Employment disruption among women with gynecologic cancers

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HIGHLIGHTS

- This study was conducted to evaluate the decrease in employment among patients in the year following the diagnosis of a gynecologic cancer compared to population-based controls.
- Gynecologic cancer patients had over a threefold increased risk of employment disruption compared to controls.
- Employment disruption is a challenge to functional recovery for gynecologic cancer patients and should be addressed during the course of oncologic care.

ABSTRACT

Background Adverse employment outcomes pose significant challenges for cancer patients, though data patients with gynecologic cancers are sparse. We evaluated the decrease in employment among patients in the year following the diagnosis of a gynecologic cancer compared with population-based controls.

Methods Patients aged 18 to 63 years old, who were diagnosed with cervical, ovarian, endometrial, or vulvar cancer between January 2009 and December 2017, were identified in Truven MarketScan, an insurance claims database of commercially insured patients in the USA. Patients working full- or part-time at diagnosis were matched to population-based controls in a 1:4 ratio via propensity score. Multivariable Cox proportional hazards models were used to evaluate the risk of employment disruption in patients versus controls.

Results We identified 7446 women with gynecologic cancers (191 vulvar, 941 cervical, 1839 ovarian, and 4475 endometrial). Although most continued working following diagnosis, 1579 (21.2%) changed from full- or part-time employment to long-term disability, retirement, or work cessation. In an adjusted model, older age, the presence of comorbidities, and treatment with surgery plus adjuvant therapy versus surgery alone were associated with an increased risk of employment disruption ($p<0.0003$, $p=0.01$, and $p<0.0001$, respectively) among patients with gynecologic cancer. In the propensity-matched cohort, patients with gynecologic cancers had over a threefold increased risk of employment disruption relative to controls (HR 3.67, 95% CI 3.44 to 3.95).

Conclusion Approximately 21% of patients with gynecologic cancer experienced a decrease in employment in the year after diagnosis. These patients had over a threefold increased risk of employment disruption compared with controls.

INTRODUCTION

Cancer patients often decrease their work hours[1 2] or modify their career trajectories,[2 3] and, if they exit the workforce, are less likely to regain employment even years after diagnosis.[2 4] A population-based study estimated that, in the USA, the annual loss of productivity among working-age cancer patients is between $9.6 and $16 billion.[5] Unemployment may also underlie and contribute to the financial toxicity incurred by a majority of cancer patients [6] and lead to the loss of employer-sponsored health insurance among patients with high healthcare-related expenses.[7] Beyond economic considerations, the importance of the ability to work following a cancer diagnosis is reflected in the association between work and emotional and social recovery and improved quality of life.[8]

Although female cancer patients are at a higher risk of unemployment than male patients and population-based controls,[3 7] and many studies have addressed employment disruption in survivors of breast cancer,[9 10] data on employment outcomes in patients with gynecologic cancer are sparse. The impact of employment disruption among survivors of gynecologic cancers may be substantial. Of the estimated 113 520 new cases of gynecologic cancer diagnosed in 2020,[11] over half were in women younger than 65 years, a group representing a major proportion of the workforce. The existing literature on employment disruption in patients with gynecologic cancer is limited to survey-based studies without control groups,[12–15] many of which were not conducted in the USA.[12 13 16] We have previously reported that approximately 22% of patients with endometrial cancer and employer-subsidized health insurance experienced employment disruption[17]; this was a hypothesis-generating study that did not include patients with other gynecologic malignancies, and importantly did not have a control group to compare to the cancer population.

In this study, we evaluated the decrease in employment among patients in the year following the diagnosis of a gynecologic cancer compared to

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population-based controls. These data are particularly important now as many women are experiencing employment changes during the pandemic-related recession[18] and employment disruption among female cancer survivors is likely to be disproportionately high.

METHODS

Data Source

With Institutional Review Board approval (protocol # 2020–0367), we identified patients with gynecologic cancer in Truven MarketScan (IBM Watson Health, Cambridge, MA), an insurance claims database that has been previously described.[19] The database consists of commercial insurance claims from over 150 large employers and 300 employer-sponsored health plans in the USA and represents a national convenience sample of approximately 50 million patients under the age of 65 years with employer-sponsored health insurance. We abstracted de-identified, patient-level, inpatient and outpatient medical and procedural claims data for patients diagnosed with vulvar, cervical, ovarian, or endometrial cancer from January 2009 to December 2017 and followed for 1 year (ie, abstracted data were collected for the period January 2009 to December 2018).

