparities in ovarian cancer treatment or survival. Pooled relative risk (RR) and 95% confidence intervals (CIs) were calculated for each outcome using a random-effects model.
Results: A total of 41 studies met the inclusion criteria for systematic review. In meta-analysis, there was a 25% decrease (RR = 0.75, 95% CI = 0.66 to 0.84) in receipt of adherent ovarian cancer treatment and 18% increased risk (RR = 1.18, 95% CI = 1.11 to 1.26) of mortality for blacks compared to whites. Receipt of adherent ovarian cancer treatment was 15% lower (RR = 0.85, 95% CI = 0.77 to 0.94) in the lowest vs highest SES group and 30% lower (RR = 0.70, 95% CI = 0.58 to 0.85) among patients at lower vs higher hospital volumes.
Conclusion: We found consistent and strong evidence for continued lack of quality ovarian cancer treatment and higher mortality among ovarian cancer patients who are black, are of low SES, and/or have poor access to care. Interventions focused on these groups targeting specific barriers to care are needed to reduce disparities in ovarian cancer treatment and mortality.

Ovarian cancer is the fifth leading cause of cancer-related deaths in the United States and the most common type of gynecological cancer (1,2). Lack of definitive symptoms and effective screening strategies often results in late-stage diagnosis and relatively low 5-year survival rates (3,4). Although ovarian cancer survival has improved modestly over the past few decades, data from the Surveillance, Epidemiology, and End Results registry show that marked racial disparities exist. Five-year survival for white ovarian cancer patients increased from 33% to 47% between 1975 and 2010, but decreased from 44% to 36% in black ovarian cancer patients in the same period (1,5); statistically significant but more modest survival gaps have also been reported among Hispanic (6–8) and Asian (6,9–11) women relative to white women.

This marked racial disparity is likely due to differential access to guideline-adherent treatment, an important determinant of survival (7,9,12). Several studies have documented socioeconomic (10,13) and access to health-care disparities in use of ovarian cancer care (6,11,12,14,15). Notably, among black

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and white patients who received similar guideline-adherent treatment, there were no racial differences in survival outcomes observed (16), suggesting that disparities in access to quality treatment is a key driver of ovarian cancer survival disparities. Factors associated with receipt of quality treatment, defined based on the National Comprehensive Cancer Network guidelines, and survival likely exist and may have differential impact across individual, neighborhood, and health-systems levels and may be modifiable to eliminate persistent disparities in ovarian cancer outcomes. Although multiple studies have reported disparities in ovarian cancer treatment and survival because of race, socioeconomic status (SES), or health-care access, there are currently no systematic reviews or meta-analyses of the literature that synthesize key findings to identify gaps for future research.

The goal of this review is to synthesize the current scientific evidence regarding the role of race, SES, and access to care on ovarian cancer treatment and survival, to generate summary estimates of the associations across studies, and to highlight key gaps that may inform future research and interventions to eliminate the persistent and widening gap in ovarian cancer survival among US women.

Methods

Literature Search

This systematic review and meta-analysis was conducted following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Supplementary Figure 1, available online) (17). Published articles between January 2000 and March 2017 were identified through searches in PubMed, Scopus, and EMBASE. The search strategy identified publications focused on 1) ovarian neoplasms and permutations and abbreviations of relevant MeSH (Medical Subject Headings) and non-MeSH key terms for 2) health disparities due to race, socioeconomic factors or health-care access, and 3) treatment, surgery, therapy, mortality, and survival. The search was restricted to articles published in the English language within the United States, given the focus on health disparities and likelihood that the context of disparities may vary across countries. The complete search strategy is included in Supplementary Appendix 1 (available online).

Study Eligibility

Inclusion criteria for the selected studies were 1) ovarian cancer treatment and/or survival outcomes were evaluated, 2) disparities in ovarian cancer outcomes were examined, and 3) specific exposures (eg, race, access to care, SES, insurance, hospital characteristics, and/or physician volume) were assessed. Studies were excluded if published in languages other than English, included outcomes other than ovarian cancer treatment and survival, or were missing key study estimates. There were no age or race and/or ethnicity exclusions.

Article Selection

Two authors (SK, MEF) reviewed titles, abstracts, and full text of all studies retrieved from electronic databases. Discrepancies in selection were resolved by consensus, and disagreements were resolved in consultation with a third author (TA). The search strategy yielded 828 articles, leaving 718 articles after duplicates were removed; 520 articles were removed after title review, and 99 articles were removed after abstract review, leaving 89 articles for full-text review. Of these, 31 articles were deemed relevant and included in the systematic review and meta-analysis. An additional 19 articles were identified from searching the references of included articles, and 10 of these were deemed relevant, bringing the total number of articles included in the review to 41. Articles were excluded if missing information on disparities or relevant study outcomes, and/or they did not use primary data.

Data Extraction

One author (SK) abstracted relevant information regarding study characteristics and results from the included articles and entered this information into a prepopulated study database. Another author (MEF) independently reviewed and verified the accuracy of data collected via cross-reference with the original articles. Any discrepancies were discussed and resolved by consensus, and disagreements were resolved in consultation with a third author (TA). The study database included information on study characteristics such as study design, year, data source, and sample size. Detailed information was collected regarding study design, treatment (guideline therapy, surgery, chemotherapy, radiation, pharmacologic, none), survival/mortality, race, insurance status, SES measures (SES score, education, income, poverty, neighborhood disadvantage), health-care access measures (hospital and physician volume, hospital type), and covariates included in analysis. Measures of association from fully adjusted multivariable models in each publication, such as odds ratio (OR), relative risk (RR), or hazard ratios (HR) with 95% confidence intervals (CIs) were recorded.

Statistical Analysis

Odds ratios and relative risks for treatment received and odds ratios or hazard ratios for survival/mortality comparing the most extreme (eg, highest vs lowest) categories were extracted. To ensure consistency in meta-analysis, ratio measures were inverted to ensure reference categories matched across studies where appropriate, and when necessary, odds and hazard ratios were transformed to approximate the relative risk. Meta-analysis of summary estimates was conducted separately for each exposure and outcomes evaluated when at least three articles with unique source populations evaluated the exposure-outcome combination. Studies with duplicate populations and the same exposure-outcome definitions were excluded from meta-analysis estimates. The exposure-outcomes definitions were 1) race with treatment receipt and survival/mortality, 2) SES with treatment and survival/mortality, 3) insurance status with treatment receipt, 4) hospital characteristics with treatment receipt, and 5) comorbidities with treatment receipt and survival/mortality. Summary estimates and 95% confidence intervals were evaluated for each exposure and outcome, and random-effects models were used to pool the estimated effect to account for potential heterogeneity between the studies. Heterogeneity across studies was assessed using the I^2 statistic (17,18), and publication bias was assessed using the Egger and Begg tests (19,20). All analyses were conducted using STATA version 15 (Stata Corp LLC, College Station, TX).

