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ARTICLE

Annual Medical Expenditure and Productivity Loss Among Colorectal, Female Breast, and Prostate Cancer Survivors in the United States

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Abstract

Background: There are limited nationally representative estimates of the annual economic burden among survivors of the three most prevalent cancers (colorectal, female breast, and prostate) in both nonelderly and elderly populations in the United States.

Methods: The 2008 to 2012 Medical Expenditure Panel Survey data were used to identify colorectal (n = 540), female breast (n = 1568), and prostate (n = 1170) cancer survivors and individuals without a cancer history (n = 109 423). Excess economic burden attributable to cancer included per-person excess annual medical expenditures and productivity losses (employment disability, missed work days, and days stayed in bed). All analyses were stratified by cancer site and age (nonelderly: 18–64 years vs elderly: ≥65 years). Multivariable analyses controlled for age, sex, race/ethnicity, marital status, education, number of comorbidities, and geographic region. All statistical tests were two-sided.

Results: Compared with individuals without a cancer history, cancer survivors experienced annual excess medical expenditures (for the nonelderly population, colorectal: $8647, 95% confidence interval [CI] = $4932 to $13 974, $P < .001$; breast: $5119, 95% CI = $3439 to $7158, $P < .001$; prostate: $3586, 95% CI = $1792 to $6076, $P < .001$; for the elderly population, colorectal: $4913, 95% CI = $2768 to $7470, $P < .001$; breast: $2288, 95% CI = $814 to $3995, $P = .002$; prostate: $3524, 95% CI = $1539 to $5909, $P < .001$). Nonelderly colorectal and breast cancer survivors experienced statistically significant annual excess employment disability (13.6%, $P < .001$, and 4.8%, $P = .001$) and productivity loss at work (7.2 days, $P < .001$, and 3.3 days, $P = .002$) and at home (4.5 days, $P < .001$, and 3.3 days, $P = .003$). In contrast, elderly survivors of all three cancer sites had comparable productivity losses as those without a cancer history.

Conclusions: Colorectal, breast, and prostate cancer survivors experienced statistically significantly higher economic burden compared with individuals without a cancer history; however, excess economic burden varies by cancer site and age. Targeted efforts will be important in reducing the economic burden of colorectal, breast, and prostate cancer.

In 2014, an estimated 14.5 million individuals with a history of cancer were alive in the United States. This number is projected to increase because of growth and aging of the population and improved survival associated with advances in early detection and treatment (1,2). Compared with individuals without a cancer history, cancer survivors in aggregate face greater economic burden, including medical expenditures and productivity losses (3–10). However, little is known about whether and how these

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components of economic burden vary by cancer site in comparison with similar individuals without a cancer history. Moreover, the excess economic burden associated with cancer is likely to vary by age because younger cancer survivors are more likely to receive aggressive treatments than older cancer survivors (1,11–13). Information on the total and excess economic burden by cancer site and age can help plan, implement, and evaluate interventions that target cancer survivors who are most economically vulnerable (4,14,15). To our knowledge, there are limited nationally representative estimates of the total and excess economic burden by cancer site in both nonelderly and elderly populations.

To date, the majority of studies with detailed information on economic burden by cancer site were conducted among elderly Medicare beneficiaries (2,4,14,16–18), only addressed medical expenditures, and did not include non-Medicare expenditures from other payers and patient out-of-pocket (OOP) cost, which account for about 40% of total expenditures (3). Similarly, previous studies examining the economic burden by cancer site among nonelderly cancer survivors were limited to direct medical expenditures and were based on survivors enrolled in health maintenance organizations or employer-based insurance programs (19–21). Several of these studies were based on data from the early 1990s and will not reflect contemporary cancer survivorship care (19,21). Moreover, productivity losses by cancer site are rarely addressed for nonelderly cancer survivors or for elderly survivors who are still working (15). Nationally representative estimates of cancer site–specific total and excess medical expenditures and productivity losses among both nonelderly and elderly cancer survivors are important for policy makers to better understand the needs of survivors, prioritize cancer survivorship programs, and monitor the effect public health policies such as the Affordable Care Act (ACA) may have on the economic burden of cancer survivors. However, because of differences in study populations, data sources, measurements of economic burden, and statistical methods, it is difficult to have consistent estimates of the total and excess economic burden across age groups and cancer sites (15,20,22–24).

Herein, we provide nationally representative estimates of annual total economic burden among colorectal, female breast, and prostate cancer survivors by age group and cancer site. Moreover, we examine the excess economic burden associated with the three most prevalent cancers compared with individuals without a cancer history. In this paper, we report the annual economic burden for cancer survivors, including medical expenditures and productivity losses (employment disability, missed work days, and days stayed in bed).

Methods

Data Sources

The 2008 to 2012 Medical Expenditure Panel Survey (MEPS) Household Component (HC) data were used to identify colorectal, female breast, and prostate cancer survivors and individuals without a cancer history. The MEPS is a nationally representative survey of the US civilian noninstitutionalized population conducted by the Agency for Healthcare Research and Quality (AHRQ). It collects detailed information on demographic characteristics, comorbid conditions, payments for medical care, health insurance coverage, and family income. The survey response rates ranged from 53.5% to 59.3% from 2008 to 2012. A detailed description of the MEPS can be found elsewhere (25).