Cohort Selection

We identified patients aged 18 to 63 years old who received a diagnosis of vulvar, cervical, ovarian, or endometrial cancer as determined by codes from the International Classification of Diseases, 9th and 10th editions (ICD-9, ICD-10) (Figure 1). Similar to our previous protocol,[17] to be included, patients had to have one of the four gynecologic cancer diagnoses on at least one inpatient claim[20] or at least two outpatient claims dated 30 days apart.[21] Based on studies using commercial claims data for each gynecologic cancer site,[21–25] we identified incident cancer cases by requiring a 12 month wash-out period without a cancer diagnosis or cancer-related treatment prior to the earliest date of cancer diagnosis in the study period. We followed patients who were working full- or part-time at diagnosis for the first year after diagnosis. The

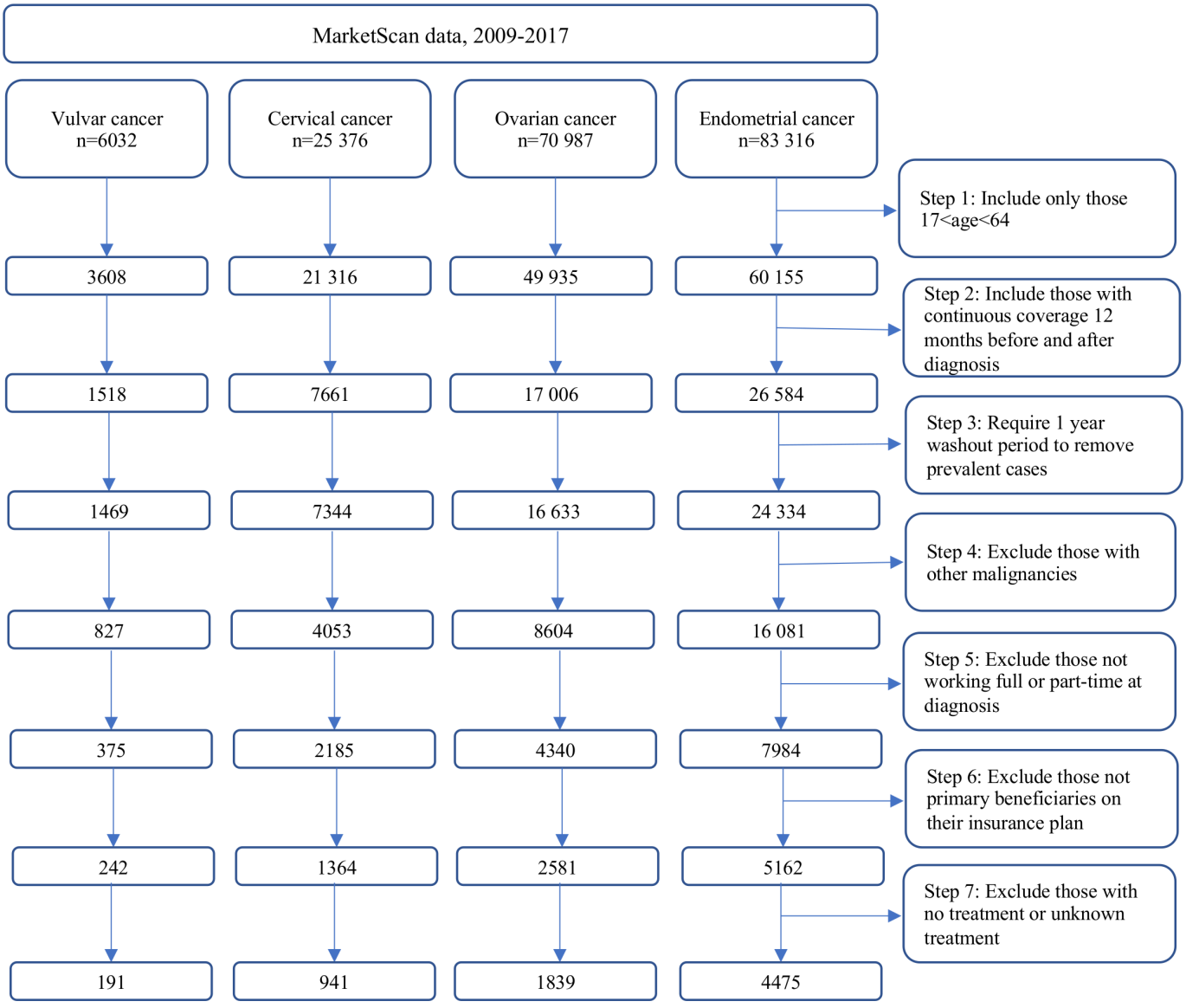

Figure 1 Cohort selection process.

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cohort was therefore restricted to patients who were continuously covered for 12 months before and after their cancer diagnosis. For this reason, although we followed patients through 2018, the last date of cancer diagnosis was in December 2017. This restriction also ensured that the patients were alive during the year following diagnosis. Patients with other cancer diagnoses, those who did not receive any oncologic treatment during the year following diagnosis (surgery, systemic, or local), those who were not the primary beneficiaries on their health insurance plans, and those with unknown employment information were excluded.

