

Impact of nonbiological factors on the stage of diagnosis and cancer-specific mortality for gynecologic cancer: a competing risk analysis

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Abstract

Background The emphasis on gynecologic cancer prognosis has been on clinicopathological features and molecular markers, and few studies to date have investigated the relationship between the nonbiological factors (NBFs) and the entire gynecologic cancer patients. The objective of this study is to evaluate the impact of race, marital status, insurance type, socioeconomic status, and education degree on the stage of diagnosis and the risk of cancer-specific mortality for gynecologic cancer patients. **Methods** Data was obtained from the Surveillance, Epidemiology and End Results database between 2007 and 2014. Survival time between different groups was compared using Kaplan-Meier analysis and log-rank tests. A multivariate logistic regression model was utilized to identify NBFs associated with stage at diagnosis. Fine and Gray competing risk regression models were used to identify NBFs associated with cancer-specific survival. **Results** 35,854 patients were included in this analysis. After adjusting for age and malignancy site, gynecologic cancer patients who were single, divorced, black, any-Medicaid insured were more likely to present with metastatic disease at diagnosis. For both metastatic and non-metastatic gynecologic cancer, being single, divorced, widowed, black, any-Medicaid insured, uninsured, and having lower socioeconomic status were all significant predictors of poor cancer-specific survival. **Conclusions** The characteristics of being unmarried, black, any-Medicaid insured, and having lower socioeconomic status have a significant impact on the early diagnosis and survival of gynecologic cancer patients. Future improvements in cancer care and adequate social support is imperative and would play a vital role in the prognosis of this disadvantaged group.

Background

Gynecologic cancer is a group of diseases occurring in the female reproductive system, which includes uterine cancer, cervical cancer, ovarian cancer, vaginal cancer, vulvar cancer, and other female genital cancer. In the United States, studies reported that there were 53,028 cases diagnosed with uterine cancer in 2014, followed by ovarian cancer and cervical cancer, which had 21,161 and 12,578 new cases, respectively. Vaginal and vulvar cancer was rare with 1,312 and 5,133 new cases, respectively, and together they only accounted for 6% to 7% of all gynecologic cancers diagnosed in the United States. Despite advances in surgical techniques and chemotherapy that have provided an increasing number of treatment options for women with these cancers, mortality remains high, and disparity still exists. Unlike clinicopathological factors, which have been investigated extensively for survival disparities in many researches, nonbiological factors (NBFs) such as marital status, insurance status, race/ethnicity, education, and socioeconomic status, which may affect how one accesses and interacts with health care and, ultimately, clinical outcomes, have relatively less been evaluated.

Studies assessing the impact of NBFs on disease-specific survival among patients with gynecologic cancer mainly involved a single malignancy and focused on a specific factor[1–10]. Moreover, they often yielded conflicting results. For example, Stewart et al. have demonstrated a significant and persistent disparity in ovarian cancer survival among black women and white women[1]. Brewer et al. showed that neighborhood socioeconomic status (SES) is a predictor of survival in women diagnosed with ovarian

cancer in Cook County, Illinois[10]. However, Coker et al. proved that neither minority race/ethnicity nor poorer socioeconomic status was associated with poorer survival among older women diagnosed with invasive cervical cancer [6].

To the best of our knowledge, none of these studies have integrated all the common NBFs and evaluate their combined impact on disease-specific survival for women with any gynecologic cancer. Given that the National Institutes of Health/National Cancer Institute spends approximately 5 billion dollars per annum on cancer research focused mainly on biological investigations, targeted social support interventions could prove to be a cost-effective method of improving survival among at-risk patients.

We used the Surveillance, Epidemiology and End Results(SEER) database to study patients with gynecologic cancer and make generalizable conclusions regarding the impact of the NBFs including marital status, race, insurance status, income level, and education level on stage at diagnosis and disease-specific survival, particularly among those diagnosed before the age of 65.

Materials And Methods

Data Source and Case Definition

We obtained data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) database which routinely collects and publishes cancer incidence, survival, and treatment data from 18 regional cancer registries across the United States. These registries account for approximately 27.8% of the US population.

For the current study, we defined gynecological cancer to be that occurring at the following sites, using the International Classification of Diseases for Oncology, 3rd Edition ("site recode ICD-O-3/WHO 2008"): "corpus uteri"(C540-C543, C548-C549, C559), "cervix uteri"(C530-C531, C538-C539), "ovary"(C569), "vulva"(C519), "vagina"(C510-C512, C518, C529), or "other female genital"(C570, C571-C574, C577-C579).

