Absenteeism associated with gynecologic cancer in the United States

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Abstract

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Background: Diagnosis of gynecologic cancer (GC) has been associated with employment disruption (decrease in work hours or cessation of work altogether) and identified as a substantial contributor to financial hardship. To our knowledge, no studies to date have quantified absenteeism (time spent off work due to illness) or the attributable indirect cost following a diagnosis of GC.

Objective: To quantify the incremental impact of non-metastatic and metastatic gynecologic cancer (nmGC and mGC) on absenteeism, in the year following diagnosis, among commercially insured women in the US.

Methods: Retrospective cohort study using MarketScan health insurance claims data. Incident GC patients were identified between May 1st, 2016 to December 31st, 2019 and followed for up to one year after diagnosis. Non-cancer controls were matched 3:1 to GC cases. Mean annual workdays lost was calculated as the sum of days missed due to nonrecreational absenteeism, short-term, and long-term disability during the follow-up period. The indirect cost attributable to workdays lost was calculated assuming an 8-hour workday and using the US average hourly wage (May 2022). Kaplan-Meier sample average technique was employed to calculate workdays lost while accounting for participants who were censored during follow-up, and bootstrapping was performed to generate 95% confidence intervals (CI).

Results: In the year following GC diagnosis, on average, women with nmGC lost 6.1 (95% CI: 5.4 – 6.7) incremental workdays, corresponding to an indirect cost of $1,555 (95% CI: $1,390 – $1,720), and women with mGC experienced more absenteeism, having 17.6 (95% CI: 14.6 – 20.8) incremental workdays lost with an indirect cost of $4,497 (95% CI: $3,727 – $5,314).

Discussion: We found that women with non-metastatic or metastatic gynecologic cancer missed significantly more workdays when compared with matched non-cancer controls. This analysis primarily assessed full-time employees with employer-sponsored private health insurance and disability benefits, therefore the results may not be generalizable to the broader US population. The results of this analysis may be used to inform societal perspective economic models.

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1. Introduction

Gynecologic cancers in the US are expected to account for an estimated 115,130 new cancer cases and 32,830 deaths in 2022.[1] The five main types of gynecologic cancer, from highest to lowest incidence, are: uterine, ovarian, cervical, vulvar, and vaginal.[1] While there are differences in symptoms and severity across types of gynecologic cancer, survival is primarily associated with cancer stage, with non-metastatic gynecologic cancer having the best prognosis.[2]

Gynecologic cancer is likely to impact workplace productivity and/or employment status because most cases are diagnosed in women of working age.[3] One study found that approximately 21% of commercially insured patients with gynecologic cancer experienced a decrease in employment in the year following diagnosis.[4] Loss of income stemming from employment disruption (decrease in work hours or cessation of work altogether) has been identified as a substantial contributor to financial hardship faced by patients with gynecologic cancer.[5] However, to the best of our knowledge, no studies to date have quantified missed worktime or the attributable indirect cost following a diagnosis of gynecologic cancer.

New treatment options offering greater time to progression, fewer adverse treatment effects, or less frequent provider visits, in addition to providing clinical and humanistic benefit, may alleviate some of the financial burden incurred by patients due to missed worktime. Understanding the current impact of gynecologic cancer on patient productivity may be useful in assessing the value of new treatment options.

Productivity loss is generally classified into absenteeism (time spent off work due to illness) and presenteeism (reduced work performance due to illness).[6] The objective of this study was to quantify the incremental impact of non-metastatic gynecologic cancer (nmGC) and metastatic gynecologic cancer (mGC) on absenteeism among commercially insured women in the US.

2. Methods

2.1 Study Design and Data Source

We conducted a matched retrospective cohort study, using health insurance claims data, to quantify the number of workdays lost among US women in the year following a new diagnosis of nmGC or mGC versus matched controls.

The MarketScan Commercial Claims and Encounters (CCAE) and Health and Productivity Management (HPM) databases were used to identify patients and capture absenteeism, respectively. The CCAE database contains a convenience sample of medical and pharmacy claims from US beneficiaries with employer-sponsored private health insurance. The HPM database contains workplace absence, short-term, and long-term disability information collected by employers for a subset of beneficiaries in the CCAE database with employer-sponsored disability benefits.[7]

The study period was from October 1st, 2015 (US implementation of International Classification of Diseases 10th revision [ICD-10] coding) through December 31st, 2020 (the end of available data) (Figure 7.1). The index period was from May 1st, 2016, through December 31st, 2019, to allow for one year of potential follow-up. A 6-month washout period from October 1st, 2015, through April 30th, 2016, was implemented to remove prevalent cases.

At the time of the analysis, MarketScan data met Health Insurance Portability and Accountability Act of 1996 (HIPAA) requirements for fully de-identified data sets.[7] Institutional Review Board (IRB) approval at the University of Washington was not required, as the study met criteria for non-human subjects research as specified by the Human Subjects Division at the University of Washington.