Results

Of the 828 articles identified from database searches and 19 identified from review of reference lists, 41 studies were

included in the final systematic review. The selection process is outlined in Supplementary Figure 1 (available online), and characteristics of included studies are summarized in Table 1. Of the 41 studies included, 22 examined ovarian treatment outcomes (7–11,13,14,21–35), and 26 studies examined ovarian cancer survival or mortality outcomes (5,9,13–15,26,27,30,34–51). Among the studies that examined treatment, four studies evaluated the receipt of chemotherapy (22,24,26,28), eight studies examined surgical therapy (6,8,21,25,30,31,33,35), and 11 studies examined receipt both of surgery and chemotherapy based on recommended guidelines (7,9–11,13,22,27,29,32–34). Most (n = 21) of the studies included were published between 2011 and 2016 (5,7–11,13,14,30–34,43–48,50,51), 16 studies were published in 2006–2010 (6,15,21,24–29,35,37–42), and four studies were published between 2000 and 2005 (22,23,36,49). Included studies used a variety of data sources: Eighteen analyzed data from national cancer databases (eg, Surveillance, Epidemiology, and Ends Results, National Cancer Database) (5,7,9,13,15,21–24,27,30,34,36,40,42–45), seven studies used hospital database data (25,28,31,35,38,41,48), 14 studies used state registry data (6,8,10,11,14,26,29,32,33,37,46,47,49,51), and two studies used primary data (39,50). A total of 39 studies assessed predictors of ovarian cancer outcomes at the patient level (eg, race, insurance), 16 studies assessed predictors at the residential level (eg, neighborhood poverty) (7,9–11,13,15,21,23–25,27,32,41,46,47,51), and 17 studies assessed access to health care or health-care characteristics (eg, hospital volume, physician volume, and distance to care) (6–8,10,11,13–15,24–26,31,32,34,35,37,51). A majority (n = 38) of included studies evaluated race as a predictor of ovarian cancer treatment and/or mortality outcome, and 16 studies evaluated SES as a composite score or based on income, education, residence, poverty, or neighborhood disadvantage (7,9–11,13,15,21,23–25,27,32,41,46,47,51). A total of 14 studies evaluated insurance status (6–8,10,13,15,22,24,28,32,34,38,41,51), and 11 studies evaluated comorbidities (7–9,21–23,27,28,34,45,49). A detailed summary of each study and main findings are presented in the Supplementary Table 1 (available online).

Race and Ovarian Cancer Treatment

A total of 22 studies examined racial disparities in ovarian cancer treatment receipt: 21 among whites (6–11,13,21–25,27–35), 18 studies among blacks (6–11,13,22–25,27,29–33,35), 11 among Hispanics (6–11,22,23,25,30,32), seven among Asians/Pacific Islanders (6,9–11,25,30,32), and eight among other races or in unspecified racial groups (6,9,21,23–25,28,34). Of the 18 studies that included black patients, 16 observed lower likelihood of treatment compared to whites or other races (6–10,13,23–25,27,29–33,35), although three studies were not statistically statistically significant (10,23,30), and one study observed that blacks had 4% higher odds of receiving neoadjuvant chemotherapy and surgery (11). Four studies also observed that black patients were significantly more likely to receive treatment that was nonadherent to National Comprehensive Cancer Network guidelines (9,10,13,32). Of the 11 studies that examined Hispanic patients (6–11,22,23,25,30,32), seven found a lower likelihood of receiving treatment compared with whites or other races (6–10,23,25), with two of the studies not statistically significant (9,10), whereas two studies observed that Hispanic patients were more likely to receive treatment (30,32), and Long et al. (11) reported Hispanics were more likely to receive neoadjuvant chemotherapy and surgery. Of the studies examining Asian and Pacific Islander patients (6,9–11,25,30,32), four observed a lower likelihood of treatment compared with whites (6,9,25,32), with three of the four studies statistically nonsignificant (6,9,32), whereas two studies found higher likelihood of treatment (10,11), both not statistically significant. In meta-analysis of 16 studies including 175 350 patients (Figure 1), compared to white patients, there was a significant 25% decrease (RR = 0.75, 95% CI = 0.66 to 0.84; I^2 = 85.0%; $P < .001$) in receipt of ovarian cancer treatment in black patients, a statistically nonsignificant 9% decrease (RR = 0.91, 95% CI = 0.82 to 1.01, I^2 = 88.2%; $P < .001$) among Hispanic patients, and no association observed for Asian and Pacific Islander patients. There was evidence of publication bias (Egger test: −1.39, $P = .01$; Begg test: 0.49, $P = .62$).

Race and Ovarian Cancer Survival and/or Mortality

A total of 22 studies examined racial disparities in ovarian cancer survival and/or mortality (5,9,13,15,26,27,30,34,36,38–48,50,51): All except one (34) included data on black patients, six studies included Hispanics (9,15,26,30,48,51), and six studies included Asian and Pacific Islanders (5,9,26,30,48,51). Of the studies evaluating black patients, 15 observed higher ovarian cancer mortality among blacks compared with whites or other races (13,15,30,36,39–48,51), with 10 of these being statistically significant (13,15,36,39,41–44,46,51), whereas one result was statistically significant only among a subset of patients who received chemotherapy (48). Among studies evaluating Hispanics and Asian patients, none observed statistically significant differences in mortality outcomes compared with whites or other races. In meta-analysis of 16 studies with 190 107 patients (Figure 2), there was a significant 18% increased risk of mortality among black patients (RR = 1.18, 95% CI = 1.11 to 1.26, I^2= 74.9%; $P < .001$) and no association found among Hispanics (RR = 0.96, 95% CI = 0.84 to 1.10, I^2 =50.6%; $P = .108$) compared with whites or other races. There was evidence of between-study heterogeneity in studies evaluating mortality outcomes by race, but no evidence of publication bias (Egger test: −0.26, $P = .79$; Begg test: 0.61, $P = .54$).

SES and Ovarian Cancer Outcomes

Of the 16 studies that evaluated SES and ovarian cancer outcomes, 11 studies examined treatment outcomes (7,9–11,13,21,23–25,27,32) and eight studies examined survival/mortality outcomes (9,13,15,27,41,46,47,51). Five studies evaluated SES as a composite score (10,11,27,32,51), eight studies evaluated income or poverty percentage (7,9,13,15,21,24,25,41), two studies evaluated neighborhood disadvantage (46,47), one study evaluated affluence (46), one study evaluated residence in a metropolitan location (23), and four studies evaluated education as a measure of SES (13,21,24,41). All SES variables were assessed at the area level, and several studies used multiple measures of SES, whereas four studies used only one variable (7,15,23,25). Of the 11 studies that evaluated receipt of appropriate treatment, the majority (n = 8) observed that low SES was associated with reduced treatment compared to high SES (9,10,13,21,24,25,27,32). Eight studies evaluated the association between SES and ovarian cancer survival; of these, five studies observed that at least one measure of SES was inversely associated with risk of mortality (13,15,27,46,47,51). Bristow et al. (9) observed that among patients who received nonadherent treatment, lowest SES was associated with higher likelihood of mortality. In meta-analyses of 10 studies with 130 801 patients (Figure 3), there was a statistically significant 15% decrease in