We identified 75,073 patients diagnosed as aforementioned gynecological cancer in 2007(the year that the database began to include insurance information) through 2014(the most recent year with follow-up information). Patients were excluded if the only resource of information was the autopsy report or the death certificate, age at diagnosis was less than 18 years or more than 64 years(age at diagnosis \geq 65 were usually eligible for or enrolled in Medicare), a prior malignancy had been diagnosed, clinical information was incomplete, insurance status was unknown, or if the cause of death was unknown, leaving 35,854 patients in the final cohort. Because this dataset is within the public domain and all patient information is de-identified, it was deemed exempt from review by the Institutional Review Board of Harbin Medical University, and the informed consent was waived.

Definition of Nonbiological Factors

For each case, we extracted three groups of factors: demographic, socioeconomic, and survival. Demographic factors included age at diagnosis, marital status, race, and insurance status. Age at diagnosis was treated as a continuous variable; marital status was classified as married, single (including never married, unmarried or domestic partner), divorced (including separated and divorced), widowed, and unknown; race was categorized as white, black, and others (including American Indian/AK Native, Asian/Pacific Islander, and other unspecified); insurance status was classified as any-Medicaid, non-Medicaid (including insured, insured/no specifics), and uninsured. For socioeconomic factors, county-level median household income (in quartile) and percentage of residents aged ≥ 25 years with at least a bachelor's degree (in quartile) were determined by linkage to the 2000 US Census. Survival related information included duration of follow-up, cause-specific death classification, and other cause death classification.

Statistical analysis

According to SEER stage, we classified study patients as non-metastatic (in situ, localized, and regional) and metastatic (distant) given the assumption that the influence of nonbiological factors on patients may vary with cancer stage.

Baseline characteristic was summarized and presented as the median and interquartile range for continuous variable and the number of cases and percentages for categorical variables. A multivariate logistic regression model was used to determine patient demographic and socioeconomic factors (including age at diagnosis, marital status, race, insurance status, county-level median household income and percentage of adults with at least a bachelor's degree) associated with being diagnosed with metastatic disease versus non-metastatic disease.

Our primary endpoint was cancer-specific death, which was identified using cause-specific death classification, and other cause death classification in the SEER database. Patients who died from their cancers were coded as the event of interest; patients who died from other causes other than cancer were coded as competing events, and patients who were alive at the end of follow-up were coded as censor. The adjusted associations between nonbiological factors and cancer-specific mortality were examined by Fine and Gray competing risks regression models for patients with and without metastatic diseases. Survival plots were generated using the Kaplan-Meier method. Survival curves were compared using log-rank tests. All statistical analyses were performed using SAS statistical software and a p -value < 0.05 was considered to be statistically significant.

Results

There were 35,854 patients diagnosed with gynecological cancer between 2007 and 2014, of which 18,213 (50.80%) cases had uterine cancer, 5,731 (15.98%) had cervical cancer, 7,383 (20.59%) had ovarian cancer, 3,635 (10.14%) had vulvar/vaginal cancer, and 892 (2.49%) had other female genital cancer.

28,775(80.26%) patients were diagnosed with local or regional (non-metastatic) cancer, while 7,079(19.74%) were diagnosed with distant(metastatic) cancer. Married patients accounted for 52.82%, white patients accounted for 76.61%, and patients with non-Medicaid insurance accounted for 81.91%, of all cases. The characteristics of patients included in this study are shown in *Table 1*.

NBFs and stage at diagnosis

In the multivariate logistic regression model adjusted for demographic and socioeconomic factors, individuals were more likely to be diagnosed with metastatic cancer if their malignancy occurred at cervix uteri (OR, 1.90; 95%CI, 1.71–2.10), ovary (OR, 1.90; 95%CI, 1.71–2.10), and other female genital (OR, 1.90; 95%CI, 1.71–2.10), while patients with vulvar/vaginal cancer were less likely to be diagnosed with late-stage cancer, compared with malignancy at corpus uteri. Single and divorced patients were more likely to be diagnosed with late-stage cancer than married patients (OR, 1.20; 95%CI, 1.11–1.30; OR, 1.19; 95%CI, 1.08–1.31, respectively). Patients having non-Medicaid insurance or uninsured status were less likely to be diagnosed with metastatic cancer in comparison with those having any-Medicaid insurance (OR, 0.63; 95%CI, 0.57–0.69; OR, 0.81; 95%CI, 0.69–0.91, respectively). Black women were also more likely to be diagnosed with late-stage cancer than white women ((OR, 1.46; 95%CI, 1.32–1.61). County-level median household income and percent of the adult with a bachelor's degree did not show a significant impact on patients' stage at diagnosis (*Table 2*).