The control group consisted of women aged 18 to 63 years old who had had a billable encounter with a medical provider reported to MarketScan during the study period. The date of the billable encounter was defined as the index date. We first matched controls to patients such that the available controls for each patient had an index date within 3 months of the patient's diagnosis date and were of the same age as the patient during this time. This yielded a pool of 3 196 347 controls who were then subjected to the same selection criteria as those applied to the cancer patients, that is, 12 months of continuous coverage before and after the index date and full- or part-time employment. We excluded women who were not the primary beneficiaries on their health insurance plans and those with unknown employment information. We conducted a secondary analysis using the same methodology, but extended follow-up to 2 years. As women compete in the same job market as men, a sensitivity analysis using a control group comprised of both men and women was also performed.

Covariates

The following data were examined: age at diagnosis or index date (continuous and ≤44, 45–49, 50–53, 54–57, and 58–63 years), health plan type (health maintenance organization, preferred provider organization, and other), region of residence (northeast, north central, south, west, and unknown), and year of diagnosis or index date. The Klabunde modification of the Charlson Comorbidity Index[26] was used to assess for non-cancer-related comorbidities; a score of 0 meant that none of the included comorbidities were present.

For the cohort of cancer patients, we examined treatment-related variables using ICD-9/ICD-10 diagnosis and procedure codes and Common Procedural Terminology codes. The ICD-9, ICD-10, and Common Procedural Terminology codes for the surgical procedures and treatments (eg, external-beam radiation therapy, chemotherapy, chemoradiation) are listed by cancer type in Online Supplemental Appendix 1. To harmonize the possible treatment combinations across the different gynecologic cancers, we categorized treatment as follows: (1) surgery only; (2) surgery with adjuvant treatment (any kind of systemic or local therapy); and (3) chemotherapy, radiation, or chemoradiation only (systemic or local therapy without surgery).

We used ICD-9/ICD-10 and Common Procedural Terminology codes to identify adverse events in the year following diagnosis. These adverse events included gastrointestinal complications, venous thromboembolic disease, fistula formation, hematologic complications, lymphedema, and infectious complications (pneumonia, sepsis, surgical site infection, deep abscess, urinary tract infection, *Clostridium difficile* infection). Patients were categorized as experiencing no events, one event, or two or more events. Finally, we identified metastatic disease using ICD-9 and ICD-10 codes for 'secondary malignant neoplasm'.[27]

Primary Outcome

The primary outcome was a decrease in employment in patients with gynecologic cancer compared with controls. As previously described,[17] we determined employment status using definitions provided by the Truven MarketScan database and mapped from insurance-carrier-specific coding to Truven Health standard values. These definitions were as follows: active full-time, active part-time or seasonal, early retiree, Medicare-eligible retiree, retiree (status unknown), Comprehensive Omnibus Budget Reconciliation Act (COBRA, which allows eligible employees and their dependents the continued benefits of health insurance coverage when an employee loses their job or experiences a reduction of work hours), long-term disability, or other/unknown. For the 12 months following diagnosis for the patients and the index date for the controls, we recorded employment status on a monthly basis. A decrease in employment was identified when individuals who were working full- or part-time at diagnosis or on the index date changed their status to any of the other categories. Patients were censored after their first employment change. Because the database does not link data between employers, we did not assess re-employment following a change in employment status.

Statistical Analysis

Descriptive statistics were used to summarize demographic and clinical characteristics. Student's t-test was used to assess differences in the means of continuous variables. For each gynecologic cancer site, χ^2 or Fisher's exact tests were used to assess the distribution of demographic and clinical characteristics between those who did and did not experience a decrease in employment. To assess variables associated with employment disruption among all gynecologic cancer patients, Cox proportional hazards models adjusted for age, insurance plan type, region of residence, year of diagnosis, comorbidity index score, cancer type, treatment, and the presence of adverse events were used and adjusted hazard ratios (HRs) and their 95% 95% CIs were calculated. We also used Cox proportional hazards models to assess factors associated with employment disruption for each gynecologic cancer type.

To match controls to patients with gynecologic cancer, we used greedy nearest neighbor propensity-score matching without replacement in a 1:4 ratio of cases to controls (when possible). The caliper width was set to 0.2 times the standard deviation of the propensity score. This method selects a patient with gynecologic cancer and then selects, as a matched subject, the control whose propensity score is closest to that of the patient. All available covariates were used in this model. To adjust for unequal follow-up times, a Cox proportional hazards analysis was used to assess the risk of employment disruption among patients compared with controls. All statistical tests were two-sided. A p value <0.05 and a 95% CI not inclusive of the null (1.0) were considered statistically significant and STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) guidelines for observational research were followed.[28] All analyses were performed in SAS Enterprise Guide version 7.11 (SAS Institute, Inc)

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Sensitivity Analysis for Unmeasured Confounding

As propensity score matching can only adjust for observed variables, we evaluated the robustness of the study estimates to unmeasured confounding. The 'E-value' developed by VanderWeele and Ding[29] is a method that makes no assumptions about the underlying structure of unmeasured confounders, and quantifies the minimum strength of association that an unmeasured confounder must have with both the exposure (in our study, a gynecologic cancer diagnosis) and the outcome (employment disruption) to drive the derived estimate to the null. To address statistical uncertainty, we also calculated the E-value required to explain away the lower confidence limit. These analyses were performed in Stata/MP version 16.0 (StataCorp LLC) (see Online Supplemental Appendix 2 for details).