Table 1. Summary statistics for studies included after full-text review (n = 41)

Study characteristics	No. of studies (n = 41)	Treatment (n = 22)	Survival/ Mortality (n = 26)
Publication years			
2000–2005	4	2	2
2006–2010	16	9	10
2011–2016	21	11	15
Data source			
National cancer database (eg, SEER, NCDB)*	18	10	13
Hospital database	7	4	4
State registry data	14	8	7
Primary data	2	0	2
Exposure of interest			
Race	38	21	22
White	37	21	21
Black	35	18	21
Hispanics	15	11	6
Asians	11	7	6
Other	8	8	2
SES	16	11	8
Income/Poverty	8	6	4
Education	4	3	2
Composite SES	5	4	2
Neighborhood disadvantage/ Affluence	2	0	2
Insurance	14	9	6
Comorbidity	11	9	3
Hospital characteristics	17	13	7
Hospital volume	11	8	5
Physician volume	10	7	3
Hospital type	3	3	1
Distance to care	2	1	1
Level of assessment			
Patient	39	22	24
Residential	16	11	8
Health care	17	13	8

*NCDB = National Cancer Database; SEER = Surveillance, Epidemiology, and End Results; SES = socioeconomic status.

receipt of ovarian cancer treatment comparing the lowest SES with the highest SES category (RR = 0.85, 95% CI = 0.77 to 0.94, I^2 = 82.7%; $P < .001$). In a meta-analysis of seven studies with 78 061 patients (Figure 3), lower SES was associated with a 10% increased risk of mortality (RR = 1.10, 95% CI = 1.03 to 1.18, I^2 = 80.5%; $P < .001$). There was evidence of statistically significant heterogeneity between studies of SES and treatment and mortality outcomes, however, there was no evidence of publication bias (Egger test: -1.28 $P = .16$; Begg test: −1.25, $P = .22$).

Insurance and Ovarian Cancer Outcomes

A total of 14 studies examined the association between health insurance status and ovarian cancer outcomes. Of the 14 studies, nine assessed treatment (6–8,10,13,22,24,28,32) and six assessed survival and/or mortality outcomes (13,15,34,38,41,51). Four of the nine studies evaluating receipt of treatment showed that uninsured and/or public insurance patients had lower likelihood of treatment (7,10,13,32) compared with patients with private insurance. Harlan et al. (22) observed that blacks and Hispanics with private insurance had a higher likelihood of receiving guideline-adherent treatment compared with women with public insurance, no insurance, or unknown insurance, whereas Liu et al. (8) observed that patients with public insurance had a lower likelihood of receiving hysterectomy and lymphadenectomy. Chase et al. (28) reported that women with public insurance (Medicaid, Medicare, or none) were more likely to receive neoadjuvant chemotherapy, whereas Polsky et al. (24) did not observe an association between health maintenance organization penetration and receipt of chemotherapy. Of the six studies that assessed survival or mortality outcomes, three observed higher mortality among patients who were uninsured or on public insurance (13,15,34), two did not observe any statistically significant difference by insurance status (38,51), and Kim et al. (41) did not find any association between proportion of Medicaid patients and survival. Bristow et al. (13) reported a 32% higher risk of mortality among uninsured or self-pay patients compared with private insurance, whereas in a separate analysis, Bristow et al. (15) observed that being uninsured was associated with a 19% increased mortality. In a meta-analysis of five studies and 103 477 patients for Medicaid, six studies and 111 410 patients for Medicare, and eight studies and 112 734 patients for other insurance statuses (Figures 4 and 5), compared with patients on private insurance, there was a 10% decrease in treatment receipt among patients with Medicare compared to private insurance or managed care (RR = 0.90, 95% CI = 0.82 to 0.97, $I^2 = 89.7\%$; $P < .001$) and a 12% decrease in treatment receipt among patients who are uninsured self-paying, on public insurance, or other insurance compared with private insurance (RR = 0.88, 95% CI = 0.83 to 0.94). Medicaid patients had a nonstatistically significant decreased risk of treatment receipt. There was evidence of statistically significant heterogeneity between studies, but there was no publication bias detected (Egger test: −1.4, $P = .19$; Begg test: −0.66, $P = .53$; and Egger test: −0.40 $P = .45$; Begg test: −0.45 $P = .65$, respectively). There were not enough studies with unique populations to conduct a meta-analysis for insurance status and ovarian cancer mortality outcomes.

Hospital Characteristics and Ovarian Cancer Outcomes

Of the 17 studies that evaluated hospital characteristics and ovarian cancer outcomes, 13 studies evaluated treatment outcomes (6–8,10,11,13,24–26,31,32,34,35) and seven evaluated survival/mortality outcomes (13–15,34,35,37,51). Of the 13 studies that evaluated treatment outcomes, one study assessed distance to care and distance to high-volume hospital (32), one study assessed location of the hospital (25), eight studies assessed hospital volume (8,10,11,13,25,32,34,35), seven studies assessed physician and surgeon volume or availability of a gynecologic oncologist (6,10,11,24–26,31), and three studies evaluated hospital type (7,10,34). Studies evaluating distance to a high-volume hospital and hospital location observed that increased distance or rural hospital settings were associated with lower likelihood of treatment (25,32). Most studies that evaluated hospital volume and treatment receipt observed that patients treated at low-volume hospitals (defined as ≤5 ovarian cancer cases treated per year) were less likely to receive treatment compared to high-volume hospitals (8,13,25,32). However, Hodeib et al. (10) did not observe a statistically significant association between hospital volume and treatment receipt, and Long et al. (11) reported that patients treated at low-volume hospitals were 42% more likely to receive neoadjuvant chemotherapy. Similarly, of the seven studies that evaluated physician volume and treatment receipt, three studies reported that