NBFs and cancer-specific mortality for non-metastatic cancer

For non-metastatic cancer, unadjusted 5-year cancer-specific survival was highest for women with vulvar/vaginal cancer (92.01%), followed by those having uterine cancer (90.64%), ovarian cancer (86.57%), cervical cancer (78.59%), and other female genital cancer (69.08%). The unadjusted 5-year survival was also highest for white women (89.50%), followed by women of black (77.27%) and other races (87.67%). Women who were married (89.93%) and who were non-Medicaid insured (89.66%) had higher 5-year cancer-specific survival than women who were single (86.21%), divorced (84.99%) or widowed (80.31%), and women who were any-Medicaid insured (79.07%) or uninsured (81.09%). Finally, patients in the 3rd quartile of county-level median household income (89.59%) and percent of the adult with bachelor's degree (89.04%) had higher survival rate than patients in the other three quartiles. Malignancy, marital status, race, insurance status, county-level income, and education degree were all significantly associated with cancer-specific 5-year survival ($P<.001$; *Fig. 1A-F*).

In Fine and Gray competing risks regression model, those with malignancy at cervix uteri, ovary, and other female genital had higher mortality risk, while fatality at vulva/vagina had a lower risk than malignancy at corpus uteri. Single, divorced, and widowed patients all shared a higher risk of dying than married patients. Black patients and patients with any-Medicaid insurance were also at higher risk than white

patients and those with non-Medicaid insurance, respectively. Women at quartile 3 of county-level income had the lowest adjusted mortality risk than the other three quartiles (*Table 3*).

NBFs and cancer-specific mortality for metastatic cancer

For metastatic cancer, unadjusted 5-year cancer-specific survival was highest for women with ovarian cancer (40.31%), followed by those having uterine cancer (33.69%), other female genital cancer (30.74%), vulvar/vaginal (25.22%), and cervical cancer (20.82%). White women had a higher 5-year survival rate than black women (38.02% vs. 22.39%). The unadjusted 5-year survival was also highest for married women (40.34%), followed by women of unknown marital status (36.82%), single (33.91%), divorced (29.76%), and widowed (22.97%). Women who were non-Medicaid insured (38.97%) had higher 5-year survival than women who were any-Medicaid insured (24.89%) or uninsured (27.88%). Finally, the 5-year survival rate of patients increased with quartile of county-level income or education rising. Malignancy, marital status, race, insurance status, county-level income, and education degree were all significantly associated with cancer-specific 5-year survival ($P < .001$; *Fig. 2A-F*).

In Fine and Gray competing risks regression model, compared with uterine cancer, cervical cancer had a higher mortality risk, ovarian cancer showed lower mortality risk, while the others did not show a significant difference. As with the results of non-metastatic cancer analysis, single, divorced, and widowed patients all had a higher risk of dying from cancer than married patients. Black patients and patients with any-Medicaid insurance showed greater mortality risk than white patients and those with non-Medicaid insurance, respectively. Women at quartile 3 and quartile 4 of county-level income had lower adjusted mortality risk than the other women at quartile 1 and quartile 2 (*Table 3*).

NBFs and cancer-specific mortality by malignancy site

We performed Fine and Gray competing risks regression models for malignancy in different locations. The results are shown using forest plot in Fig.3A (for non-metastatic cancer) and Fig.3B (for metastatic cancer). Only seven subgroups were analyzed, due to a limited sample size of specific subgroups (non-metastatic cancer of other female genital and metastatic cancer of vulva/vagina and other female genital), which cannot satisfy the requirement of model fitness. The results showed that for non-metastatic tumors, patients with uterine cancer and ovarian cancer tended to have higher hazard if they were widowed and black; patients with cervical cancer had higher mortality risk if they were single, divorced, and black; other race was an independent risk factor for patients with vulvar/vaginal cancer; non-Medicaid insurance was an independent protective factor for patients with malignancy at corpus uteri, cervix uteri, and vulva/vagina; cervical cancer patients at quartile 3 and 4 and vulvar/vaginal cancer patients at quartile 2 and 3 of education degree had lower mortality risk; besides, the risk of death increased with age for all malignancies.

For metastatic cancers, black women had a higher risk for all three sites; single, divorced, and widowed were risk factors for ovarian cancer; non-Medicaid served as protective factor for malignancy at corpus uteri and ovary; besides, patients at quartile 4 of education degree and quartile 4 of household income

shared a lower hazard for cervical and ovarian cancer, respectively; finally, older age was still associated with an increased risk for ovarian and uterine cancer.

Discussion

The emphasis on gynecologic cancer prognosis has been on cytogenetic and molecular markers, and only a few studies to date have addressed isolated NBFs, with conflicting findings. Studying the impact of NBFs on the combination of all kinds of gynecologic cancer not only enlarges the sample size but also provides a manageable way to identify disadvantaged ones among this particular population. To the best of our knowledge, the current study is the most extensive study to date assessing the impact of NBFs on the stage at diagnosis and disease-specific survival of patients with gynecologic cancer diagnosed before the age of 65 years.