RESULTS

A total of 7446 women with cancer (191 vulvar, 941 cervical, 1839 ovarian, and 4475 endometrial) worked full- or part-time at diagnosis and met the inclusion criteria. The baseline characteristics of the included patients are provided in Table 1, and Figure 1 is the CONSORT (CONsolidated Standards Of Reporting Trials) diagram depicting cohort selection. Although most patients continued working in the 12 months following diagnosis, 21.2% (n=1579) experienced a decrease in employment. This included 15.7% (n=30) of patients with vulvar cancer, 20.6% (n=194) of those with cervical cancer, 20.8% (n=383) of those with ovarian cancer, and 21.7% (n=972) of those with endometrial cancer.

Before propensity-score matching, there were significant demographic differences between the patients with gynecologic cancer and the controls (Table 2). The patients with cancer were older (median age, 53 vs 46 years; p<0.0001) and had more comorbidities than the controls (12.5% vs 6.7% had at least one non-cancer comorbidity; p<0.001). Using the propensity scores in a 1:4 ratio (when possible), we matched 7294 patients with gynecologic cancer to 28 019 controls. After propensity-score matching, the distributions of the observed demographic and clinical covariates were similar between the two groups (Table 2). The proportion of missing data was less than 0.1%.

In the propensity-matched cohort, 21.0% of patients with gynecologic cancer (n=1535) and 6.4% of controls (n=1799) had a decrease in employment in the 12 months following diagnosis or the index date, respectively. Most of these women (97%) held a full-time job and 3% held a part-time job at diagnosis or the index date. In a Cox proportional hazards model accounting for unequal follow-up time, the patients with gynecologic cancer had over a threefold higher risk of employment disruption compared with controls (adjusted HR 3.67, 95% CI 3.44 to 3.95; p<0.0001).

Factors Associated with Employment Disruption among Patients with Gynecologic Cancer

Among the 1535 patients with gynecologic cancer who experienced employment disruption, the most common employment changes were from full-time employment to the other/unknown (75.1%), retiree (10.3%), long-term disability (7.3%), and COBRA (5.1%) groups. No one who worked part-time at diagnosis increased her work hours to full-time during the study period.

In a multivariable Cox proportional hazards model (Table 3), employment disruption was associated with having a Charlson Comorbidity Index of at least 1 compared with having no comorbidities (adjusted HR 1.21, 95% CI 1.05 to 1.41; p=0.01). Those aged 58–63 years were 30% more likely to experience a decrease in employment compared with those aged 44 years or less (adjusted HR 1.32, 95% CI 1.14 to 1.54; p<0.0003). Compared with the northeast, residing in the south was protective for employment decrease (adjusted HR 0.76, 95% CI 0.65 to 0.87; p=0.0002), while residing in the west was associated with increased risk of employment disruption (adjusted HR 1.25, 95% CI 1.06 to 1.47; p=0.0064). Those who underwent surgery with adjuvant therapy and those who received any kind of systemic or local treatment without undergoing surgery were more likely to experience employment disruption than those who underwent surgery alone (adjusted HR 1.35, 95% CI 1.20 to 1.52; p<0.0001, and adjusted HR 1.39, 95% CI 1.10 to 1.76, p=0.006, respectively). Examination of the multivariable models for each gynecologic cancer type revealed no obvious, consistent themes. The results from these models are provided in Online Supplemental Appendix 3.

Results of Sensitivity Analyses

Patients with gynecologic cancer had a higher risk of employment disruption than propensity-matched controls (HR 3.67, 95% CI 3.44 to 3.95; p<0.0001) (Online Supplemental Appendices 4 and 5). Given the limitations of the database, we were only able to control for observed covariates via the propensity score (age, insurance plan type, comorbidities, region of residence, and year of diagnosis or index date). Other potentially important confounders that our estimates were not adjusted for include race, socioeconomic status, educational attainment, and marital status. In assessing the sensitivity of our estimate to unmeasured confounding, we found that an unmeasured confounder that was associated with gynecologic cancer and employment disruption by an HR of 6.8-fold each could shift the HR for the association between gynecologic cancer and employment disruption to the null, but weaker confounding could not. In other words, the magnitude of the confounder associations that could produce confounding bias equal to the observed treatment–outcome association in this case would have to be substantial. In reference to statistical uncertainty, an unmeasured confounder that was associated with the outcome and the treatment by an HR of 6.3 could explain away the lower confidence interval, but a weaker confounder could not.

A sensitivity analysis including patients who could be followed-up for 2 years following diagnosis revealed that the patients with gynecologic cancer still had a higher risk of employment disruption compared with controls (adjusted HR 2.68, 95% CI 2.45 to 2.93; p<0.0001).