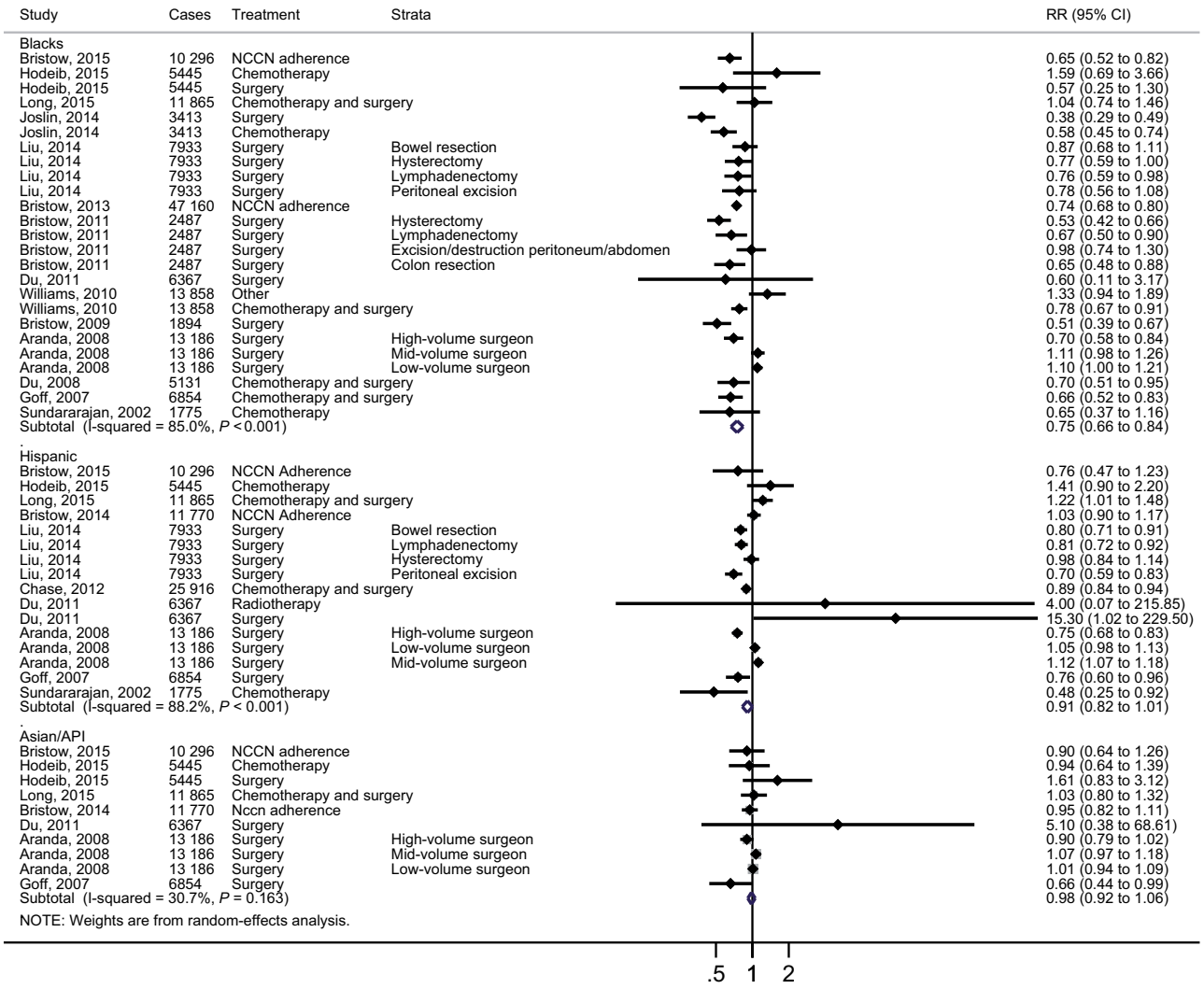

Figure 1. Meta-analysis of the association between race (Blacks vs whites, Hispanics vs whites, Asian/Pacific Islander vs whites) and ovarian cancer treatment. Asian/API = Asian/Pacific Islander; CI = confidence interval; NCCN = National Comprehensive Cancer Network; RR = relative risk.

patients treated in hospitals with a low volume of surgeons or physicians were less likely to receive treatment (10,25,31). Hodeib et al. (10) observed that low physician volume was statistically significantly associated with a lack of surgical treatment. Chan et al. (26) reported that patients treated by gynecologic oncologists were 4.1 times more likely to receive chemotherapy compared with other physicians, and Polsky et al. (24) observed that treatment in hospitals with oncology facilities was statistically significantly associated with receipt of chemotherapy.

Seven studies evaluated an association between health-care characteristics and survival (13–15,34,35,37,51). In three different studies (13,15,51), Bristow et al. (14) observed a statistically significant 8–16% increased mortality in low- vs high-volume hospitals and a 31% higher mortality in low-volume hospital and low-volume physicians compared with high-volume hospital and high-volume physicians. Another study, by Chan et al. (37), observed a statistically nonsignificant 10% lower risk of disease-specific mortality among patients treated by a gynecologic oncologist compared with other providers. In a meta-analysis of 10 studies and 218 126 patients (Figure 6), there was a statistically significant 30% decrease in treatment receipt among patients treated at lower vs higher hospital volumes (RR = 0.70, 95% CI = 0.58 to 0.85, I^2 = 97.7%; $P < .001$). In addition, there was a statistically significant 31% decrease in treatment receipt among patients treated by lower vs higher surgeon and/or physician volume (RR = 0.69, 95% CI = 0.56 to 0.85, I^2 = 85.0%; $P < .001$) and a statistically significant 16% lower likelihood of treatment based on worse vs better hospital characteristics (RR = 0.84, 95% CI = 0.79 to 0.90, I^2 = 84.1%; $P < .001$). There was evidence of statistically significant heterogeneity between studies; however, there was no evidence of publication bias (Egger test: −0.2.00, $P = .26$; and Begg test: −0.93, $P = .36$). There were no three studies that evaluated the same hospital characteristics in relation to survival and/or mortality to allow for a meta-analysis.

Comorbidities and Ovarian Cancer Outcomes

A total of 11 studies examined the association between comorbidities and ovarian cancer outcomes, nine evaluated receipt of treatment (7–9,21–23,27,28,34), and three studies evaluated survival and/or mortality (27,45,49). Seven studies evaluating treatment observed a statistically significantly lower likelihood of treatment receipt with higher burden of comorbidities (7,9,21–23,27,34), and Liu