In the MEPS, cancer status is self-reported. Survey respondents were asked whether they had ever been told by a doctor or other health professional that they had cancer or a malignancy of any kind, followed by another question about the type of cancer. We identified all adults who reported colorectal, female breast, or prostate cancer among nonelderly (age 18–64 years) and elderly (age 65+ years) survey respondents. The final sample consisted of colorectal (nonelderly: n = 169; elderly: n = 371), breast (nonelderly: n = 777; elderly: n = 791), and prostate (nonelderly: n = 281; elderly: n = 889) cancer survivors and individuals without a cancer history (nonelderly: n = 95 640; elderly: n = 13 792). For breast and prostate cancer survivors, we created comparison groups by stratifying individuals without a cancer history by sex: men (nonelderly: n = 45 465; elderly: n = 5614) and women (nonelderly: n = 50 175; elderly: n = 8178).

Patient-Level Characteristics

Patients' demographic and clinical variables included in the analyses were age (18–49, 50–64, 65–79, or 80+ years), sex, race/ethnicity (non-Hispanic white or other), educational attainment (≤ high school graduate or ≥ some college), marital status, family income level by quartiles, geographic region (Northeast, Midwest, South, or West), number of comorbid conditions (0, 1, 2, or 3+), and health insurance coverage. Health insurance coverage was defined differently for the two age groups (for nonelderly population: any private or other; for elderly population: Medicare and private or other [Medicare and public, Medicare only, or other]). A treatment status variable was created to identity cancer survivors who were receiving cancer related treatments at the time of the MEPS survey (26). We used the MEPS medical event files to search for any prescriptions for antineoplastic agents in Prescribed Medicines File or receipt of chemotherapy, radiation therapy, or surgery related to cancer in Outpatient Visits File, Office-Based Medical Provider Visits File, and Hospital Inpatient Stays File. The treatment status variable is highly correlated with time since diagnosis (4). We used age at the time of the survey and age at cancer diagnosis to calculate time since diagnosis. Prior studies using this approach have identified recently diagnosed and previously diagnosed as less two years and two or more years, respectively (3). Therefore, we further stratify the treatment status variable by two years since diagnosis.

Economic Burden Measures

Figure 1 shows the definitions and relationships of the components of economic burden measured in this study, including medical expenditures and productivity losses. Medical expenditures are payments for health care services provided during the year, including office and inpatient–based and outpatient hospital–based care, home health care, dental services, vision aids, and prescribed medicines. The total medical expenditure was further examined by source of payment (OOP, private health insurance, Medicare, Medicaid, or other) and type of services (ambulatory care, inpatient care, prescription medications, or other services). Ambulatory care included office-based provider visits and outpatient visits. All medical expenditures were adjusted to 2012 dollars using the price indices recommended by the AHRQ for use with the MEPS (27).

Productivity losses included monetary measures of probability of employment disability, number of missed work days, and number of days stayed in bed (shown in Figure 1). In the MEPS, all respondents were asked about their employment

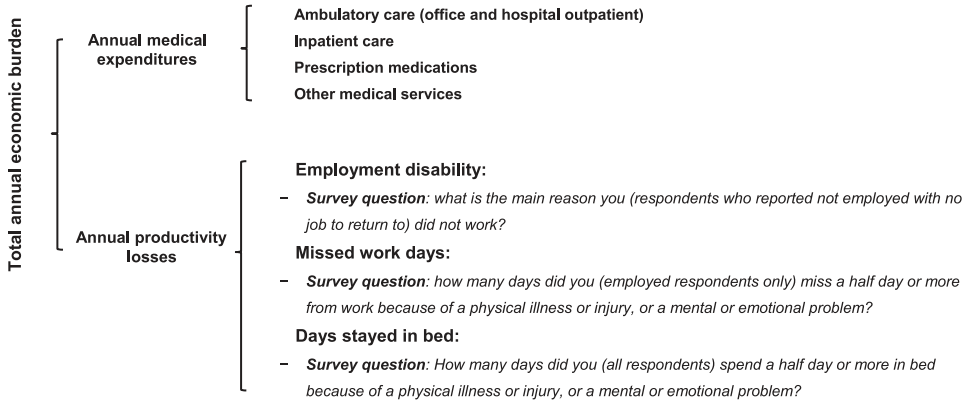

Figure 1. A diagram of total annual economic burden measured in the current study. Medical expenditures include the sum of payments for ambulatory care, inpatient care, prescription medications, and other medical services provided during the year. Medical expenditures are measured at the event level for each participant and can also be itemized by source of payment (out-of-pocket [OOP], private health insurance, Medicare, Medicaid, or other). OOP includes all payments for health care services provided during the year that were paid by respondents. Productivity losses include employment disability, missed work days, and days stayed in bed. Monetary value of employment disability = year 2012 annual median wage ($34 764) × probability of employment disability; monetary value of number of missed work days = year 2012 median national daily wage (median hourly wage $16.7 × 6 hours) × number of missed work days; monetary value of days stayed in bed = year 2012 daily home productivity ($42) × number of days stayed in bed. Medical expenditures and measures of employment disability, missed work days, and days stayed in bed contained in the Medical Expenditure Panel Survey Household Component file.