An analysis including a control population of both men and women was conducted with the rationale that patients with gynecologic cancer compete in the same job market as both men and women. The demographic characteristics before and after propensity score matching can be found in Online Supplemental Appendix 4. We found that, compared with controls comprised of both men and women, patients with gynecologic cancer had a fourfold increased risk of employment disruption (HR 4.01, 95% CI 3.74 to 4.29; p<0.0001).

DISCUSSION

Summary of Main Results

In this observational study, patients with gynecologic cancer had a substantially higher risk of employment disruption in the year

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Table 1 Characteristics of patients with vulvar, cervical, ovarian, and endometrial cancer who were actively working at the time of diagnosis, reported to MarketScan, diagnosed between 2009 and 2017 and followed through 2018

	Vulvar cancer			Cervical cancer			Ovarian cancer			Endometrial cancer		
Characteristics	**EC (n=30)**	**No EC (n=161)**	**P***	**EC (n=194)**	**No EC (n=747)**	**P***	**EC (n=383)**	**No EC (n=1456)**	**P***	**EC (n=972)**	**No EC (n=3503)**	**P***
Age at diagnosis, n (%)			0.4			0.4			<0.001			<0.001
44 or less	4 (13.3)	25 (15.5)		100 (51.5)	426 (57.0)		76 (19.8)	388 (26.6)		121 (12.4)	473 (13.5)	
45 to 49	6 (20.0)	33 (20.5)		31 (16.0)	126 (16.9)		59 (15.4)	241 (16.6)		103 (10.6)	439 (12.5)	
50 to 53	3 (10.0)	38 (23.6)		19 (9.8)	66 (8.8)		55 (14.4)	255 (17.5)		121 (12.4)	619 (17.7)	
54 to 57	8 (26.7)	29 (18.0)		19 (9.8)	49 (6.6)		78 (20.4)	274 (18.8)		250 (25.7)	904 (25.8)	
58 to 63	9 (30.0)	36 (22.4)		25 (12.9)	80 (10.7)		115 (30.0)	298 (20.5)				
Health insurance plan type, n (%)			0.4			0.644			0.9			<0.001
HMO	5 (16.7)	15 (9.3)		24 (12.4)	111 (14.9)		64 (16.7)	227 (15.6)		131 (13.5)	553 (15.8)	
PPO	16 (53.3)	101 (62.7)		106 (54.6)	405 (54.2)		208 (54.3)	806 (55.4)		508 (52.3)	2008 (57.3)	
Other†	9 (30.0)	45 (28.0)		64 (33.0)	231 (30.9)		111 (29.0)	423 (29.1)		333 (34.3)	942 (26.9)	
Region, n (%)			0.002			0.7			<0.001			<0.001
Northeast	5 (16.7)	23 (14.3)		34 (17.5)	112 (15.0)		61 (15.9)	254 (17.4)		186 (19.1)	615 (17.6)	
North central	16 (53.3)	35 (21.7)		45 (23.2)	158 (21.2)		71 (18.5)	270 (18.5)		274 (28.2)	791 (22.6)	
South	6 (20.0)	81 (50.3)		79 (40.7)	338 (45.2)		140 (36.6)	659 (45.3)		299 (30.8)	1454 (41.5)	
West	3 (10.0)	22 (13.7)		36 (18.6)	138 (18.5)		111 (29.0)	271 (18.6)		212 (21.8)	639 (18.2)	
Unknown	0 (0.0)	0 (0.0)		0 (0.0)	1 (0.1)		0 (0.0)	2 (0.1)		1 (0.1)	4 (0.1)	
Charlson Comorbidity Index score, n (%)			0.6			<0.001			0.7			0.2
0	26 (86.7)	144 (89.4)		174 (89.7)	717 (96.0)		348 (90.9)	1332 (91.5)		806 (82.9)	2965 (84.6)	
1+	4 (13.3)	17 (10.6)		20 (10.3)	30 (4.0)		35 (9.1)	124 (8.5)		166 (17.1)	538 (15.4)	
Metastatic status, n (%)‡			0.9			0.003			<0.001			0
Non-metastatic	27 (90.0)	146 (90.7)		150 (77.3)	643 (86.1)		178 (46.5)	922 (63.3)		853 (87.8)	3188 (91.0)	
Metastatic	3 (10.0)	15 (9.3)		44 (22.7)	104 (13.9)		205 (53.5)	534 (36.7)		119 (12.2)	315 (9.0)	
Treatment group, n (%)			0.9			0.2			<0.001			<0.001
Surgery only	26 (86.7)	136 (84.5)		111 (57.2)	476 (63.7)		99 (25.8)	662 (45.5)		755 (77.7)	2904 (82.9)	
Surgery with adjuvant treatment	4 (13.3)	24 (14.9)		50 (25.8)	154 (20.6)		244 (63.7)	708 (48.6)		202 (20.8)	550 (15.7)	
Chemotherapy, radiation, or chemoradiation only	0 (0.0)	1 (0.6)		33 (17.0)	117 (15.7)		40 (10.4)	86 (5.9)		15 (1.5)	49 (1.4)	