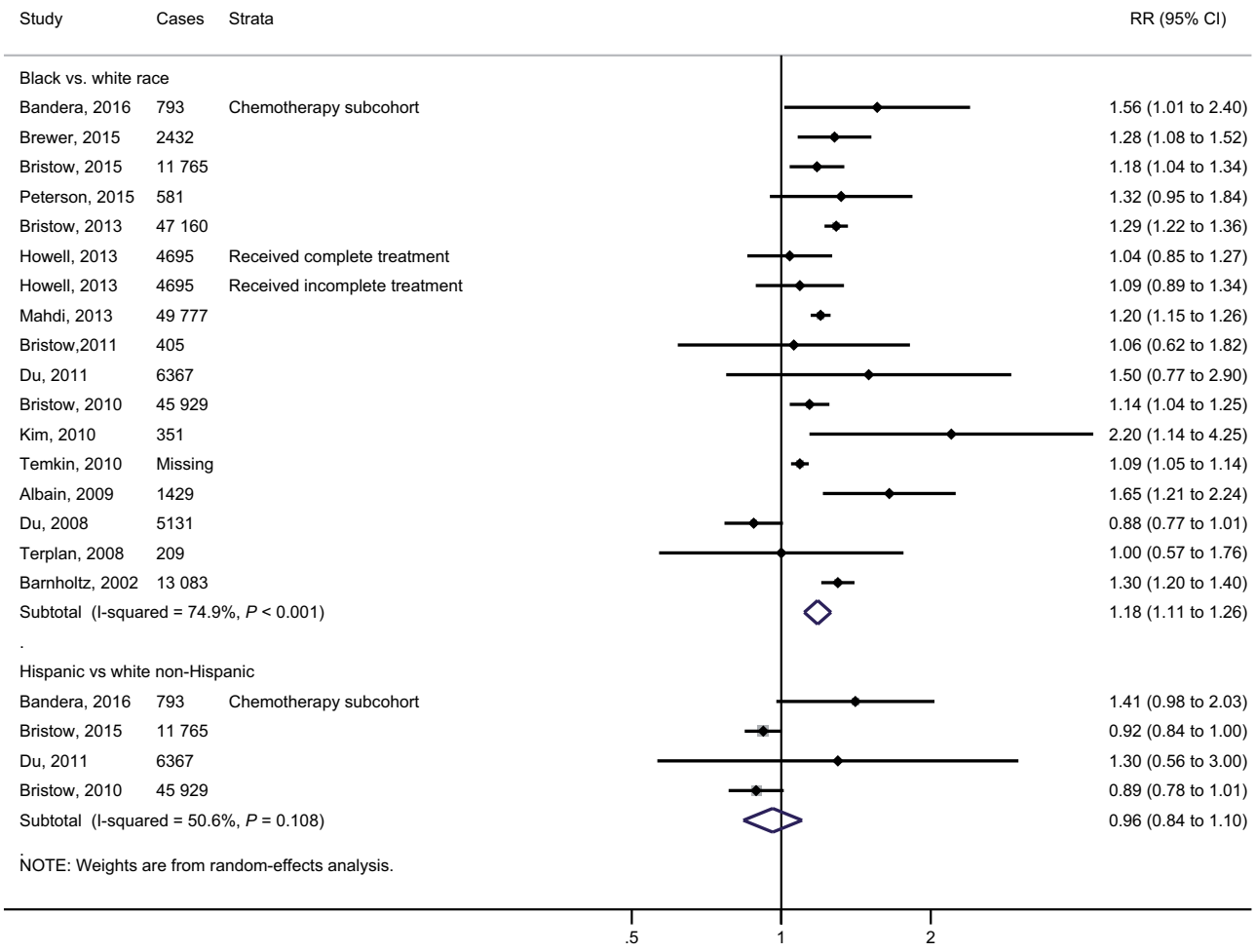

Figure 2. Meta-analysis of the association between race (blacks vs whites, Hispanics vs whites) and ovarian cancer mortality. CI = confidence interval; RR = relative risk.

et al. (8) observed that patients with a higher modified Charlson Comorbidity Index score were less likely to receive lymphadenectomy (OR = 0.45, 95% CI = 0.26 to 0.79), and other surgical procedures were not statistically significantly associated with comorbidity, whereas Chase et al. (28) observed medically compromised patients were more likely to receive neoadjuvant chemotherapy. Three studies examined comorbidities in relation to mortality, and all studies observed a statistically significantly higher risk of mortality with higher comorbidities, ranging from a 10% to 69% increase (27,45,49). In a meta-analysis of nine studies with 152 899 patients (Figure 7), there was a statistically significant 43% decrease in treatment received comparing highest vs lowest comorbidity scores (RR = 0.57, 95% CI = 0.46 to 0.71, I^2 = 83.7%; $P < .001$). In meta-analysis of three studies with 10 010 patients, a 33% increased risk of mortality was observed in patients with highest vs lowest comorbidity scores (RR = 1.33, 95% CI = 1.16 to 1.53, I^2 = 93.0%; $P < .001$). There was evidence of statistically significant heterogeneity between the studies; however, there was no evidence of publication bias (Egger test: −2.70, $P = .07$; Begg test: −0.45, $P = .67$).

Discussion

This systematic review and meta-analysis provides a summary of the current published literature assessing predictors of receipt of ovarian cancer treatment and mortality and a summary estimate of the associations across studies, and highlighting areas for future research. For this study, 41 articles met the inclusion criteria, directly examining associations between race, SES, insurance status, hospital characteristics, and comorbidities with ovarian cancer treatment and mortality outcomes between 2000 and 2017. Consistently across the included studies, black, lower SES, nonprivately insured, and patients with a higher burden of comorbidities were less likely to receive guideline-adherent treatment. Patients who were black, of lower SES, or with higher comorbidity burden experienced higher mortality. Meta-analysis of included studies showed a statistically significant 25% reduction in likelihood of guideline-adherent treatment among blacks compared with whites, a statistically nonsignificant 9% reduction among Hispanics, and a statistically nonsignificant reduction among Asian and Pacific Islanders, indicating that racial disparities in quality treatment remain a major public health challenge. Reflecting the treatment disparity, meta-analysis also showed that black patients experienced a statistically significant 18% higher risk of ovarian cancer mortality compared with whites. There was some evidence of heterogeneity in the meta-analysis, likely because of variations in the study population, data source, exposure definition, and analytical approaches. Nevertheless, the summarized evidence indicates that

