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Chronic Comorbid Conditions among Adult Cancer Survivors in the United States: Results from National Health Interview Survey, 2002 to 2018

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Abstract

Background: Cancer survivors develop other chronic medical conditions due to shared risk factors and the delayed effects from cancer treatment. We investigated the trends in the prevalence and estimated the population sizes of chronic diseases among adult cancer survivors in the US from 2002 to 2018.

Methods: Using the 2002–2018 National Health Interview Survey data, we calculated the age-sex-race/ethnicity-adjusted prevalence and estimated the population sizes of the following chronic conditions among cancer survivors: hypertension, diabetes, stroke, heart disease, chronic obstructive pulmonary disease (COPD)/asthma, hepatitis, arthritis, liver disease, kidney disease, and morbid obesity. We also examined multiple chronic conditions (MCC, three or more health conditions). The trends for MCC were further examined by sociodemographic factors to identify high-risk populations. Parallel analyses were performed for participants without a cancer history to provide a reference.

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Results: Among 30,728 cancers survivors, we observed increasing trends in prevalence of hypertension, diabetes, kidney disease, liver disease and morbid obesity, while decreasing prevalence trends of ischemic heart disease, COPD, and hepatitis. Cancer survivors with MCC increased from 4.7 million in 2002 to 8.1 million in 2018 (prevalence from 48.7% to 53.0%). The increase was more pronounced among survivors aged 18–44 years. Among adults without a cancer history, MCC prevalence also increased, although slower than among survivors.

Conclusions: The number of adult cancer survivors in the US with comorbid illnesses has increased substantially over the past two decades. Optimal management of comorbid conditions and aggressive interventions for risk reduction may benefit the cancer survivor population.

Precis for use in the Table of Contents:

The prevalence of most comorbid illnesses increased significantly amongst cancer survivors in the United States. Cancer survivors with multiple comorbidities almost doubled from 2002 to 2018.

Keywords

Cancer survivorship; Comorbidity; Disease burden; Public Health; Multimorbidity management

Introduction

Due to improvements in early diagnosis and advances in cancer treatment, the number of cancer survivors grew rapidly from 10 million in 2002 to 16.9 million in 2019, and is projected to reach 22.1 million by 2031.[1,2] Cancer survivors commonly suffer from comorbid chronic conditions due to shared risk factors such as smoking and obesity in addition to lasting and delayed effects of cancer treatment.[2–4] The presence of comorbid chronic conditions has been linked to psychological distress, increased healthcare service use, higher medical costs, adverse clinical outcomes, and financial hardship in cancer survivors.[5–10]

Management of cancer and comorbid conditions has been challenging. If the condition developed prior to cancer diagnosis, it can frequently complicate or alter cancer treatment, and can lead to inferior outcomes for cancer patients undergoing active treatment.[9,11] On the other hand, if the condition developed after cancer diagnosis, its management is often compromised in consideration of patients' cancer history.[9,11] To assist clinicians navigating some of these challenges, The American Society of Clinical Oncology published a curriculum for cancer survivorship and emphasized the need for management of comorbid conditions as the cancer survivor population continues to grow rapidly.[12]

Understanding the current burden of comorbid chronic conditions among cancer survivors is essential for care planning and delivery. For example, despite decreased smoking rates and improved cancer treatment outcomes during the last two decades in the US, obesity and metabolic syndromes have continued to increase dramatically. The changes in these lifestyle and clinical factors may have affected the type and burden of comorbid conditions in cancer survivors in the U.S.[13,14] However, to our knowledge, the trend of chronic conditions among cancer survivors has never been firmly elucidated in the current literature, limiting effective care planning and resource allocation. Using a nationally representative sample, this study

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examines the prevalence and population size of common chronic conditions and multiple chronic conditions (MCC) among cancer survivors over the past two decades in the US in comparison to their peers without a cancer history.