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Table 1 Continued

Characteristics	Vulvar cancer			Cervical cancer			Ovarian cancer			Endometrial cancer		
	EC (n=30)	No EC (n=161)	P*	EC (n=194)	No EC (n=747)	P*	EC (n=383)	No EC (n=1456)	P*	EC (n=972)	No EC (n=3503)	P*
Adverse events, n (%)			0.2			0.4			0.04			0.7
None	28 (93.3)	127 (78.9)		177 (91.2)	659 (88.2)		264 (68.9)	1094 (75.1)		814 (83.7)	2972 (84.8)	
1	2 (6.7)	33 (20.5)		14 (7.2)	78 (10.4)		106 (27.7)	315 (21.6)		140 (14.4)	474 (13.5)	
2+	0 (0.0)	1 (0.6)		3 (1.5)	10 (1.3)		13 (3.4)	47 (3.2)		18 (1.9)	57 (1.6)	
Year of diagnosis, n (%)			0.5			0.8			0.031			0.2
2009	4 (13.3)	14 (8.7)		14 (7.2)	67 (9.0)		22 (5.7)	122 (8.4)		90 (9.3)	296 (8.4)	
2010	3 (10.0)	10 (6.2)		14 (7.2)	76 (10.2)		33 (8.6)	126 (8.7)		80 (8.2)	339 (9.7)	
2011	0 (0.0)	11 (6.8)		15 (7.7)	61 (8.2)		35 (9.1)	149 (10.2)		101 (10.4)	357 (10.2)	
2012	5 (16.7)	17 (10.6)		20 (10.3)	64 (8.6)		30 (7.8)	150 (10.3)		92 (9.5)	384 (11.0)	
2013	1 (3.3)	18 (11.2)		17 (8.8)	68 (9.1)		32 (8.4)	115 (7.9)		96 (9.9)	358 (10.2)	
2014	2 (6.7)	16 (9.9)		17 (8.8)	72 (9.6)		18 (4.7)	120 (8.2)		81 (8.3)	363 (10.4)	
2015	5 (16.7)	14 (8.7)		33 (17.0)	98 (13.1)		41 (10.7)	154 (10.6)		126 (13.0)	428 (12.2)	
2016	4 (13.3)	27 (16.8)		35 (18.0)	123 (16.5)		87 (22.7)	260 (17.9)		165 (17.0)	515 (14.7)	
2017	6 (20.0)	34 (21.1)		29 (14.9)	118 (15.8)		85 (22.2)	260 (17.9)		141 (14.5)	463 (13.2)	

*P values were derived using the χ^2 test or Fisher's exact test when appropriate.
†Other health insurance plans include comprehensive, point-of-service, point-of-service with capitation, high-deductible, and exclusive-provider-organization health plans.
‡Metastatic status was derived using ICD 9/ICD 10 codes.
EC, employment change; HMO, health maintenance organization; ICD 9/ICD 10, International Classification of Diseases 9th and 10th editions; PPO, preferred provider organization.

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Table 2 Characteristics of patients with gynecologic cancer diagnosed between 2009 and 2017 and female controls, before and after propensity-score matching

Characteristic	Before matching			Propensity score-matched cohort		
	Cases (n=7446)	Controls (n=3 196 347)	P*	Cases (n=7294)	Controls (n=28 019)	P*
Age at cohort entry, median (IQR)†	53 (46–58)	46 (36–54)	<0.0001	53 (46–58)	53 (46–58)	0.2
Age at cohort entry by group, n (%)†			<0.001			0.8
44 or less	1613 (21.7)	1 504 223 (47.0)		1597 (21.9)	6263 (22.4)	
45 to 49	1038 (13.9)	459 818 (14.4)		1023 (14.0)	3986 (14.2)	
50 to 53	1176 (15.8)	377 048 (11.8)		1155 (15.8)	4468 (15.9)	
54 to 57	1611 (21.6)	382 509 (12.0)		1567 (21.5)	5940 (21.2)	
58 to 63	2008 (27.0)	472 749 (14.8)		1952 (26.8)	7362 (26.3)	
Health insurance plan type, n (%)			0.3			0.1
HMO	1130 (15.2)	481 569 (15.1)		1070 (14.7)	3867 (13.8)	
PPO	4158 (55.8)	1 763 576 (55.2)		4116 (56.4)	16 046 (57.3)	
Other‡	2158 (29.0)	951 202 (29.8)		2108 (28.9)	8106 (28.9)	
Region, n (%)			<0.001			0.6
Northeast	1290 (17.3)	484 037 (15.1)		1249 (17.1)	4717 (16.8)	
North central	1660 (22.3)	649 676 (20.3)		1615 (22.1)	6131 (21.9)	
South	3056 (41.0)	1 395 390 (43.7)		3037 (41.6)	11 916 (42.5)	
West	1432 (19.2)	661 986 (20.7)		1392 (19.1)	5254 (18.8)	
Unknown	8 (0.1)	5258 (0.2)		1 (0.0)	1 (0.0)	
Charlson Comorbidity Index score, n (%)			<0.001			<0.001
0	6512 (87.5)	2 981 805 (93.3)		6485 (88.9)	25 542 (91.2)	
1+	934 (12.5)	214 542 (6.7)		809 (11.1)	2477 (8.8)	
Index date year, n (%)			<0.001			<0.001
2009	629 (8.4)	312 039 (9.8)		620 (8.5)	2041 (7.3)	
2010	681 (9.1)	316 182 (9.9)		672 (9.2)	2541 (9.1)	
2011	729 (9.8)	339 851 (10.6)		709 (9.7)	2676 (9.6)	
2012	762 (10.2)	352 848 (11.0)		739 (10.1)	2809 (10.0)	
2013	705 (9.5)	276 864 (8.7)		687 (9.4)	2672 (9.5)	
2014	689 (9.3)	277 150 (8.7)		669 (9.2)	2500 (8.9)	
2015	899 (12.1)	348 106 (10.9)		871 (11.9)	3032 (10.8)	
2016	1216 (16.3)	464 009 (14.5)		1198 (16.4)	4629 (16.5)	
2017	1136 (15.3)	509 298 (15.9)		1129 (15.5)	5119 (18.3)	