status and the main reason for not working. Respondents can choose one of the following options as the main reason for not working: 1) could not find work, 2) retired, 3) ill health, 4) on temporary layoff, 5) maternity/paternity leave, 6) going to school, 7) taking care of home or family, 8) wanted some time off, 9) wanting to start new job, 10) other. Therefore, employment disability was identified among those who were not employed with no job to return to and reported "unable to work because ill/disabled" as the main reason for both nonelderly and elderly populations. The number of missed work days was limited to nonelderly and elderly respondents who worked during the survey year. We used the probability of employment disability multiplied by 2012 annual median wage ($34 764) to calculate per capita wage loss (28). Per capita productivity loss at work was calculated by multiplying the number of missed work days by the number of working hours (assuming 6 hours per day) and the 2012 median hourly wage ($16.7). Per capita productivity loss at home was calculated by multiplying the number of days stayed in bed by 2012 daily home productivity ($42). The total productivity loss is the sum of monetary measures of all three items.

Statistical Methods

Distributions of patient-level characteristics were examined and compared between cancer survivors and individuals without a cancer history using Pearson's chi-squared test. Adjusted analyses estimated medical expenditures and productivity losses among cancer survivors and individuals without a cancer history, controlling for differences in age, race/ethnicity, sex (colorectal cancer only), educational attainment, marital status, number of comorbid conditions, health insurance coverage (total medical expenditure only), and geographic region. Excess economic burden associated with cancer was measured by the differences in adjusted medical expenditures and productivity losses between cancer survivors and individuals without a cancer history. A generalized linear regression with a gamma distribution was utilized for medical expenditures. A logistic regression model was utilized to estimate the probability of employment disability, and a negative binomial regression was utilized for number of missed work days and days stayed in bed. Predictive margins were generated in all adjusted analyses and used to estimate the excess economic burden faced by survivors of each cancer site (3,29,30). Analytic files were created using SAS 9.3 (SAS Institute Inc, Cary, NC), and all regression analyses were performed using STATA 13.1 (StataCorp LP, College Station, TX) Command GLM. The MEPS sampling weights were used to account for the complex survey design and provide nationally representative estimates (31). Statistical comparisons were two-sided, and statistical significance was defined at a P value of less than .05.

Results

Distribution of Patient-Level Characteristics

Table 1 reports the distributions of patient-level characteristics between cancer survivors and individuals without a cancer history. Compared with those without a cancer history, we found that: 1) both nonelderly and elderly cancer survivors of all three major cancer sites were more likely to be older, non-Hispanic white, and have more comorbid conditions; 2) nonelderly cancer survivors were more likely to have higher family income; 3) elderly colorectal cancer survivors were less likely to be married but nonelderly breast and prostate cancer survivors were more likely to be married and privately insured. For the treatment status variable (Supplementary Table 1, available online), we found that nonelderly colorectal cancer survivors (84.9%) were more likely to be receiving cancer-related treatment than elderly colorectal cancer survivors (52.4%) within two years since diagnosis and nonelderly prostate cancer survivors (27.2%) were less likely to be receiving cancer-related treatment than elderly prostate cancer survivors (43.2%) after two years since diagnosis.

Total Adjusted Annual Economic Burden Among Cancer Survivors

Figure 2 shows the total adjusted annual economic burden among cancer survivors, which is the sum of medical expenditures and productivity losses. For the nonelderly population, colorectal cancer was associated with the highest annual economic burden ($20 219), followed by breast cancer ($14 167) and

Table 1. Distribution of patient-level characteristics of colorectal, breast, and prostate cancer survivors and individuals without a history of cancer by age and sex*, 2008–2012