We found a significantly greater risk of presentation with metastatic cancer for patients being single or divorced; being black; being any Medicaid beneficiary, after adjusting for age and malignancy. Part of the results had been previously confirmed on a single type of gynecological cancers. Studies demonstrated that black-white differences in stage at diagnosis existed, and lower neighborhood socioeconomic status had been associated with tumor characteristics indicative of more advanced and aggressive disease for ovarian cancer [2]. The reason may be related to the different utilization of cancer screening, as evidence had already shown that screening utilization differed between ethnic groups and socioeconomic groups in the US for cervical cancer[11–15].

For both non-metastatic and metastatic cancer, we also found that single, divorced, and widowed patients, black patients, and patients with any-Medicaid or no insurance, at county-level median household income quartile 1 or 2 all had a lower cancer-specific mortality risk than their reference group. The results are consistent with the findings of several related studies which focused on single cancer. Bristow RE et al. confirmed that independent racial and SES predictors of ovarian cancer survival were black race, Medicaid payer status, not insured payer status, and median household income less than \$35 000, after controlling for disease and treatment-related variables[8]. Another study by Zeng C, et al. said African Americans experienced poorer survival than whites for all cancers, and the racial difference increased for ovarian cancer[16].

The reasons for the racial disparities of cancer survival have been studied widely. Evidence showed that black women were less likely than white women to receive guideline-recommended care, and women who did not receive recommended treatment had lower survival rates than women who received recommended care[17]. Specifically, Liu FW et al. confirmed that black patients were significantly less likely to undergo important ovarian cancer-specific surgical procedures compared to white patients[18].

Marital status was proved to be a significant predictor of gynecologic cancer prognosis in this study, and married patients had the best prognosis. Several possible reasons were discussed and investigated by other studies. One of the reasons is that unmarried patients may have worse adherence to the prescribed treatments than married patients[19]. Studies have proved a strong relationship between marriage and

the depression degree which had a negative relationship with the adherence to treatment[20, 21]. Physiologically, marriage has been demonstrated beneficial for endocrine, cardiovascular, and the function of the immune system, though the magnitude of effect primarily depends on the quality of marriage[22]. Moreover, adequate social support may lower the level of cortisol, which has been linked with natural-killer cell count and survival in cancer patients[19, 23].

The critical role of medical insurance in survival has rarely been studied among the entire gynecologic cancers. However, the disadvantage of any-Medicaid or no insurance for this group of patients was within expectation. Similar disadvantage had been discovered among chronic myeloid leukemia patients under the age of 65 years[24], breast cancer patients[25], and colorectal cancer patients[26]. A study also concluded that compared with private insurance, men with Medicaid were more likely to present with metastatic disease, were less likely to receive definitive treatment, and had increased prostate cancer-specific mortality[27]. Higher socioeconomic status, which is represented with county-level median household income (the highest two quartiles), served as a protective factor against poor prognosis for gynecologic cancers. The same effect was also detected for multiple myeloma patients[28].

Another phenomenon which requires attention is that after adjusting for nonbiological factors, the risk of being diagnosed at a late stage for malignancy at ovary was about 18 times the risk of that for malignancy at corpus uteri. However, once diagnosed as metastatic cancer, the risk of cancer-specific death for malignancy at ovary was only 0.78 times of that for malignancy at corpus uteri. When at the early stage, malignancy at corpus uteri was still less threatening than malignancy at cervix uteri and ovary, which indicates the vital role of cancer screening and early detection.

The current study has several limitations. Firstly, due to the small sample size of vulvar/vaginal cancer, the 95% confidence intervals of the hazard ratios, when the competing risk analysis for each malignancy was performed for each malignancy, were relatively large, making the inferences less reliable. For metastatic vulvar/vaginal, the sample size was even smaller and could not afford a multivariate analysis. Secondly, the classification of the NBFs may be crude, and any subtype under any NBF can be further subdivided to better represent the characteristics of patients. However, we sacrificed the refinement to get enough sample size for each subtype. Finally, due to the limitation of the SEER database, the household income and education degree were reported at the county level, not at the individual level, thereby disabling further refinement of this analysis.

Despite these potential limitations, our study utilized available information in the SEER database from 2007 to 2014, which represented the whole group of patients with gynecologic cancer in the United States. In addition, competing risk analysis properly solved the problem brought by several alternative types of death of cancer patients. Finally, identifying factors associated with varied possibility of presenting with metastatic cancer and cancer-specific mortality risk can inform future improvements in cancer care for all.

Declarations

Acknowledgments

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Availability of data and materials

The datasets generated and analyzed during the current study are available in the Surveillance, Epidemiology, and End Results database, which can be accessed at <https://seer.cancer.gov/>.