2.2 Sample Selection

Cases

We used the CCAE database to identify patients with gynecologic cancer (GC), defined as having ≥2 outpatient claims on separate days or ≥1 inpatient claim with a GC diagnosis in any billing position during the study period.[8] Patients having ≥1 claim with a diagnosis of a secondary malignancy in any billing position within 12 months following their initial GC diagnosis were included in the mGC cohort, and patients with no secondary malignancy diagnoses were in the nmGC cohort. The first claim with a

diagnosis of GC in the index period was selected to serve as the index date for patients in the nmGC cohort, and the first claim carrying a secondary malignancy diagnosis during the index period, following initial GC diagnosis, was selected as the index date for patients in the mGC cohort.

We required GC patients to meet the following inclusion criteria: (1) continuous insurance enrollment for ≥6 months before initial GC diagnosis to ensure incident cancer, (2) ≥6 months continuous insurance enrollment before index date to calculate comorbidity index score, (3) female sex, (4) age 18-63 at index to ensure working age, (5) full-time or part-time employment at index to ensure working status, (6) primary beneficiary status to allow for linkage of absenteeism, short-term disability, and long-term disability (ABS+STD+LTD) data, and (7) ≥1 month follow-up after index with continuous insurance enrollment, ABS+STD+LTD eligibility, and no decrease in employment status.

Patients with a GC diagnosis in any billing position during the washout period were excluded as prevalent cases. We also excluded any patients with a diagnosis of primary cancer other than GC, in any billing position, during study period to ensure GC was the primary cancer and that any secondary malignancies were GC metastases.

Controls

We used the CCAE database to identify control patients by selecting a random inpatient or outpatient medical claim during the index period to serve as the index date. Controls were required to meet the following inclusion criteria: (1) ≥6 months continuous insurance enrollment before index date to calculate comorbidity index score, (2) female sex, (3) age 18-63 at index to ensure working age, (4) full-time or part-time employment at index to ensure working status, (5) primary beneficiary status to allow for linkage of ABS+STD+LTD data, and (6) ≥1 month follow-up after index with continuous insurance enrollment, ABS+STD+LTD eligibility, and no decrease in employment status. Patients with a diagnosis of any cancer, in any billing position, during the study period were excluded to avoid bias, as cancer was not included in the comorbidity index calculation, as described in section 2.3.

Matching

We employed greedy nearest neighbor propensity score matching to match controls 3:1 to GC cases based on age, comorbidity index, region, year of index, employment status (full-time vs part-time), and insurance plan type.[9-12] Matching was performed separately for nmGC and mGC cohorts.

2.3 Study Measures and Outcomes

Baseline characteristics including patient age, region, year of index, insurance plan type, and employment status were assessed on index date. We calculated a modified Charlson Comorbidity Index, which excluded malignancies to avoid biasing the case-control match, using ICD-10 diagnosis codes on medical claims collected during the 6-month pre-index period.[13-15]

The primary outcome of interest was mean annual workdays lost, defined as the sum of days missed due to nonrecreational absenteeism, short-term disability (STD), and long-term disability (LTD). Non-recreational absenteeism included time off due to sickness, disability, leave, Family Medical Leave Act, or other, but excluded recreational time off.

The secondary outcome of interest was the indirect cost attributable to workdays lost which was calculated assuming an 8-hour workday and using the seasonally adjusted average hourly earnings of $31.95 for all employees on private nonfarm payrolls in May 2022, as reported by the US Bureau of Labor Statistics (BLS).[16]

2.4 Statistical Analysis

Baseline characteristics were summarized with mean and standard deviation (SD) for continuous variables, and count and percentage for categorical variables. Differences between matched cohorts were assessed via absolute standardized mean difference (ASMD), with an ASMD of ≤0.2 considered small.[17]

Kaplan-Meier sample average (KMSA) technique was employed to calculate workdays lost to account for patients who were censored during follow-up due to break in continuous enrollment, break in ABS+STD+LTD eligibility, or decrease in employment status. We divided the follow-up period into 1-

month intervals, multiplied mean workdays lost in each interval by the survival probability at the beginning of the interval, then summed across the intervals.[18] Balanced bootstrapping with 10,000 replicates was performed to generate 95% confidence intervals (CI) to estimate uncertainty in workdays lost.[19] Significance of the difference in mean workdays lost was assessed using unpaired t-tests.

Cohort selection and statistical analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC).

3. Results

3.1 Baseline Characteristics

From the MarketScan CCAE inpatient and outpatient services tables, we identified 39 million individuals with claims during the index period of May 1st, 2016 to December 31st, 2019. From this population, 22,243 incident GC cases were identified, with 9,407 meeting eligibility criteria for the analysis (Figure 7.2). The study population included 8,143 nmGC patients with 24,429 matched controls and 1,264 mGC patients with 3,792 matched controls. Roughly half of GC cases had uterine cancer (53.1%), followed by ovarian (25.5%), cervical (20.5%), vulvar (2.7%), and vaginal (0.7%) cancers.