	Colorectal (n = 540)				No cancer (n = 109 432)		Breast (n = 1568)				No cancer female (n = 58 353)		Prostate (n = 1170)				No cancer male (n = 51 079)	
	Age 18–64 y		Age ≥ 65 y		Age 18–64 y	Age ≥ 65 y	Age 18–64 y		Age ≥ 65 y		Age 18–64 y	Age ≥ 65 y	Age 18–64 y		Age ≥ 65 y		Age 18–64 y	Age ≥ 65 y
	(n = 169)		(n = 371)		(n = 95 640)	(n = 13 792)	(n = 777)		(n = 791)		(n = 50 175)	(n = 8178)	(n = 281)		(n = 889)		(n = 45 465)	(n = 5 614)
Patient-level characteristics	Col %	P†	Col %	P†	Col %	Col %	Col %	P‡	Col %	P‡	Col %	Col %	Col %	P§	Col %	P§	Col %	Col %
Age, y																		
18–49	16.3	<.001			71.1		20.5	<.001			70.9		6.8	<.001			71.3	
50–64	83.7				28.9		79.5				29.1		93.3				28.7	
65–79			56.9	<.001		75.6			66.6	.02		72.4			65.3	<.001		80.2
≥80			43.1			24.4			33.4			27.6			34.7			19.8
Sex																		
Male	44.2	.36	46.6	.18	50.0	41.5	0.0	---	0.0	---	0.0	0.0	100	---	100	---	100	100
Female	55.8		53.4		50.0	58.5	100		100		100	100	0.0		0.0		0.0	0.0
Race/ethnicity																		
Non-Hispanic white	71.6	.14	84.7	.001	63.6	74.5	74.5	<.001	86.8	<.001	63.2	73.8	77.9	.001	82.9	<.001	64.0	75.4
Other	28.4		15.3		36.4	25.5	25.5		13.2		36.8	26.2	22.1		17.1		36.0	24.6
Education																		
≤High school	50.6	1.0	61.9	.87	50.6	62.7	45.1	.34	64.2	.70	47.9	65.3	36.4	.001	52.7	.03	53.3	58.9
≥Some college	49.4		38.1		49.4	37.3	54.9		35.8		52.1	34.7	63.6		47.3		46.7	41.1
Marital status																		
Not married¶	40.2	.23	54.5	.02	48.0	45.7	34.5	<.001	55.9	.50	47.1	57.9	29.7	<.001	30.1	.57	48.8	28.6
Married	59.8		45.5		52.0	54.3	65.5		44.1		52.9	42.1	70.3		69.9		51.2	71.4
Number of comorbid conditions																		
0	14.3	<.001	4.7	.001	54.0	8.7	28.5	<.001	8.7	.26	54.4	7.2	21.8	<.001	7.3	.001	53.5	10.8
1	27.0		15.7		23.3	16.2	23.2		12.1		23.1	15.7	20.5		12.1		23.5	16.8
2	26.8		16.5		12.2	24.6	23.4		26.2		12.1	26.0	28.6		23.0		12.3	22.5
3+	31.9		63.1		10.5	50.5	24.9		53.0		10.3	51.0	29.1		57.6		10.7	49.9
Health insurance																		
≤64 y, any private	69.9	.92			70.4		79.3	.001			70.9		86.2	<.001			69.9	
≤64 y, other	30.1				29.6		20.7				29.1		13.8				30.1	
≥65 y, Medicare and private			37.9	.99		38.0			39.1	.97		39.2			36.3	.99		36.3
≥65 y, other			62.1			62.0			60.9			60.8			63.7			63.7
Family income quartile, $																		
Q1 (≤27k)	31.7	.002	40.4	.03	22.5	35.2	17.0	<.001	39.7	.84	24.0	40.1	15.2	.001	26.6	.71	21.0	28.4
Q2 (27k to 53k)	16.9		32.1		25.0	28.6	22.1		28.5		24.9	27.9	14.2		28.3		25.0	29.5
Q3 (53k to 92k)	13.1		17.4		26.1	19.9	31.1		19.6		25.4	18.4	32.6		23.0		26.8	21.9
Q4 (>92k)	38.3		10.0		26.4	16.3	29.8		12.3		25.7	13.6	38.1		22.1		27.1	20.2
Census region																		
Northeast	10.3	.04	21.1	.84	18.3	19.8	18.8	.16	20.7	.82	18.4	20.2	21.2	.15	22.3	.10	18.1	19.2
Midwest	17.3		24.0		21.5	22.1	21.6		20.4		21.3	22.1	15.3		23.0		21.7	22.1
South	56.2		35.8		36.6	36.6	41.2		36.4		37.0	37.1	44.4		36.9		36.2	35.9
West	16.2		19.1		23.6	21.5	18.4		22.5		23.3	20.6	19.1		17.8		24.0	22.9

* All statistical tests were two-sided, and all *P* values were calculated using Pearson's chi-squared test. Shaded area represents age group 18–64 years.
† *P* value generated using a comparison group that included all individuals (both women and men) without a history of cancer from the same age group (18–64 or 65+ years).
‡ *P* value generated using a comparison group that included only women without a history of cancer from the same age group (18–64 or 65+ years).
§ *P* value generated using a comparison group that included only men without a history of cancer from the same age group (18–64 or 65+ years).
¶ All respondents reported "widowed," "divorced," "separated," or "never married" were grouped in the "not married" category.

prostate cancer ($9280). For the elderly population, the economic burden of colorectal cancer remained the highest ($19 051), followed by prostate cancer ($16 851) and breast cancer ($14 391) (all $P < .001$). The proportion of medical expenditures in total economic burden ranged from 60.7% for nonelderly colorectal cancer survivors to 74.6% for elderly breast cancer survivors. Figures 3 and 4 show the proportions of medical expenditures by source of payment and type of services. Private health insurance and Medicare represented the largest source of payment for nonelderly and elderly cancer survivors, respectively (Figure 3). Ambulatory care and inpatient care together accounted for more than 60% of total medical expenditures for each of the three cancer sites and age groups (Figure 4). Detailed results of adjusted economic burden among cancer survivors across age groups and the three cancer sites are reported in Supplementary Table 2 (available online).