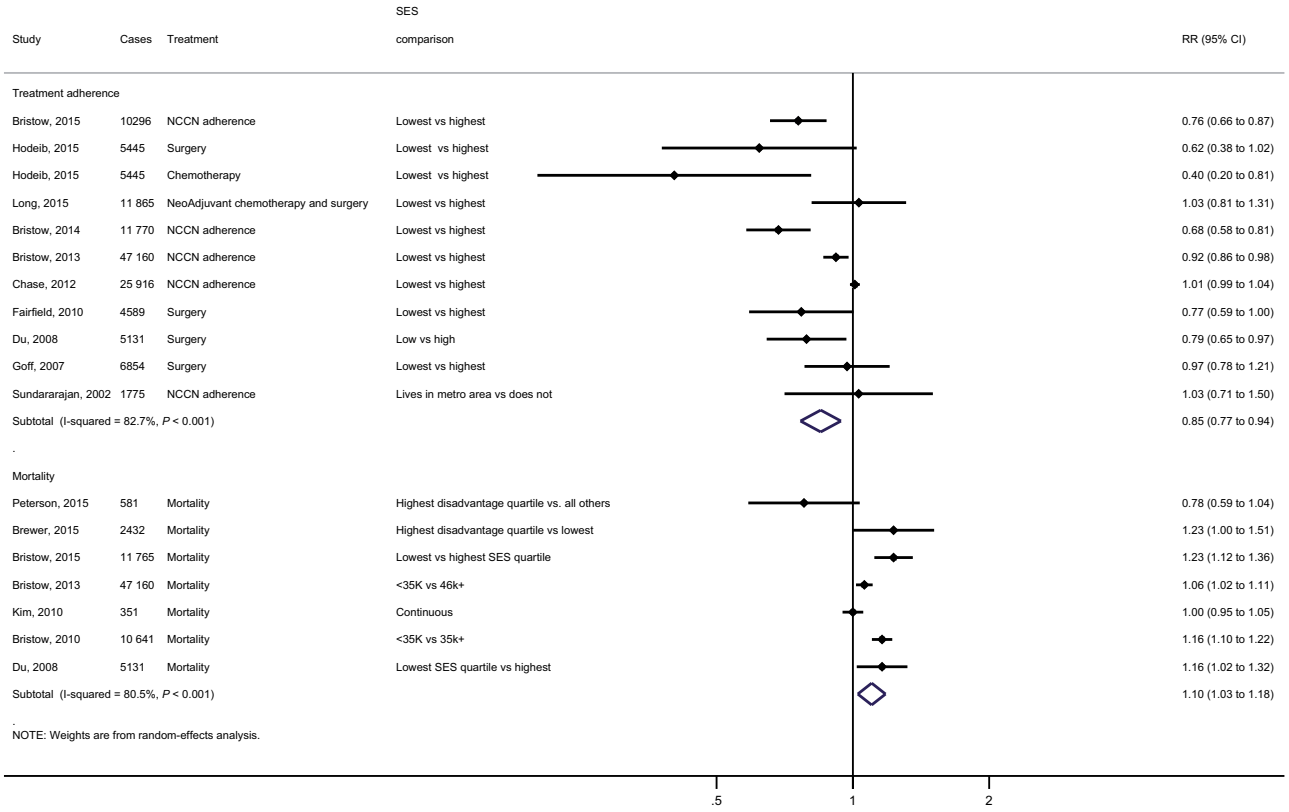

Figure 3. Meta-analysis of the association between socioeconomic status and ovarian cancer outcomes. CI = confidence interval; NCCN = National Comprehensive Cancer Network; RR = relative risks; SES = socioeconomic status.

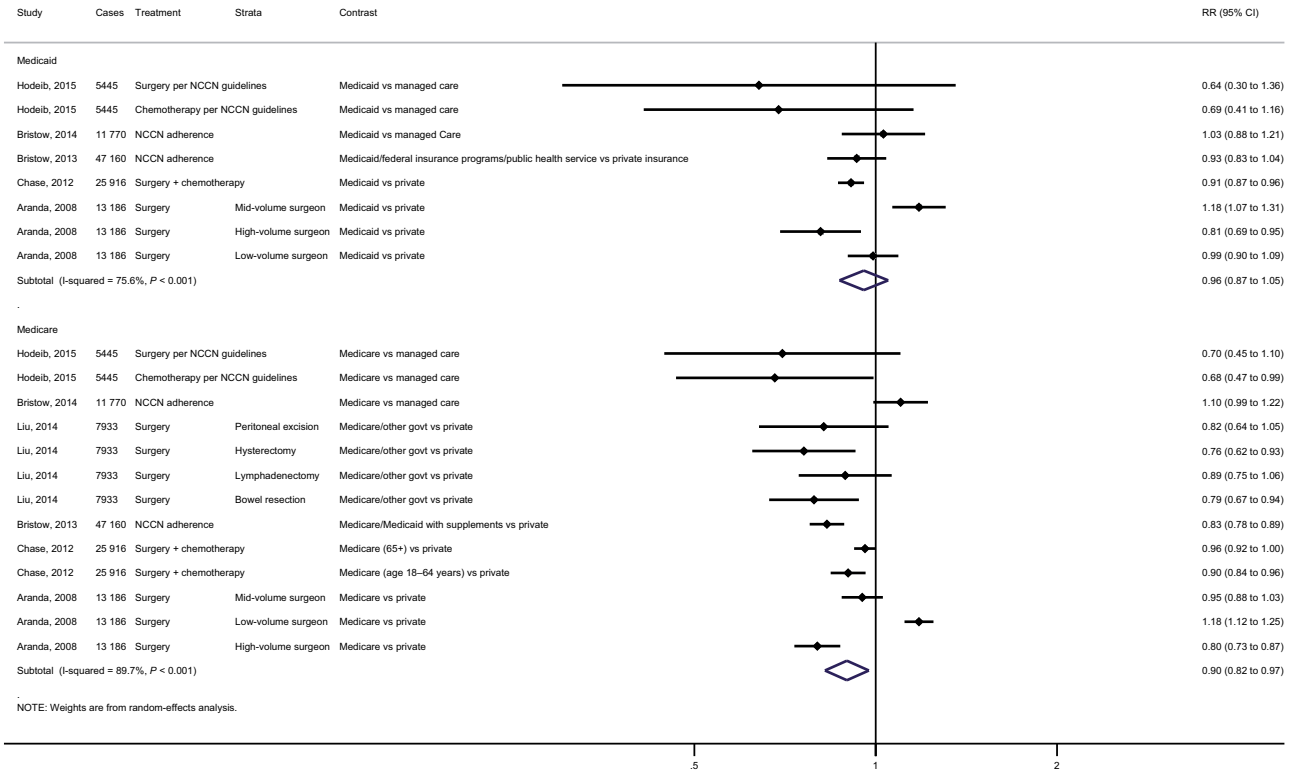

Figure 4. Meta-analysis of the association between insurance status (Medicare, Medicaid vs private insurance and/or managed care) and ovarian cancer treatment. CI = confidence interval; NCCN = National Comprehensive Cancer Network; RR = relative risks.