Compared with the nmGC cohort, on average, patients with mGC were slightly older (52.1 vs 50.0 years) and had numerically higher comorbidity index scores (0.55 vs 0.41) (Table 6.1). In both GC cohorts, patients were more likely to reside in the South than any other region, and the most common insurance plan type was preferred provider organization (PPO). Nearly all patients were full-time employees. ASMD was less than 0.2 for all characteristics among the matched cohorts, signifying no substantial differences in baseline characteristics.

3.2 Primary Outcome

Mean annual workdays lost was significantly higher for women with nmGC (8.2 [95% CI: 7.5 – 8.8]) versus matched controls (2.1 [95% CI: 1.9 – 2.3]) ($p<0.001$), as well as for women with mGC (19.6 [95% CI: 16.6 – 22.8]) versus matched controls (2.0 [95% CI: 1.6 – 2.5]) ($p<0.001$) (Table 6.2 & Figure 7.3). Incremental mean workdays lost was 6.1 (95% CI: 5.4 – 6.7) for women with nmGC and 17.6 (95% CI: 14.6 – 20.8) for women with mGC.

3.3 Secondary Outcome

The indirect cost attributable to mean workdays lost was $2,087 (95% CI: $1,927 – $2,245) for women with nmGC versus $531 (95% CI: $487 – $578) for matched controls, and $5,013 (95% CI: $4,248 – $5,825) for women with mGC versus $517 (95% CI: $407 – $635) for matched controls (Table 6.2 & Figure 7.3). The incremental indirect cost was $1,555 (95% CI: $1,390 – $1,720) for women with nmGC and $4,497 (95% CI: $3,727 – $5,314) for women with mGC.

4. Discussion

We conducted a retrospective cohort study using MarketScan claims data to quantify the number of workdays lost associated with nmGC or mGC among commercially insured US women in the year following cancer diagnosis. On average, women with nmGC lost 6.1 incremental workdays, corresponding to an indirect cost of $1,555, and women with mGC experienced more absenteeism, having 17.6 incremental workdays lost with an indirect cost of $4,497. These results highlight the economic burden of lost worktime associated with gynecologic cancer and may be used to inform societal perspective economic models to assess the value of novel therapies that result in less workplace disruption.

To our knowledge, this is the first study to analyze absenteeism among employed women diagnosed with gynecologic cancer. We identified a retrospective cohort study assessing absenteeism associated with breast cancer which also used the MarketScan HPM database.[20] This study found that women with breast cancer missed 16 incremental workdays compared to matched controls but did not stratify by stage. Our study found fewer workdays lost among women with nmGC but similar workdays lost for women with mGC. Both studies assessed women with employer-sponsored private health insurance and disability benefits. Notably, the breast cancer study calculated workdays lost as the sum of absenteeism (including recreational time off) and STD (but not LTD), while our study used the sum of non-recreational absenteeism, STD, and LTD. Additionally, the difference in results may reflect differences in treatment, symptoms, and prognosis between breast and gynecologic cancers, as well as underlying differences in study population characteristics.

Our study has several limitations. First, to achieve sufficient sample size, we grouped gynecologic cancers together for our analysis and stratified by presence of metastases to capture differences in

cancer stage. However, we recognize that there are differences in mean age of diagnosis, symptoms, treatment, and prognosis across gynecologic cancer types which may differentially impact productivity loss. Future studies could assess workdays lost separately for each gynecologic cancer type.

This analysis primarily assessed full-time employees with employer-sponsored private health insurance and disability benefits. Therefore, the results may not be generalizable to the broader US population. According to the BLS, over 80% of low-income workers do not have access to disability benefits, and about half do not have paid sick leave.[21] We hypothesize that low-income patients may be less likely to miss workdays but may face larger financial consequences from missed worktime. This is especially important considering cervical cancer disproportionately affects low-income women.[22] Future studies should leverage datasets with productivity loss data for low-income patients and, if possible, analyze the financial impact of productivity loss in this population.

While the MarketScan HPM database contains employer-collected information for nonrecreational absenteeism, STD, and LTD, this may not be comprehensive of all missed worktime; for example, if a woman were to leave work early for a provider visit, this may not be captured. Additionally, to be conservative in our definition of absenteeism associated with GC, we did not assess differences in recreational absenteeism. Finally, we did not have information on presenteeism which is an important facet of productivity loss that many patients may experience following a diagnosis of gynecologic cancer.[23] Therefore, our results likely underestimate the full impact of gynecologic cancer on workplace productivity.

5. Conclusion

Women with gynecologic cancer were found to have significantly greater workdays lost and attributable indirect costs in the year following diagnosis versus matched controls. The results of this analysis highlight the economic burden of lost worktime associated with gynecologic cancer and may be used to inform societal perspective economic models to assess the value of novel therapies that result in less workplace disruption.