Authors' contributions

FG and WX conceived of the study, participated in the study design. XW and CJ analyzed the data and interpreted the results. WX drafted the initial manuscript and ZX revised the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Because this dataset is within the public domain and all patient information is de-identified, the study has been granted an exemption from requiring ethics approval by Institutional Research Board of Beijing Children's Hospital, and the informed consent was waived.

Consent for publication

Not applicable.

Competing interests

All authors declare that they have no competing interest.

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Tables

Table 1. The characteristics of patients included in this study.

	All	Non-metastatic	Metastatic
No.	35854	28775	7079
Median age (IQR), y	54(46-59)	53(45-59)	55(49-60)
Malignancy			
corpus uteri	18213(50.80%)	16690(58.00%)	1523(21.51%)
cervix uteri	5731(15.98%)	5051(17.55%)	680(9.61%)
ovary	7383(20.59%)	3048(10.59%)	4335(61.24%)
vulva/vagina	3635(10.14%)	3593(12.49%)	42(0.59%)
others	892(2.49%)	393(1.37%)	499(7.05%)
Marital status			
Married	18939(52.82%)	15269(53.06%)	3670(51.84%)
Single	9374(26.14%)	7468(25.95%)	1906(26.92%)
Divorced	4486(12.51%)	3513(12.21%)	973(13.74%)
Widowed	1337(3.73%)	1037(3.60%)	300(4.24%)
Unknown	1718(4.79%)	1488(5.17%)	230(3.25%)
Race			
White	27467(76.61%)	22148(76.97%)	5319(75.14%)
Black	3763(10.50%)	2891(10.05%)	872(12.32%)
Others	4624(12.90%)	3736(12.98%)	888(12.54%)
Insurance			
Any-Medicaid	4793(13.37%)	3679(12.79%)	1114(15.74%)
Non-Medicaid	29367(81.91%)	23789(82.67%)	5578(78.80%)
Uninsured	1694(4.72%)	1307(4.54%)	387(5.47%)
County-level median household income			
Median(IQR)	60.12k(49.72k-66.04k)	-	-
Quartile1	24.25k-49.72k	7386(25.67%)	1731(24.45%)
Quartile2	50.00k-60.12k	7471(25.96%)	1808(25.54%)
Quartile3	60.55k-66.04k	7840(27.25%)	2007(28.35%)
Quartile4	66.45k-90.03k	6078(21.12%)	1533(21.66%)
County % with bachelor degree			
Median(IQR)	29.60%(20.59%-38.21%)	-	-
Quartile1	9.90%-20.59%	7410(25.75%)	1764(24.92%)
Quartile2	20.76%-29.60%	7879(27.38%)	1860(26.27%)
Quartile3	29.72%-38.21%	7411(25.75%)	1823(25.75%)
Quartile4	39.01%-60.48%	6075(21.11%)	1632(23.05%)

Table 2. The impact of NBFs on the stage at diagnosis.

	OR	95%CI	<i>P</i>
Age	1.04	1.04-1.05	<.0001
Malignancy			<.0001
corpus uteri	1.00	Reference	-
cervix uteri	1.90	1.71-2.10	<.0001
ovary	18.76	17.43-20.20	<.0001
vulva/vagina	0.16	0.12-0.21	<.0001
others	14.48	12.52-16.74	<.0001
Marital status			<.0001
Married	1.00	Reference	-
Single	1.20	1.11-1.30	<.0001
Divorced	1.19	1.08-1.31	0.0006
Widowed	1.01	0.86-1.20	0.8655
Unknown	0.77	0.65-0.91	0.0024
Race			<.0001
White	1.00	Reference	-
Black	1.46	1.32-1.61	<.0001
Others	1.01	0.92-1.12	0.7757
Insurance			<.0001
Any-Medicaid	1.00	Reference	-
Non-Medicaid	0.63	0.57-0.69	<.0001
Uninsured	0.81	0.69-0.95	0.0089
County-level median			0.4549
household income			
Quartile1	1.00	Reference	-
Quartile2	1.07	0.96-1.18	0.2268
Quartile3	1.09	0.98-1.21	0.1158
Quartile4	1.08	0.96-1.23	0.2004
County %			0.5963
with bachelor degree			
Quartile1	1.00	Reference	-
Quartile2	0.94	0.85-1.05	0.2687
Quartile3	0.93	0.83-1.04	0.1938
Quartile4	0.95	0.84-1.07	0.3857

Table 3. The impact of NBFs on the risk of cancer-specific mortality.