Excess Adjusted Annual Medical Expenditure and Productivity Loss Associated With Cancer

Table 2 shows the results of excess adjusted annual medical expenditures and productivity losses associated with cancer, measured as the differences between cancer survivors and individuals without a cancer history. When compared with individuals without a cancer history (whose economic burden is shown in Supplementary Table 3, available online), cancer survivors experienced excess medical expenditures across age groups and cancer sites. For nonelderly cancer survivors, colorectal cancer

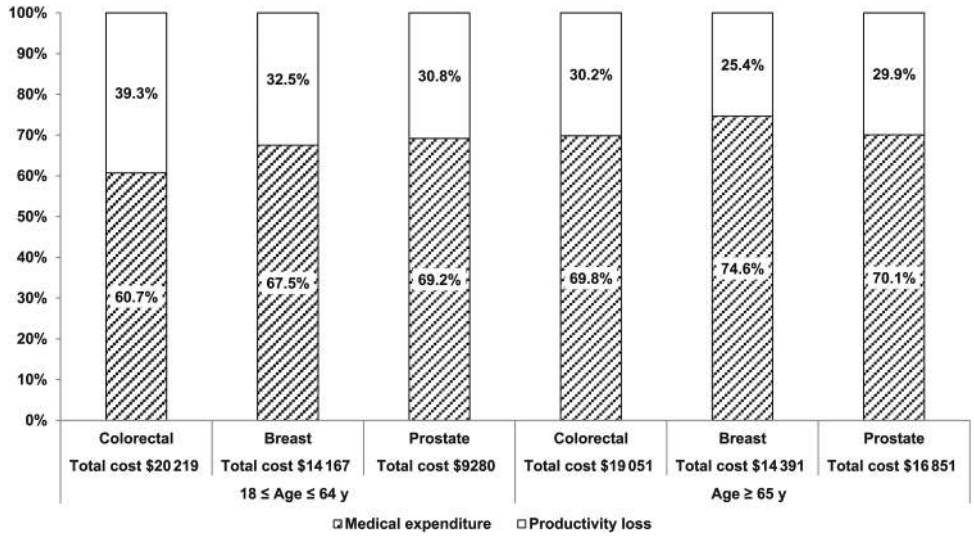

Figure 2. Total adjusted annual economic burden of colorectal, female breast, and prostate cancer survivors, stratified by age (nonelderly: 18–64 years vs elderly: ≥65 years). The total economic burden is the sum of medical expenditures and productivity losses.

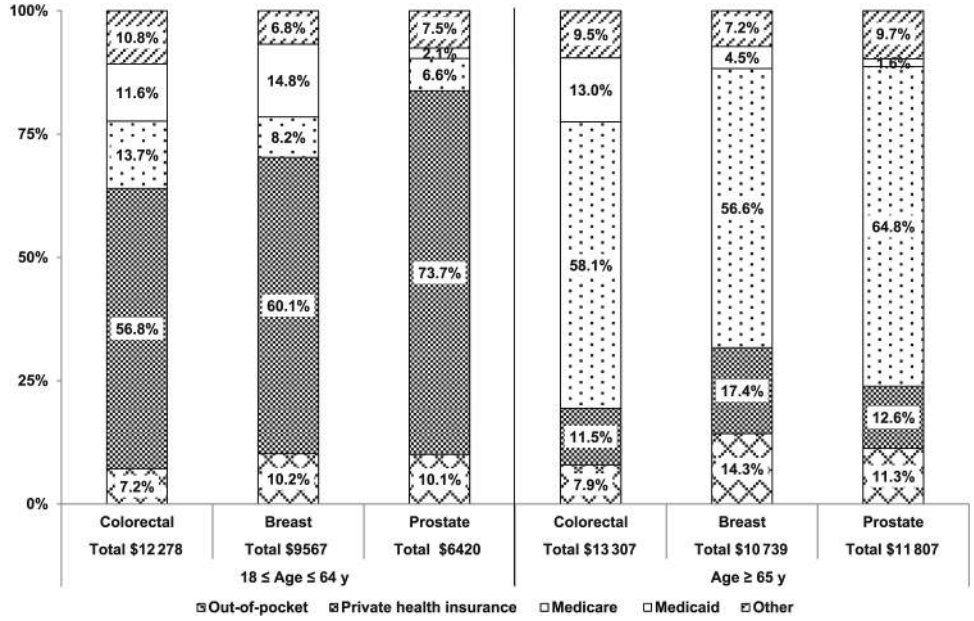

Figure 3. Total adjusted annual medical expenditures of colorectal, female breast, and prostate cancer survivors, stratified by age (nonelderly: 18–64 years vs elderly: ≥65 years). The annual medical expenditures are itemized by source of payment (out-of-pocket, private health insurance, Medicare, Medicaid, or other).