6. Tables

6.1 Baseline characteristics of matched GC cohort and controls

Characteristic	nmGC			mGC		
	Cases (n = 8143)	Controls (n = 24429)	ASMD	Cases (n = 1264)	Controls (n = 3792)	ASMD
Age (years) – mean (SD)	50.0 (9.6)	50.0 (9.6)	0.01	52.1 (8.6)	52.1 (8.6)	0.01
Age (years) – n (%)						
18 – 34	703 (8.6)	2111 (8.6)	0.01	61 (4.8)	181 (4.8)	0.01
35 – 44	1576 (19.4)	4708 (19.3)	0.01	181 (14.3)	543 (14.3)	0.00
45 – 54	2513 (30.9)	7530 (30.8)	0.01	399 (31.6)	1194 (31.5)	0.01
55 – 63	3351 (41.2)	10080 (41.3)	0.01	623 (49.3)	1874 (49.4)	0.01
Insurance plan type – n (%)						
Comprehensive	80 (1.0)	237 (1.0)	0.01	6 (0.5)	16 (0.4)	0.01
EPO	67 (0.8)	196 (0.8)	0.01	11 (0.9)	30 (0.8)	0.01
HMO	1037 (12.7)	3109 (12.7)	0.01	162 (12.8)	488 (12.9)	0.01
POS	1088 (13.4)	3265 (13.4)	0.01	156 (12.3)	462 (12.2)	0.01
PPO	4044 (49.7)	12152 (49.7)	0.01	649 (51.3)	1952 (51.5)	0.01
POS with capitation	9 (0.1)	22 (0.1)	0.01	1 (0.1)	1 (0.1)	0.02
CDHP	911 (11.2)	2727 (11.2)	0.01	140 (11.1)	424 (11.2)	0.01
HDHP	785 (9.6)	2362 (9.7)	0.01	122 (9.7)	368 (9.7)	0.01
Unknown	122 (1.5)	359 (1.5)	0.01	17 (1.3)	51 (1.3)	0.00
Region – n (%)						
Northeast	1572 (19.3)	4717 (19.3)	0.01	216 (17.1)	642 (16.9)	0.01
North Central	1716 (21.1)	5159 (21.1)	0.01	284 (22.5)	845 (22.3)	0.01
South	3429 (42.1)	10299 (42.2)	0.01	541 (42.8)	1634 (43.1)	0.01
West	1396 (17.1)	4178 (17.1)	0.01	222 (17.6)	666 (17.6)	0.00
Unknown	30 (0.4)	76 (0.3)	0.01	1 (0.1)	5 (0.1)	0.02
Comorbidity index – mean (SD)	0.41 (0.88)	0.40 (0.87)	0.01	0.55 (1.04)	0.54 (1.03)	0.01
Comorbidity index – n (%)						
0	5999 (73.7)	18008 (73.7)	0.01	841 (66.5)	2527 (66.6)	0.01
1	1540 (18.9)	4616 (18.9)	0.01	292 (23.1)	881 (23.2)	0.01
2	278 (3.4)	839 (3.4)	0.01	62 (4.9)	179 (4.7)	0.01
≥3	326 (4.0)	966 (4.0)	0.01	69 (5.5)	205 (5.4)	0.01
Year of index – n (%)						
2016	1665 (20.4)	4987 (20.4)	0.01	199 (15.7)	597 (15.7)	0.00
2017	2195 (27.0)	6591 (27.0)	0.01	311 (24.6)	928 (24.5)	0.01

2018	2521 (31.0)	7580 (31.0)	0.01	412 (32.6)	1241 (32.7)	0.01
2019	1762 (21.6)	5271 (21.6)	0.01	342 (27.1)	1026 (27.1)	0.00
Employment status – n (%)						
Full-Time	7979 (98.0)	23941 (98.0)	0.01	1243 (98.3)	3723 (98.2)	0.01
Part-Time	164 (2.0)	488 (2.0)	0.01	21 (1.7)	69 (1.8)	0.01

ASMD = absolute standardized mean difference; CDHP = consumer driven health plan; EPO = exclusive provider organization; HDHP = high deductible health plan; HMO = health maintenance organization; mGC = metastatic gynecologic cancer; nmGC = non-metastatic gynecologic cancer; POS = point of service plan; PPO = preferred provider organization; SD = standard deviation