	Non-metastatic			Metastatic		
	5-year survival	HR (95%CI)	P	5-year survival	HR (95%CI)	P
Age		1.04	<.0001		1.02	<.0001
Malignancy		(1.03-1.04)			(1.01-1.02)	
corpus uteri	90.64%	1.00	-	33.69%	1.00	-
cervix uteri	78.59%	(reference) 3.62	<.0001	20.82%	(reference) 1.50	<.0001
ovary	86.57%	(3.22-4.08) 2.16	<.0001	40.31%	(1.32-1.72) 0.78	<.0001
vulva/vagina	92.01%	(1.87-2.49) 0.61	<.0001	25.22%	(0.71-0.85) 1.39	0.0938
others	69.08%	(0.49-0.77) 5.56	<.0001	30.74%	(0.95-2.03) 1.15	0.0604
Marital status		(4.43-6.97)			(0.99-1.34)	
Married	89.93%	1.00	-	40.34%	1.00	-
Single	86.21%	(reference) 1.26	<.0001	33.91%	(reference) 1.25	<.0001
Divorced	84.99%	(1.12-1.41) 1.22	0.0039	29.76%	(1.15-1.36) 1.20	0.0005
Widowed	80.31%	(1.07-1.40) 1.35	0.0070	22.97%	(1.08-1.32) 1.29	0.0021
Unknown	90.27%	(1.08-1.67) 0.88	0.2985	36.82%	(1.10-1.52) 0.97	0.7790
Race		(0.70-1.12)			(0.78-1.20)	
White	89.50%	1.00	-	38.02%	1.00	-
Black	77.27%	(reference) 1.94	<.0001	22.39%	(reference) 1.43	<.0001
Others	87.67%	(1.71-2.20) 1.14	0.0721	39.28%	(1.29-1.58) 0.99	0.7991
Insurance		(0.99-1.31)			(0.88-1.10)	
Any-Medicaid	79.07%	1.00	-	24.89%	1.00	-
Non-Medicaid	89.66%	(reference) 0.61	<.0001	38.97%	(reference) 0.77	<.0001
Uninsured	81.09%	(0.54-0.69) 1.06	0.5421	27.88%	(0.70-0.85) 1.04	0.6764
County-level median		(0.87-1.29)	0.0731		(0.88-1.22)	0.0400

household income							
Quartile1	86.07%	1.00	-	33.58%	1.00	-	
		(reference)			(reference)		
Quartile2	87.37%	0.98	0.7544	34.03%	0.94	0.2655	
		(0.84-1.13)			(0.84-1.05)		
Quartile3	89.59%	0.85	0.0480	38.72%	0.86	0.0114	
		(0.73-1.00)			(0.77-0.97)		
Quartile4	89.23%	0.99	0.9508	39.09%	0.85	0.0172	
		(0.83-1.20)			(0.75-0.97)		
County %			0.3246			0.7018	
with bachelor degree							
Quartile1	86.18%	1.00	-	33.28%	1.00	-	
		(reference)			(reference)		
Quartile2	88.83%	0.93	0.3592	36.18%	0.95	0.3650	
		(0.81-1.08)			(0.85-1.06)		
Quartile3	89.04%	0.87	0.1073	37.28%	0.99	0.9284	
		(0.74-1.03)			(0.88-1.12)		
Quartile4	88.08%	0.96	0.6513	38.73%	0.96	0.4846	
		(0.80-1.15)			(0.84-1.09)		