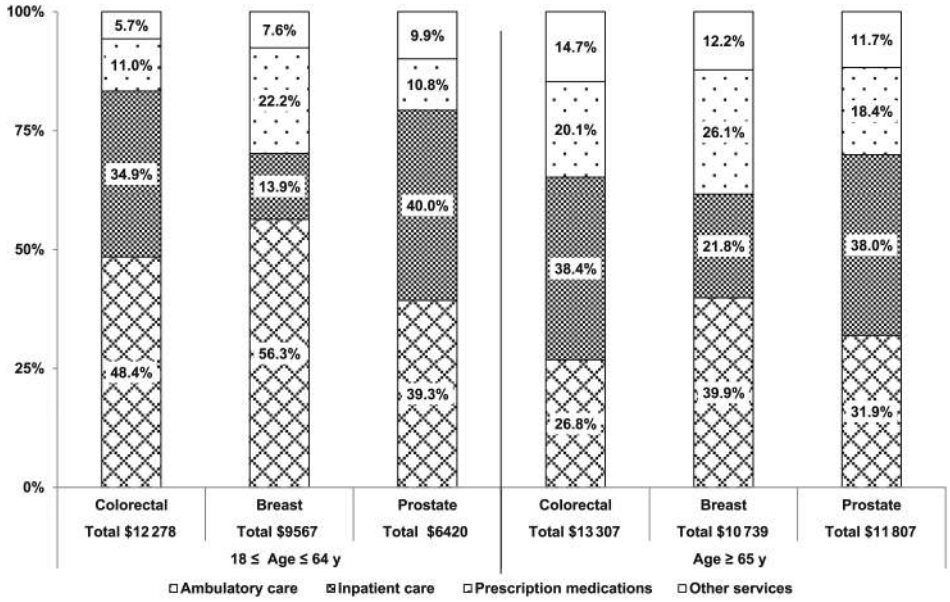

Figure 4. Total adjusted annual medical expenditures of colorectal, female breast, and prostate cancer survivors, stratified by age (nonelderly: 18–64 years vs elderly: ≥65 years). The annual medical expenditures are itemized by type of services (ambulatory care, inpatient care, prescription medications, or other services).

was associated with the greatest annual excess medical expenditures ($8647, 95% CI = $4932 to $13 974), followed by breast cancer ($5119, 95% CI = $3439 to $7158) and prostate cancer ($3586, 95% CI = $1792 to $6076) (all $P < .001$). For elderly cancer survivors, excess medical expenditures associated with colorectal cancer were the highest ($4913, 95% CI = $2768 to $7470, $P < .001$), followed by prostate cancer ($3524, 95% CI = $1539 to $5909, $P < .001$) and breast cancer ($2288, 95% CI = $814 to $3995, $P = .002$).

For productivity losses, nonelderly colorectal cancer survivors experienced statistically significant excess productivity losses resulting from employment disability (13.6%, 95% CI = 6.1% to 25.9%), number of missed work days (7.2 days, 95% CI = 2.1 to 17.1 days), and number of days stayed in bed (4.5 days, 95% CI = 1.4 to 9.5 days). Nonelderly breast cancer survivors also faced statistically significant excess productivity losses from employment disability (4.8%, 95% CI = 1.7% to 9.2%), number of missed worked days (3.3 days, 95% CI = 1.0 to 6.6 days), and number of days stayed in bed (3.3 days, 95% CI = 0.9 to 6.8 days). Elderly colorectal and breast cancer survivors and nonelderly and elderly prostate cancer survivors generally experienced comparable productivity losses as individuals without a cancer history.

Discussion

In this study, we examined the annual economic burden among nonelderly and elderly colorectal, breast, and prostate cancer survivors using a nationally representative sample. We found that the total economic burden was similar across age groups for colorectal and breast cancer survivors but nearly twice as high for the elderly as the nonelderly prostate cancer survivors. Compared with individuals without a cancer history, both nonelderly and elderly cancer survivors face greater annual economic burden for all three major cancer sites. However, we found that the magnitude of excess economic burden varies by cancer site. For the nonelderly population, the annual excess medical expenditures were about $8600 for colorectal, $5100 for breast, and $3600 for prostate cancer. For the elderly population, the annual excess medical expenditures were about $4900 for colorectal, $2300 for breast, and $3500 for prostate cancer. Nonelderly colorectal and breast cancer survivors also bear statistically significant excess productivity losses. To our knowledge, this is the first study that provides a comprehensive analysis of medical expenditures and productivity losses in both nonelderly and elderly populations for the three most common cancers in the United States using contemporary, nationally representative data.

Compared with individuals without a cancer history, the statistically significantly higher medical expenditures among cancer survivors may reflect costs of treatments associated with cancer and comorbid conditions (8,10,32). In our sample, close to 60% of the nonelderly cancer survivors had at least two additional comorbid conditions compared with approximately 23% of nonelderly individuals without a cancer history. Among the elderly population, about 80% of the cancer survivors had at least two additional comorbid conditions compared with approximately 75% of elderly individuals without a cancer history (Table 1). Previous research linked comorbid conditions with high economic burden (23–26). The presence of comorbid conditions may also increase the likelihood of inability to work and time spent in bed.

In contrast to our findings for colorectal and breast cancer survivors, the patterns of total and excess economic burden measures by age group were different for prostate cancer survivors. This likely reflects differences in treatment patterns among survivors of these cancers by age group. Although the overall proportion of survivors receiving cancer-related treatment at the time of the MEPS was similar by cancer site and age group, we observed differences in nonelderly cancer survivors by cancer site when stratified by time since diagnosis (Supplementary Table 1, available online). Among both recently and previously diagnosed nonelderly cancer survivors, prostate cancer was associated with lower likelihood of receiving cancer-related treatments than colorectal and breast cancers. Although we do not have details on the specific chemotherapy regimens,

Table 2. Excess adjusted annual medical expenditure and productivity loss of colorectal, breast, and prostate cancer survivors compared with age- and sex-specific individuals without a history of cancer *, 2008–2012