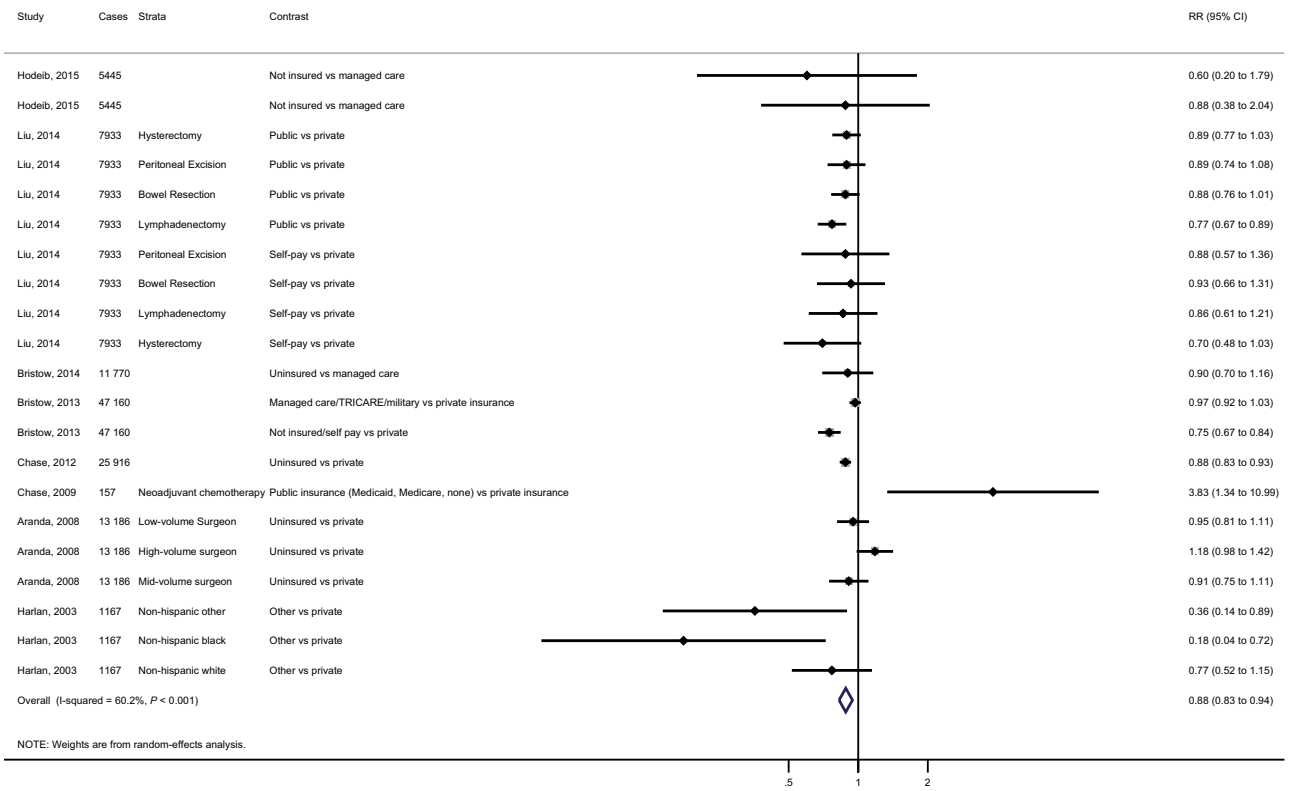

Figure 5. Meta-analysis of the association between insurance status (uninsured, public, self-pay, other vs private insurance and/or managed care) and ovarian cancer treatment. CI = confidence interval; RR = relative risk.

substantial disparities still exist in receipt of quality ovarian cancer treatment and survival.

Previous studies have shown that racial differences in mortality outcomes disappear when comparing black and white women who received quality treatment (16,27,38,50). Factors that may explain disparities in receipt of guideline-adherent treatment include SES, access to health care, and burden of comorbidities. In a meta-analysis, there was a statistically significant 15% reduced risk of ovarian cancer treatment among patients with lower vs higher SES. Furthermore, most insurance types other than private (eg, uninsured, self-pay, Medicare) were associated with a reduced likelihood of receiving quality treatment. Patients treated at hospitals with lower hospital and/or surgeon volume were at a statistically significantly reduced likelihood of quality treatment; however, there were insufficient studies to evaluate mortality outcomes. Patients with a greater burden of comorbidities were less likely to receive guideline-adherent treatment and were at increased risk of mortality. These findings indicate that factors associated with use of health care are central to the observed ovarian cancer disparities, and strategies that target specific barriers to receiving quality treatment will be critical to eliminating the persistent disparities in outcomes.

There were several gaps and limitations observed in the studies included in this systematic review and meta-analysis. First, there was no consistent definition of SES across studies; some defined SES based on income (7,9,13,15,21,24,25,41), SES index (10,11,27,32,51), neighborhood disadvantage (46,47), and affluence (46), and included studies evaluated SES mainly at the residential level, likely because of the predominance of secondary datasets for analysis leading to the use of linked residential-level SES variables such as census tracts. Multilevel assessment of SES both at the individual and neighborhood levels may help better disentangle this association to identify opportunities for intervention. Second, the majority of the included studies documented black and white disparities in ovarian cancer outcomes; however, more studies are needed that focus on other race and/or ethnic groups that have also traditionally experienced barriers to care (eg, Asians, Native Americans, and Hispanics). Third, insurance status in most studies were classified broadly as private, public, Medicare, Medicaid, uninsured, self-pay, or other. For patients with Medicare, most studies did not stratify by age group (age of eligibility for Medicare is 65 years, although individuals with disabilities or other qualifying conditions may be eligible for Medicare at younger ages), which makes it difficult to distinguish whether disparities in ovarian cancer outcomes varies by age group within the Medicare population. There is some evidence for this; Chase et al. (28) reported that the younger Medicare patients were 10% less likely to receive standard treatment relative to privately insured patients, compared with 4% among older Medicare patients.

A major gap in the existing literature is the inadequate focus on a comprehensive assessment of access to health care in relation to ovarian cancer outcomes. Most of the reviewed studies evaluated access to care based on hospital characteristics (eg, hospital location and volume and SES). However, other important dimensions of access to care also likely to predict use of quality care—that is, accessibility (distance and transportation), availability (density of oncologists or gynecologic specialists,