Figures

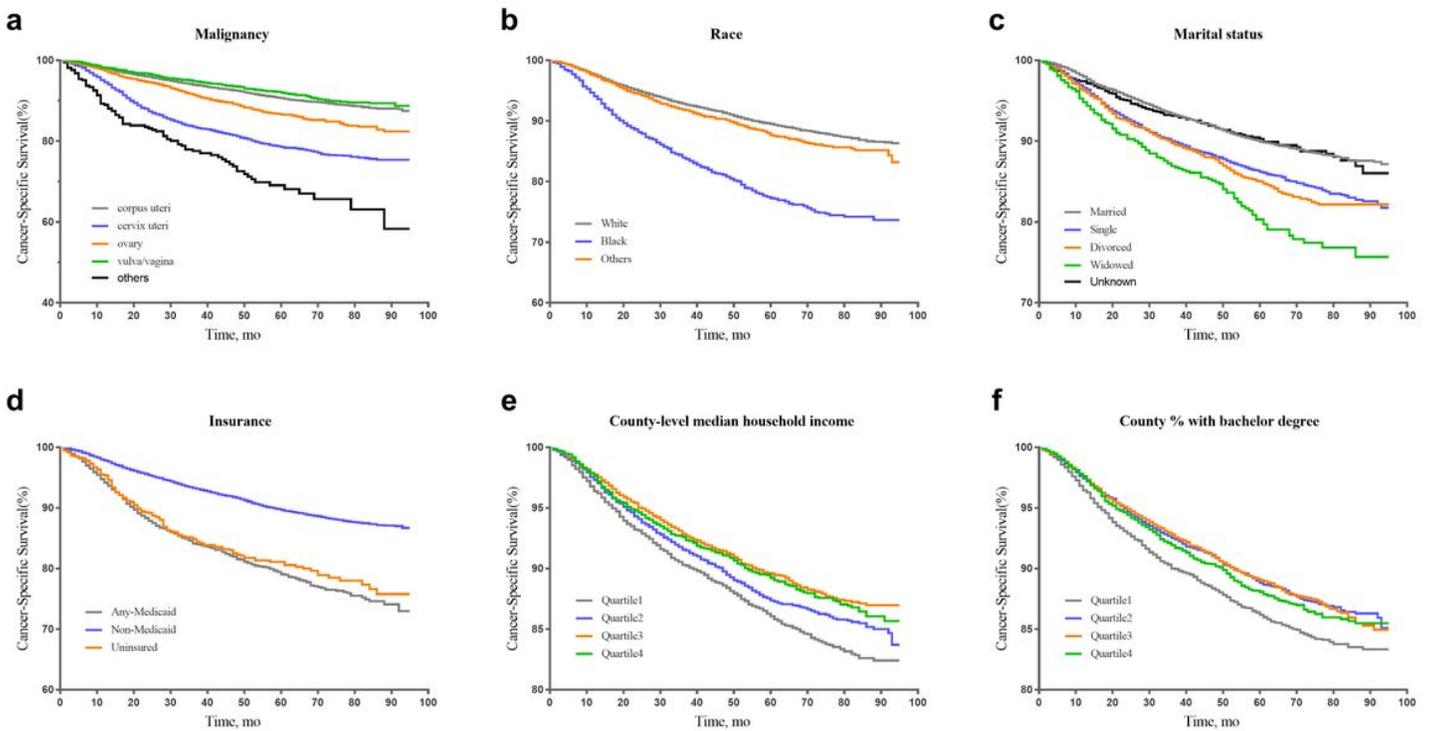


Figure 1

Cancer-specific survival curves for non-metastatic gynecologic cancer stratified by (a) malignancy site; (b) race; (c) marital status; (d) insurance type; (e) county-level median household income; (f) county % with a bachelor degree.

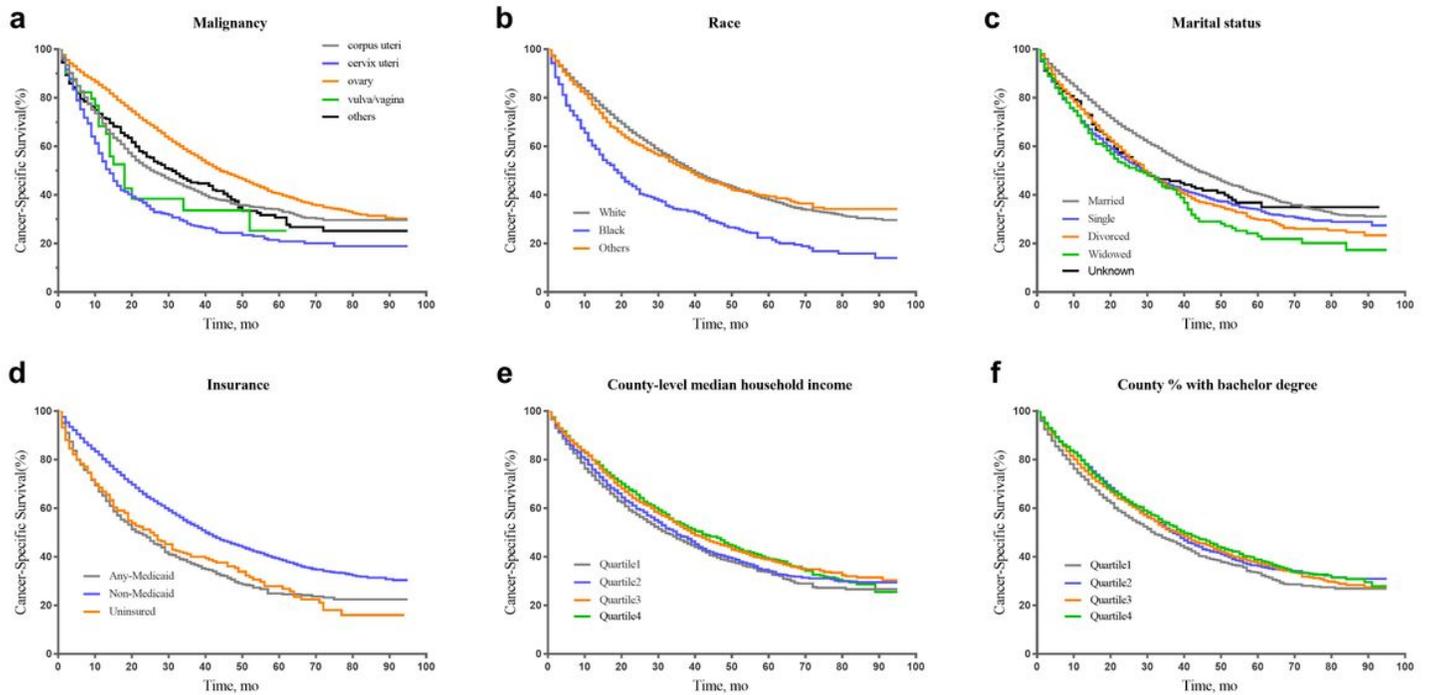


Figure 2

Cancer-specific survival curves for metastatic gynecologic cancer stratified by (a) malignancy site; (b) race; (c) marital status; (d) insurance type; (e) county-level median household income; (f) county % with a bachelor degree.