	Colorectal		Breast		Prostate	
Economic burden measurement	Mean (95% CI)	P†	Mean (95% CI)	P‡	Mean (95% CI)	P§
Age 18–64 y						
Medical expenditure Itemized by source of payment	8647 (4932 to 13 974)	<.001	5119 (3439 to 7158)	<.001	3586 (1792 to 6076)	<.001
OOP	331 (62 to 707)	.01	311 (174 to 470)	<.001	125 (0 to 283)	.05
Private health insurance	5503 (2846 to 9625)	<.001	3702 (2279 to 5551)	<.001	2943 (1449 to 5198)	<.001
Medicare	1448 (363 to 4189)	.001	484 (4 to 1595)	.05	56 (-180 to 643)	.74
Medicaid	1135 (320 to 2888)	.001	995 (48 to 3510)	.03	-126 (-200 to 47)	.12
Other sources	1050 (262 to 2831)	.001	301 (-125 to 1396)	.24	115 (-83 to 467)	.32
Itemized by type of services						
Ambulatory care	4966 (2871 to 8122)	<.001	3896 (2760 to 5323)	<.001	1630 (897 to 2664)	<.001
Inpatient care	3503 (1360 to 7606)	<.001	64 (-372 to 705)	.81	1871 (643 to 4235)	<.001
Prescription medications	577 (23 to 1486)	.04	1282 (687 to 2099)	<.001	-79 (-250 to 149)	.46
Other services	150 (-83 to 491)	.24	102 (-19 to 246)	.10	118 (-89 to 428)	.31
Productivity loss, $#	5640 (2390 to 11 121)		2139 (729 to 4148)		674 (-445 to 2507)	
Employment disability, %**	13.6 (6.1 to 25.9)	<.001	4.8 (1.7 to 9.2)	.001	1.1 (-1.5 to 5.4)	.47
Per capita productivity loss, $	4728 (2120 to 9004)		1669 (591 to 3198)		382 (-521 to 1877)	
Missed work days, No.††	7.2 (2.1 to 17.1)	<.001	3.3 (1.0 to 6.6)	.002	2.7 (1.1 to 5.1)	<.001
Per capita productivity loss, $	722 (211 to 1714)		331 (100 to 662)		271 (110 to 511)	
Days stayed in bed, No.‡‡	4.5 (1.4 to 9.5)	.002	3.3 (0.9 to 6.8)	.003	0.5 (-0.8 to 2.8)	.57
Per capita productivity loss, $	191 (59 to 402)		140 (38 to 288)		21 (-34 to 119)	
Age ≥ 65 y						
Medical expenditure¶	4913 (2768 to 7470)	<.001	2288 (814 to 3995)	.002	3524 (1539 to 5909)	<.001
Itemized by source of payment¶						
OOP	-40 (-239 to 200)	.73	289 (3 to 638)	.05	232 (27 to 474)	.03
Private health insurance	564 (-53 to 1527)	.08	854 (439 to 1383)	<.001	255 (-81 to 687)	.15
Medicare	3624 (1802 to 5932)	<.001	1123 (62 to 2399)	.04	2882 (1140 to 5129)	<.001
Medicaid	1513 (602 to 3238)	<.001	24 (-199 to 429)	.87	-131 (-244 to 151)	.26
Other sources	740 (75 to 1991)	.02	270 (39 to 595)	.02	293 (6 to 673)	.05
Itemized by type of services¶						
Ambulatory care	1480 (733 to 2418)	<.001	2030 (1245 to 2988)	<.001	1701 (1167 to 2323)	<.001
Inpatient care	2635 (1248 to 4518)	<.001	-67 (-757 to 908)	.87	1595 (29 to 3996)	.05
Prescription medications	644 (-164 to 1787)	.13	635 (133 to 1244)	.01	178 (-106 to 505)	.23
Other services	573 (-129 to 1649)	.13	-153 (-422 to 185)	.34	-17 (-262 to 280)	.90
Productivity loss, $	1453 (-843 to 5668)		-477 (-1328 to 1224)		622 (-979 to 2918)	
Employment disability, %**	2.9 (-2.1 to 11.0)	.31	-1.3 (-3.9 to 2.2)	.41	1.3 (-2.4 to 6.4)	.54
Per capita productivity loss, $	1008 (-730 to 3824)		-452 (-1356 to 765)		452 (-834 to 2225)	
Missed work days, No.††	2.2 (-1.3 to 12.7)	.32	0.3 (-1.5 to 4.2)	.84	1.4 (-0.6 to 4.8)	.19
Per capita productivity loss, $	221 (-130 to 1273)		30 (-150 to 421)		140 (-60 to 481)	
Days stayed in bed, No.‡‡	5.3 (0.4 to 13.5)	.03	-1.3 (-2.9 to 0.9)	.22	0.7 (-2.0 to 5.0)	.67
Per capita productivity loss, $	224 (17 to 571)		-55 (-123 to 38)		30 (-85 to 212)	

* All statistical tests were two-sided, and all *P* values were derived from regressions. A *P* value of less than .05 means that cancer survivors bear statistically significant higher economic burden (ie, medical expenditure and productivity loss) than individuals without a history of cancer. Shaded areas represent the age group 18 to 64 years. All regressions controlled for age, sex, race/ethnicity, educational attainment, marital status, number of comorbid conditions, health insurance, and census region. Variable sex was dropped from the regression analyses for breast and prostate cancer survivors. Because health insurance coverage variable is payer specific, it is not included in the adjusted analyses of total medical expenditures by source of payment. In addition, we did not include health insurance variable in the analyses of medical expenditure by types of services in order to have consistent estimates. All monetary values were converted to 2012 dollars using the price indices recommended by Agency for Healthcare Research and Quality. Ambulatory care includes office-based provider visits and outpatient visits. Other services include emergency room visits, home health visits, dental visits, vision expenses, and other medical expenditures. CI = confidence interval; OOP = out-of-pocket.