Propensity-score matching based on all tabulated characteristics.
*P values derived from the Pearson χ^2 test or Wilcoxon rank-sum test.
†Age at diagnosis for cancer cohort and age at index date (date of billable encounter with provider) for control cohort.
‡Other health insurance plans include comprehensive, point-of-service, point-of-service with capitation, high-deductible, and exclusive-provider-organization health plans.
HMO, health maintenance organization; PPO, preferred provider organization.

following diagnosis than population-based controls. We found variation in the risk of employment disruption within the population of patients with gynecologic cancer based on the type of cancer and the type of treatment received, but overall, having gynecologic cancer was strongly associated with employment disruption. This high rate of employment disruption is likely to have profound effects on the financial and psychological well-being of survivors.

Results in the Context of Published Literature

Unfortunately, it is common for cancer diagnoses to have negative effects on employment, career trajectories, and financial well-being.[30] Moreover, as the population of cancer patients grows due to sustained improvements in cancer detection and treatment, the negative economic implications increase. Systematic reviews have demonstrated that 30–93% of cancer patients and survivors return to work.[4 31] Given this wide range and the fact that most studies of female cancer survivors include primarily breast cancer survivors, it is difficult to know whether these data can be generalized to patients with gynecologic cancer. The estimates derived in this study, therefore, are more applicable specifically to patients receiving treatment for a gynecologic malignancy. Our results are generally consistent with those from survey studies demonstrating that approximately 16% of gynecologic cancer survivors do not

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Table 3 Adjusted hazard ratios for employment change among patients with gynecologic cancer

Characteristics	HR (95% CI)	P value
Age at diagnosis, years		
44 or less	1.00 (Reference)	
45 to 49	0.99 (0.82 to 1.18)	0.9
50 to 53	0.85 (0.71 to 1.03)	0.1
54 to 57	1.14 (0.97 to 1.34)	0.1
58 to 63	1.32 (1.14 to 1.54)	0.0003
Health insurance plan type		
HMO	1.00 (Reference)	
PPO	1.09 (0.94 to 1.27)	0.2
Other*	1.38 (1.17 to 1.63)	0.0001
Region		
Northeast	1.00 (Reference)	
North central	1.17 (1.01 to 1.37)	0.04
South	0.76 (0.65 to 0.87)	0.0002
West	1.25 (1.06 to 1.47)	0.0064
Unknown	0.68 (0.10 to 4.80)	0.7
Charlson Comorbidity Index score		
0	1.00 (Reference)	
1+	1.21 (1.05 to 1.41)	0.01
Cancer type		
Endometrial	1.00 (Reference)	
Cervical	0.96 (0.81 to 1.15)	0.7
Ovarian	0.87 (0.77 to 0.99)	0.04
Vulvar	0.76 (0.53 to 1.10)	0.1
Treatment group		
Surgery only	1.00 (Reference)	
Surgery with adjuvant treatment	1.35 (1.20 to 1.52)	<0.0001
Chemotherapy, radiation, or chemoradiation only	1.39 (1.10 to 1.76)	0.006
Adverse events		
None	1.00 (Reference)	
1	1.05 (0.91 to 1.20)	0.5
2+	1.00 (0.71 to 1.41)	0.9
Year of diagnosis		
2009	1.00 (Reference)	
2010	0.90 (0.71 to 1.15)	0.4
2011	0.98 (0.77 to 1.23)	0.8
2012	0.85 (0.67 to 1.08)	0.2
2013	0.98 (0.77 to 1.24)	0.9
2014	0.79 (0.62 to 1.02)	0.06
2015	1.00 (0.80 to 1.24)	0.9
2016	1.05 (0.85 to 1.30)	0.6
2017	0.99 (0.80 to 1.24)	0.9