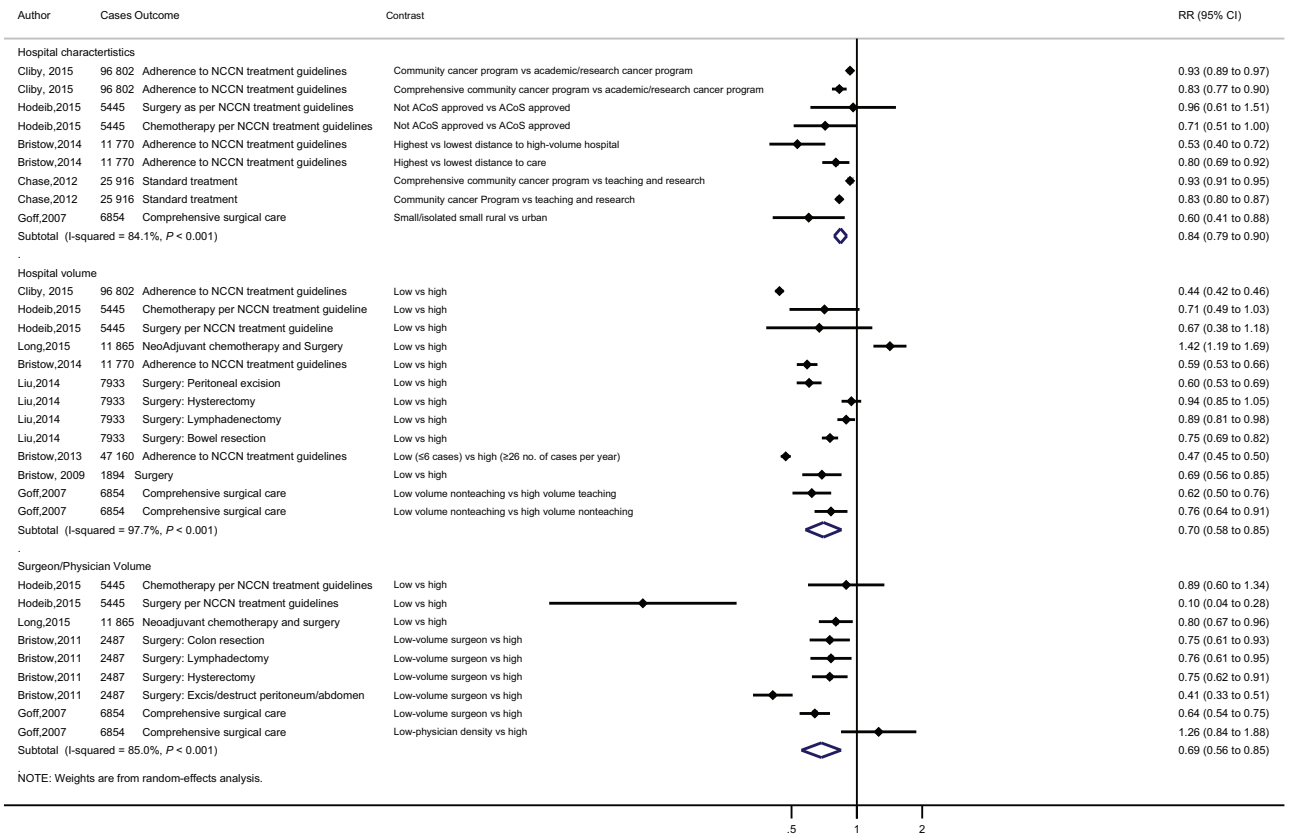

Figure 6. Meta-analysis of the association between hospital characteristics (contrast is worse vs better for all exposures) and receipt of ovarian cancer treatment. ACoS = American College of Surgeons; CI = confidence interval; Excis = excision; NCCN = National Comprehensive Cancer Network; RR = relative risks

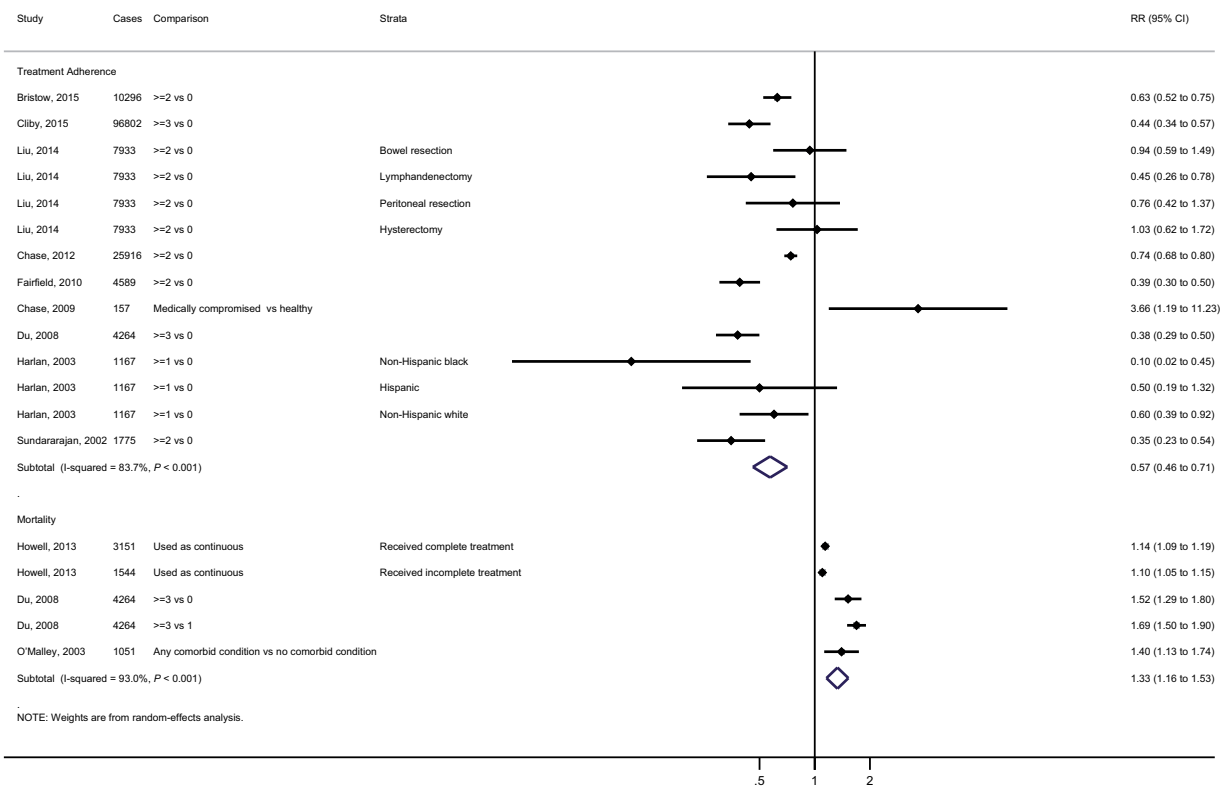

Figure 7. Meta-analysis of the association between comorbidities (higher vs lower burden) and ovarian cancer outcomes.

hospital quality), acceptability (trust and cultural competency)—remain critically understudied. Improved understanding of the multiple dimensions of health care (ie, availability, affordability, accessibility, accommodation, and acceptability [52]) can help identify opportunities for interventions to reduce disparities in receipt of guideline-adherent treatment. For instance, a recent study by Wright et al. (53) reported that targeted quality improvement efforts and strict adherence to treatment guidelines in low-volume hospitals may enhance treatment outcomes. In addition, future studies evaluating health-care fragmentation (54), shown to be a critical factor in care coordination especially among patients with multiple health conditions, may highlight potential strategies to streamline care and improve outcomes for ovarian cancer patients.

There are several limitations to this review. First, restricting the literature search to the English language and the United States led to the exclusion of articles from other countries. However, this approach minimized heterogeneity because of significant differences in culture and health care between countries, enabling us to generalize results from the current analysis to US populations. Second, there was evidence of heterogeneity between studies for most exposure and exposure categories; this may be due to differences in study design, data source, and patient characteristics. In addition, most of the exposures examined (eg, insurance, SES) were defined using broad, nonstandardized categorical cut points. However, by comparing the most extreme categories for examined measures, we can evaluate both ends of the exposure continuum and obtain summary measures of association. Furthermore, for certain racial groups (eg, Asian and Pacific Islander) and outcome combinations (eg, mortality), we were unable to identify at least three articles that met the inclusion criteria and thus were unable to conduct a meta-analysis for those groups. Future studies focused on other racial minority groups will be needed to address this limitation. The strengths of this analysis and included studies include relatively large sample sizes in included studies, standardized data on ovarian cancer outcomes from claims data, and accurate mortality data obtained from cancer registries.

In conclusion, this systematic review and meta-analysis provides evidence of continued and significant disparities in ovarian cancer treatment and mortality, especially among black patients, patients of low SES, and those with poor access to care. We strongly urge further studies in this area focused on other racial minority subgroups in the United States and more comprehensive evaluation of other predictors of care use that may inform interventions to eliminate ovarian cancer disparities.

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SK and MEF conducted the literature search, synthesized data from included studies, conducted data analysis, and prepared the first draft of the manuscript. XM, BH, MP, AP, TT, LEW, and TA participated in the writing of the manuscript. TA designed the study and oversaw the data collection and analysis, manuscript development, and interpretation of results. All authors approved the final version of the manuscript.

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