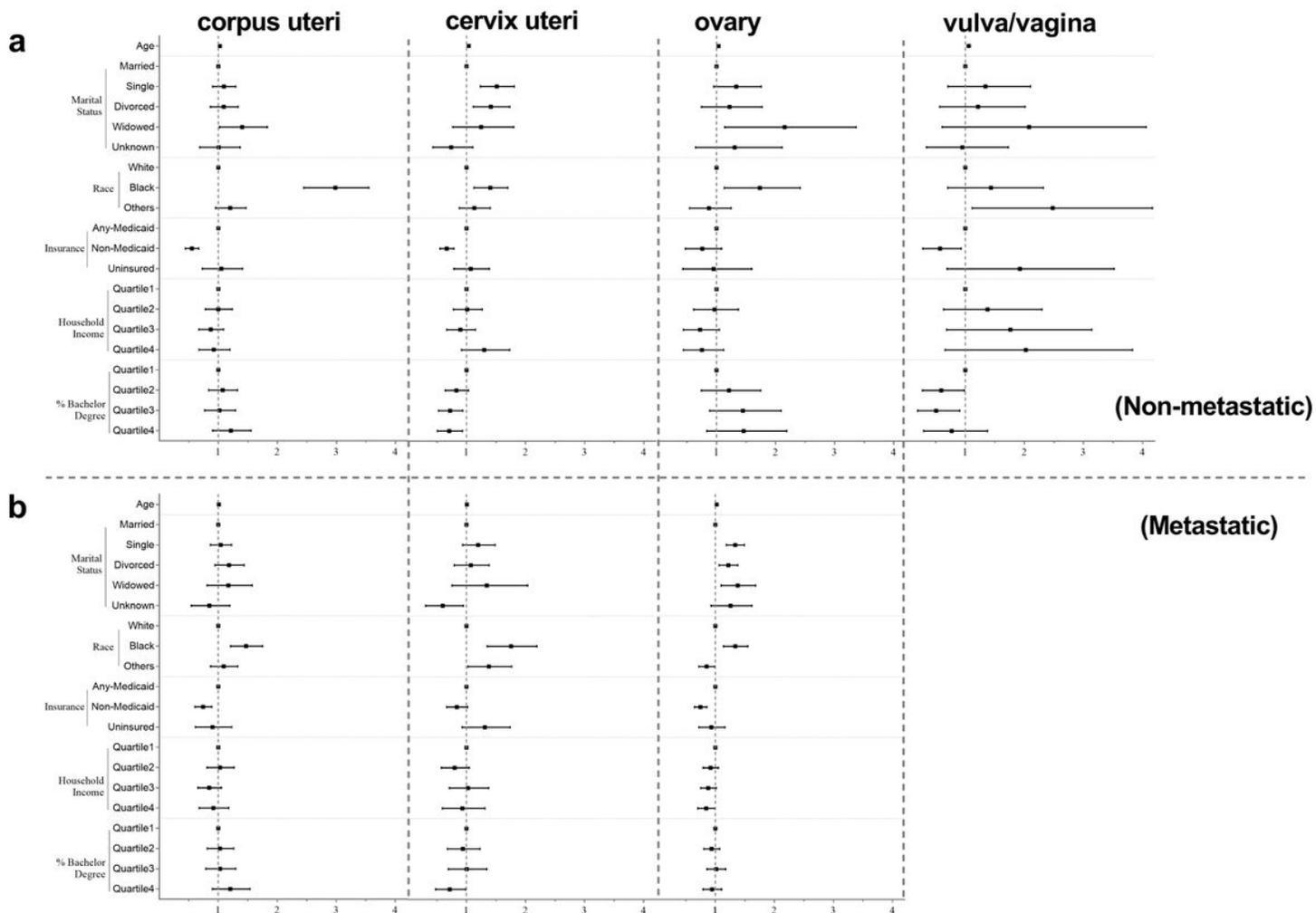


Figure 3

The impact of NBFs on the cancer-specific mortality risk for (a) non-metastatic; (b) metastatic gynecologic cancer stratified by malignancy site.