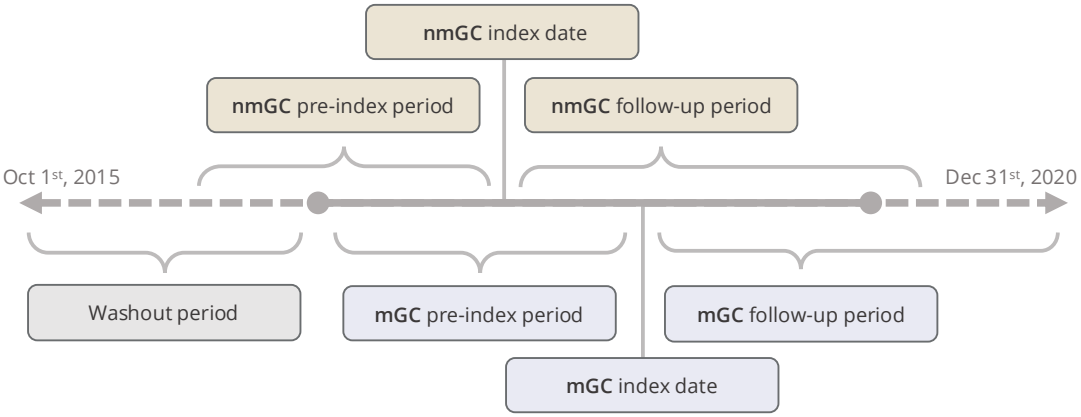
6.2 Absenteeism and attributable cost

	nmGC			mGC		
	Cases (n = 8143)	Controls (n = 24429)	p	Cases (n = 1264)	Controls (n = 3792)	p
Primary Outcome: Workdays lost (PPPY) – mean (95% CI)	8.2 (7.5–8.8)	2.1 (1.9–2.3)	<0.001	19.6 (16.6–22.8)	2.0 (1.6–2.5)	<0.001
Secondary Outcome: Estimated attributable cost (USD PPPY) – mean (95% CI)	2,087 (1,927–2,245)	531 (487–578)		5,013 (4,248–5,825)	517 (407–635)	

CI = confidence interval; mGC = metastatic gynecologic cancer; nmGC = non-metastatic gynecologic cancer; PPPY = per patient per year

7. Figures

7.1 Study design



Washout Period – No GC claims Oct 1st, 2015 – Apr 30th, 2016, to ensure incident GC

Pre-Index Period – ≥6 months continuous insurance enrollment before index date to calculate comorbidity index

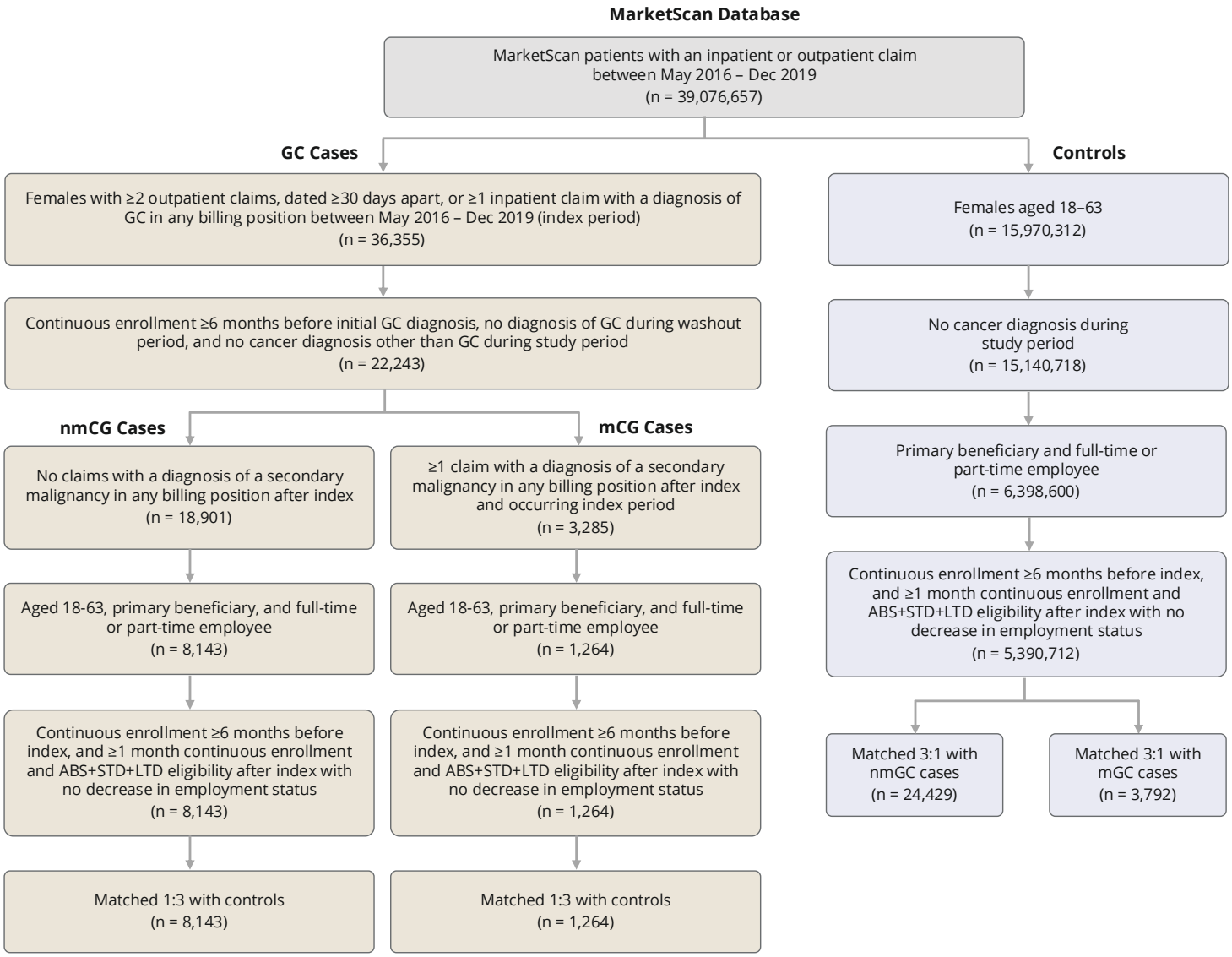
nmGC index date – First GC diagnosis between May 1st, 2016 – Dec 31st, 2019