*Other health insurance plans include comprehensive, point-of-service, point-of-service with capitation, high-deductible, and exclusive-provider-organization health plans.
HMO, health maintenance organization; PPO, preferred provider organization.

return to work.[13 16] In addition, our finding of an over threefold increased risk of employment disruption among patients with gynecologic cancer compared with controls is higher than the pooled relative risk of 1.4 from a meta-analysis by de Boer et al.[31] This is likely explained by study selection, as the majority of the included studies in the meta-analysis did not include a US population or gynecologic cancer patients.

The limited data on patients with gynecologic cancer suggest that returning to work is an important goal for a majority of survivors.[32] We cannot identify a causal pathway between gynecologic cancer and employment disruption, but it is likely that lingering symptoms from treatment[27 33] lead to potentially long-lasting limitations with intense concentration and physical loads at work.[15] As maintenance therapy becomes a more common approach in gynecologic cancer, long-term symptoms and decreased work retention may become a growing problem in this population. Our study, similar to others,[27] suggests that patients receiving multimodal therapy, including surgery with chemotherapy, radiation, and chemoradiation, may be at particular risk of poor employment outcomes. Importantly, however, treatment with adjuvant therapy may be a marker of advanced symptomatic disease that could limit work retention independent of treatment.

Implications for Future Research

Our data argue for investigating intervention approaches to mitigate employment disruption in this patient population. As described in a recent review by Blinder and colleagues,[30] poor employment outcomes may be mitigated by patient-centered, employer, and policy interventions. For example, patients would likely benefit from receiving education about existing US government policies (such as the Family and Medical Leave Act, and the Americans With Disabilities Act). One survey of patients with gynecologic cancer demonstrated that, although 74% of patients wanted to return to work, only 26% requested work accommodation and only 28% were aware of employer-specific policies regarding returning to work.[32] A meta-analysis of randomized interventions to enhance the return to work among cancer patients demonstrated that multidisciplinary interventions (vocational counseling combined with education, counseling, and physical and behavioral training) were more effective in promoting a return to work than regular care. Widespread interventions to promote a return to work among patients with gynecologic cancer are not currently available and should be the focus of future studies.

Strengths and Limitations

Our study is subject to a number of limitations. First, our result that 16–22% of patients with gynecologic cancer experience employment disruption is likely an underestimate given the selection bias derived from our inclusion criteria and the database itself. We limited our study to working-age patients with continuous, employer-sponsored insurance coverage before and after diagnosis; therefore, we selected a population with a high potential for employment retention. This is exemplified by the very low rate of employment disruption in the control group. Furthermore, women who disenrolled from their insurance within 12 months after diagnosis, were self-employed, or were on a family member's plan were not captured. However, women who left the workforce but maintained their insurance benefits, via COBRA or other means, were

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included. In addition, though MarketScan does not provide staging information, we likely selected a population with early-stage disease; these individuals would also have the highest potential for employment retention.[34] This is best exemplified by the patients with ovarian cancer, of whom 40% underwent surgery only (without chemotherapy) in the year following diagnosis. This implies that these patients had early-stage cancer, although early-stage cancer accounts for few of all ovarian cancer diagnoses. In addition, the database itself is limited to patients with employer-sponsored insurance, and it has been demonstrated that public insurance and a lack of insurance are associated with employment disruption following cancer therapy.[35] Because MarketScan primarily receives data from large employers, the vast majority of the population in this study was protected by the Americans With Disabilities Act, and the Family and Medical Leave Act, and likely had access to paid sick leave.

As in all observational studies, our results are subject to bias from unmeasured confounding. Though we could not adjust for the oncologic variables that MarketScan does not contain (histology, grade, stage) and important patient characteristics such as race, socioeconomic status, and marital status, our sensitivity analysis demonstrated that substantial confounding would be necessary to undermine the risk of employment disruption in patients with gynecologic cancer compared with controls. Finally, we defined the study outcome using categories provided by MarketScan and the majority of the recorded employment changes were from full- or part-time employment to 'other/unknown' and it is not clear what this variable signifies. In a study by Hassett and colleagues[27] that used similar methodology to ours, the authors assumed that a change in status to 'unknown' reflected a major change in employment status, as these women were not working in their old jobs and were unlikely to start a new job while receiving treatment for cancer.

Despite these limitations, we demonstrated in this population-based study that approximately 21% of women with a gynecologic malignancy and employer-subsidized health insurance experienced a change in employment status in the year following diagnosis, and that these women were at approximately a threefold higher risk of employment disruption than controls. These data demonstrate that employment disruption is likely a challenge to functional recovery for gynecologic cancer survivors and that it should be addressed during the course of their oncologic care. Future studies are necessary to develop strategies for mitigation in this patient population.

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