† Reflects the statistical significant level of multivariable-adjusted excess burden among colorectal cancer survivors compared with all individuals (both women and men) without a history of cancer from the same age group (18–64 and 65+ years).

‡ Reflects the statistically significant level of multivariable-adjusted excess burden among breast cancer survivors compared with women without a history of cancer from the same age group (18–64 and 65+ years).

§ Reflects the statistically significant level of multivariable-adjusted excess burden among prostate cancer survivors compared with men without a history of cancer from the same age group (18–64 and 65+ years).

¶ A multivariable-adjusted generalized linear regression model with a gamma distribution and a log link was utilized.

Total productivity loss is the sum of monetary values because of employment disability, missed work days, and days stayed in bed.

** A multivariable-adjusted logistic regression model was utilized. The estimated productivity loss was obtained by multiplying the adjusted probability of employment disability by the 2012 median annual wage ($34 764.7).

†† A multivariable-adjusted negative binomial regression model was utilized. The estimated productivity loss was obtained by multiplying the adjusted number of missed work days by the 2012 median daily wage ($16.7/hour x 6 hours = $100.2/day).

‡‡ A multivariable-adjusted negative binomial regression model was utilized. The estimated productivity loss was obtained by multiplying the adjusted number of days stayed in bed by the value of daily home productivity in 2012 dollars ($42.3).

hormone therapies, or types of surgery/radiation therapy received, others have reported differences in cancer-directed treatment by cancer site (1,33). The patterns of medical expenditures and productivity losses may also vary for survivors of other common cancers (eg, bladder, lung, melanoma, non-Hodgkin's lymphoma), but, unfortunately, we could not investigate other cancers in this study because of small sample sizes even with multiple years of the MEPS. Further evaluation of treatment patterns, medical expenditures, and productivity losses in large cohorts of newly diagnosed cancer patients with these and other cancers will be important for future research.

Our findings may be particularly timely as the ACA is implemented. The ACA can reduce economic burden among cancer survivors in several ways (34). Firstly, the ACA eliminated OOP cost for certain proven preventive services with most health plans (34). With respect to survivors, the ACA removed prior health conditions as a barrier to health insurance coverage (34). It will be important to continue monitoring the effect these policies may have in reducing economic burden among both nonelderly and elderly populations by cancer site. Our findings provide important information about the cancer site–specific economic burden prior to the implementation of ACA. Future research could evaluate the change in total and excess economic burden by cancer site in the post-ACA period. Moreover, our findings can be used in cost-effectiveness analysis to evaluate cancer survivorship programs or conduct budget impact analysis at the national level (4,35,36).

Our study used multiple years of the MEPS to provide nationally representative estimates of annual medical expenditure and productivity loss of the three most common cancers in the United States. Another data source commonly used to estimate the cost of cancer care in the United States is Surveillance, Epidemiology, and End Results (SEER), linked with Medicare claims data. Studies using linked SEER-Medicare data can provide detailed medical expenditures by phase of care and/or therapies received to estimate both incidence and prevalence costs (4,22,36). However, these data cannot be used to estimate productivity losses, and the little information that is available for the nonelderly population is for those beneficiaries eligible for Medicare because of permanent disability. Moreover, results from different studies that estimate either medical expenditures or productivity losses for a particular cancer site cannot be directly compared because of differences in data sources, populations, perspectives, and methodologies (15,20,22–24). In contrast, our study has the advantage of providing estimates of medical expenditures and productivity losses in the same nationally representative population, using the same methods for all three major cancers in adult cancer survivors of all ages.

There are several limitations in this study. A few important clinical variables, such as stage at diagnosis (21,37), type of treatment(s) received (23), and survival time (4), were not available in the MEPS. All cancer survivors were identified by self-report and may be subject to reporting biases. However, previous studies showed the agreement is high between medical records and self-reported cancer history (38,39). In addition, cost of care is much higher right after cancer diagnoses or near the end of life than the continuing phase of care (21,40). However, our sample is not large enough to be stratified by time since diagnosis, and we can only report annual estimates. In addition, we observed large variations for some of the estimated medical expenditures and productivity losses, which could also be because of small sample sizes. Finally, our study excluded economic burden associated with health care seeking (eg, transportation to and from care) (41) or that among informal caregivers (42). In spite of these limitations, this is the first study to provide nationally representative estimates of the economic burden of cancer for nonelderly survivors of the three major cancers in the United States.

The economic burden of cancer is substantial in the United States, and the excess economic burden associated with cancer varies by cancer site and age for the three major cancer sites considered in this analysis. In general, nonelderly cancer survivors experience statistically significantly greater excess medical expenditures and productivity losses compared with elderly cancer survivors. Understanding how the economic burden varies by cancer site and age is important to shape health care policies to target areas where cancer survivors are most vulnerable.

Notes

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention or the National Cancer Institute.

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