mGC index date – First diagnosis of secondary malignancy within 1 year following initial GC diagnosis

Follow-Up Period – Up to 12 months follow-up after index date

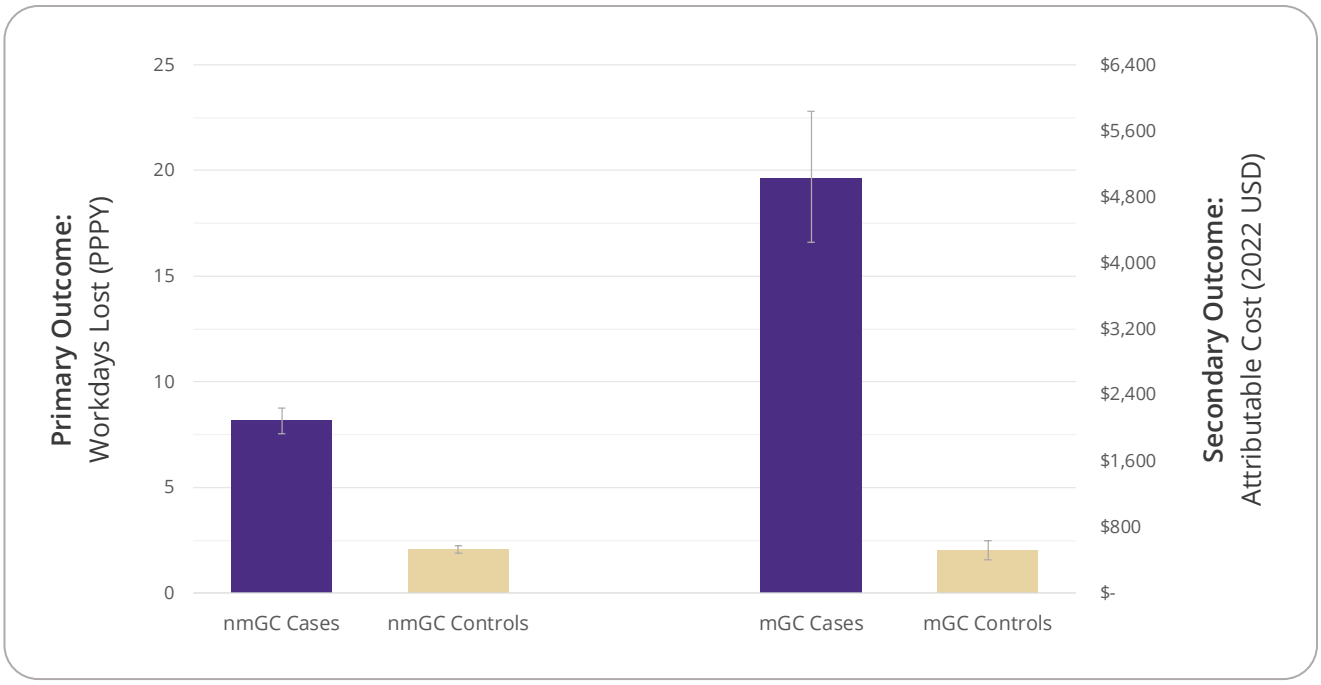
mGC = metastatic gynecologic cancer; nmGC = non-metastatic gynecologic cancer

7.2 Cohort selection process



mGC = metastatic gynecologic cancer; nmGC = non-metastatic gynecologic cancer

7.3 Bar chart of absenteeism and attributable cost



mGC = metastatic gynecologic cancer; nmGC = non-metastatic gynecologic cancer; PPPY = per patient per year; USD = United States Dollars

8. References

1. Siegel RL, Miller KD, Fuchs HE, Jemal A. Cancer statistics, 2022. *CA Cancer J Clin*. 2022;72(1):7-33. doi:10.3322/caac.21708

2. American Cancer Society. Survival Rates for Endometrial, Ovarian, Cervical, Vulvar, and Vaginal Cancers. Accessed April 10, 2022.

3. Centers for Disease Control and Prevention. Gynecologic Cancer Incidence, United States—2012-2016. https://www.cdc.gov/cancer/uscs/about/data-briefs/no11-gynecologic-cancer-incidence-UnitedStates-2012-2016.htm. Accessed Jun 6, 2022.

4. Nitecki R, Fu S, Jorgensen KA, et al. Employment disruption among women with gynecologic cancers. *Int J Gynecol Cancer*. 2022;32(1):69-78. doi:10.1136/ijgc-2021-002949

5. Zeybek B, Webster E, Pogosian N, et al. Financial toxicity in patients with gynecologic malignancies: a cross sectional study. *J Gynecol Oncol*. 2021;32(6):e87. doi:10.3802/jgo.2021.32.e87

6. Gosselin E, Lemyre L, Corneil W. Presenteeism and absenteeism: differentiated understanding of related phenomena. *J Occup Health Psychol*. 2013;18(1):75-86. doi:10.1037/a0030932

7. IBM MarketScan Research Databases for life sciences researchers. IBM Corporation. 2021. https://www.ibm.com/downloads/cas/OWZWJ0QO. Accessed May 30, 2022.

8. Esposito DB, Banerjee G, Yin R, et al. Development and Validation of an Algorithm to Identify Endometrial Adenocarcinoma in US Administrative Claims Data. *J Cancer Epidemiol*. 2019;2019:1938952. Published 2019 Nov 3. doi:10.1155/2019/1938952

9. Parsons LS. Reducing bias in a propensity score matched-pair sample using greedy matching techniques. 2001. In SAS SUGI 26, Paper 214-26. Available at: https://support.sas.com/resources/papers/proceedings/proceedings/sugi26/p214-26.pdf. Accessed May 5, 2022.

10. Stuart EA. Matching methods for causal inference: A review and a look forward. *Stat Sci*. 2010;25(1):1-21. doi:10.1214/09-STS313

11. Rassen JA, Shelat AA, Myers J, Glynn RJ, Rothman KJ, Schneeweiss S. One-to-many propensity score matching in cohort studies. *Pharmacoepidemiol Drug Saf*. 2012;21 Suppl 2:69-80. doi:10.1002/pds.3263

12. Austin PC. An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies. *Multivariate Behav Res*. 2011;46(3):399-424. doi:10.1080/00273171.2011.568786

13. Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. *J Clin Epidemiol.* 1994;47(11):1245-1251. doi:10.1016/0895-4356(94)90129-5

14. Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Med Care.* 2005;43(11):1130-1139.

15. Quan H, Li B, Couris CM, et al. Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *Am J Epidemiol*. 2011;173(6):676-682. doi:10.1093/aje/kwq433

16. US Bureau of Labor Statistics. Average hourly and weekly earnings of all employees on private nonfarm payrolls by industry sector, seasonally adjusted. https://www.bls.gov/news.release/empsit.t19.htm. Accessed Jun 5, 2022.

17. Andrade C. Mean Difference, Standardized Mean Difference (SMD), and Their Use in Meta-Analysis: As Simple as It Gets. *J Clin Psychiatry*. 2020;81(5):20f13681. Published 2020 Sep 22. doi:10.4088/JCP.20f13681

18. Etzioni R, Urban N, Baker M. Estimating the costs attributable to a disease with application to ovarian cancer. *J Clin Epidemiol*. 1996;49(1):95-103. doi:10.1016/0895-4356(96)89259-6

19. Gleason, J. R. (1988). Algorithms for Balanced Bootstrap Simulations. *American Statistician* 42:263–266.

20. Fu AZ, Chen L, Sullivan SD, Christiansen NP. Absenteeism and short-term disability associated with breast cancer. *Breast Cancer Res Treat*. 2011;130(1):235-242. doi:10.1007/s10549-011-1541-z

21. US Department of Labor. National Compensation Survey: Employee Benefits in the United States, March 2021. https://www.bls.gov/ncs/ebs/benefits/2021/employee-benefits-in-the-united-states-march-2021.pdf. Accessed Jun 5, 2022.

22. Bradley CJ, Given CW, Roberts C. Health care disparities and cervical cancer. *Am J Public Health*. 2004;94(12):2098-2103. doi:10.2105/ajph.94.12.2098

23. Nachreiner NM, Shanley R, Ghebre RG. Cancer and treatment effects on job task performance for gynecological cancer survivors. *Work*. 2013;46(4):433-438. doi:10.3233/WOR-131752

9. Appendices

9.1 Appendix A – ICD-10 diagnosis codes

Type of Cancer	ICD-10	Notes
Gynecologic cancer		*To identify GC cases*
Uterine	C54, C55	
Ovarian	C56	
Cervical	C53	
Vulvar	C51	
Vaginal	C52	
Secondary malignancy	C77 – C80	*To identify mGC cases*
Cancer other than gynecologic	C00 – C50, C60 – C97	*To ensure incident GC*
Any cancer	C00 – C97	*To identify non-cancer controls*

ICD-10 = International Classification of Diseases 10th revision; GC = gynecologic cancer; mGC = metastatic gynecologic cancer

9.2 Appendix B – Gynecologic cancer type

Type of Cancer	nmGC	mGC	Overall
Gynecologic cancer – n (%)	n = 8,143	n = 1,264	n = 9,407
Uterine	4379 (53.8)	612 (48.4)	4991 (53.1)
Ovarian	1935 (23.8)	462 (36.6)	2397 (25.5)
Cervical	1712 (21.0)	219 (17.3)	1931 (20.5)
Vulvar	228 (2.8)	25 (2.0)	253 (2.7)
Vaginal	48 (0.6)	20 (1.6)	68 (0.7)

mGC = metastatic gynecologic cancer; nmGC = non-metastatic gynecologic cancer

9.3 Appendix C – Baseline characteristics of GC cohort and controls before match

Characteristic	Controls (n = 5,390,712)	nmGC		mGC	
		Cases (n = 8,143)	ASMD	Cases (n = 1,264)	ASMD
Age (years) – mean (SD)	42.2 (11.4)	50.0 (9.6)	0.73	52.1 (8.6)	0.97
Age (years) – n (%)					
18 – 34	1,678,397 (31.1)	703 (8.6)	0.59	61 (4.8)	0.73
35 – 44	1,347,106 (25.0)	1,576 (19.4)	0.14	181 (14.3)	0.27
45 – 54	1,353,515 (25.1)	2,513 (30.9)	0.13	399 (31.6)	0.14
55 – 63	1,011,694 (18.8)	3,351 (41.2)	0.50	623 (49.3)	0.68
Insurance plan type – n (%)					
Basic / major medical	240 (0.1)	0	0.01	0	0.01
Comprehensive	46,955 (0.9)	80 (1.0)	0.01	6 (0.5)	0.05
EPO	39,517 (0.7)	67 (0.8)	0.01	11 (0.9)	0.02
HMO	583,190 (10.8)	1,037 (12.7)	0.06	162 (12.8)	0.06
POS	677,846 (12.6)	1,088 (13.4)	0.02	156 (12.3)	0.01
PPO	2,704,120 (50.2)	4,044 (49.7)	0.01	649 (51.3)	0.02
POS with capitation	4,850 (0.1)	9 (0.1)	0.01	1 (0.1)	0.01
CDHP	616,643 (11.4)	911 (11.2)	0.01	140 (11.1)	0.01
HDHP	631,587 (11.7)	785 (9.6)	0.01	122 (9.7)	0.07
Unknown	85,764 (1.6)	122 (1.5)	0.01	17 (1.3)	0.02
Region – n (%)					
Northeast	875,873 (16.2)	1,572 (19.3)	0.08	216 (17.1)	0.02
North Central	1,088,200 (20.2)	1,716 (21.1)	0.02	284 (22.5)	0.06
South	2,426,678 (45.0)	3,429 (42.1)	0.06	541 (42.8)	0.04
West	990,944 (18.4)	1,396 (17.1)	0.03	222 (17.6)	0.02
Unknown	9,017 (0.2)	30 (0.4)	0.04	1 (0.1)	0.03
Comorbidity index – mean (SD)	0.19 (0.58)	0.41 (0.88)	0.29	0.55 (1.04)	0.42
Comorbidity index – n (%)					
0	4,626,872 (85.8)	5,999 (73.7)	0.31	841 (66.5)	0.46
1	610,937 (11.3)	1,540 (18.9)	0.21	292 (23.1)	0.32
2	82,053 (1.5)	278 (3.4)	0.12	62 (4.9)	0.19
≥3	70,850 (1.3)	326 (4.0)	0.17	69 (5.5)	0.23
Year of index – n (%)					
2016	1,343,685 (24.9)	1,665 (20.4)	0.11	199 (15.7)	0.23
2017	1,214,058 (22.5)	2,195 (27.0)	0.10	311 (24.6)	0.05

2018	1,409,634 (26.1)	2,521 (31.0)	0.11	412 (32.6)	0.14
2019	1,423,332 (26.4)	1,762 (21.6)	0.11	342 (27.1)	0.01
Employment status – n (%)					
Full-Time	5,279,236 (97.9)	7,979 (98.0)	0.01	1,243 (98.3)	0.03
Part-Time	111,476 (2.1)	164 (2.0)	0.01	21 (1.7)	0.03

ASMD = absolute standardized mean difference; CDHP = consumer driven health plan; EPO = exclusive provider organization; HDHP = high deductible health plan; HMO = health maintenance organization; mGC = metastatic gynecologic cancer; nmGC = non-metastatic gynecologic cancer; POS = point of service plan; PPO = preferred provider organization; SD = standard deviation