Methods

Study Participants

We conducted a population-based study using the National Health Interview Survey (NHIS) from 2002 through 2018. The NHIS is an annual, cross-sectional, national health survey conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention.[15] The survey collects information on health of the civilian, noninstitutionalized, household population of the United States.[16] Two sets of questionnaires were used since 1997 including 1) the Core Questionnaire collecting basic health and demographic information from all individuals living in a household and 2) the Sample Questionnaire collecting detailed health information for one adult and one child, each randomly selected from the household. To be consistent in measured chronic conditions, we chose 2002 as the first year of our analysis, because it was when NHIS started to collect information about arthritis, lupus, fibromyalgia, and other rheumatologic diseases.

The annual response rate of NHIS is approximately 80 percent of the eligible households in the sample.[16] In this analysis, we included adult participants who responded to both questionnaires. Individuals were excluded if they did not answer the questions on any of their chronic conditions or basic sociodemographic information (age, sex, race/ethnicity, education level and insurance status), reported a cancer diagnosis prior to age 18 years or at unknown age, or were diagnosed with only non-melanoma skin cancer (Figure 1). We included both cancer survivors and individuals without a history of cancer to compare the difference in trends over time. This study was exempt from IRB review by the Office of Research Subject Protection at the Roswell Park Comprehensive Cancer Center because the NHIS data are de-identified and publicly available.

Cancer History

Participants were asked whether a physician had told them that they had cancer or a malignancy, and, if yes, what type of cancer and when the cancer was diagnosed. Cancer survivors were defined as participants reporting any history of cancer, consistent with the National Cancer Institute (NCI) and the National Coalition for Cancer Survivorship.[17,18]

Chronic conditions

Participants reported whether they had ever been told by a doctor or health care provider that they had hypertension, diabetes, stroke, ischemic heart disease (angina pectoris, coronary heart disease, heart attack), other heart diseases, chronic obstructive pulmonary disease (COPD), hepatitis, or arthritis. They also reported whether they had been diagnosed with any of the following conditions in the past 12 months: asthma attack, weak or failing kidneys, or any liver disease. Hypertension was determined by whether participants were told they had hypertension or high blood pressure on two or more doctor visits. Insulin-dependent diabetes was defined as diabetes managed with insulin. Individuals who reported COPD or active

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asthma were categorized as having lung diseases. Morbid obesity was defined as body mass index (BMI) >40 kg/m^2 or BMI >35 kg/m^2 with one or more comorbid conditions, where BMI was calculated with self-reported height and weight.[19] MCC was defined as having three or more chronic conditions.

Sociodemographic information

Participants also reported information on sex, age, educational attainment, race/ethnicity, marital status, poverty status, current smoking status, and health insurance coverage.

Statistical Analyses

To characterize population characteristics over time, survey participants were grouped into six periods across the survey years (2002–2003, 2004–2006, 2007–2009, 2010–2012, 2013–2015, 2016–2018). Cochran-Armitage trend tests were used to determine whether demographic and health characteristics of the population changed over time. To examine prevalence of chronic conditions, we used multivariable linear probability regression to estimate the age, sex, and race/ethnicity adjusted-prevalence of cancer survivors with each condition and MCC from 2002 to 2018 and plotted the prevalence against time. Average annual change in prevalence of each condition and MCC was calculated with the survey year entered as a continuous variable in the models. The weighted population sizes of cancer survivors with each condition and MCC were estimated based on the weighted number of cancer survivors and the weighted prevalence of MCC in the nationally representative NHIS. The estimated population sizes were plotted against time to visualize the disease burden over the study period. Stratified analyses were conducted for MCC by age group, sex, race/ethnicity and insurance. In addition, we tested interaction between year and each sociodemographic factor to explore subgroups of cancer survivors with the most rapidly increasing trend of MCC.

Parallel analyses were also performed for adults without a cancer history in the US from 2002–2018 for reference. The difference in trends of adjusted prevalence of each condition and MCC between cancer survivors and individuals without a cancer history was tested by including an interaction term of cancer status and survey year in the models.

All analyses were conducted using SAS statistical software, version 9.4 (SAS Institute Inc). The SAS procedures PROC SURVEYFREQ and PROC SURVEYREG were used for descriptive analyses and modeling. Both procedures incorporate the complex survey sample design of NHIS, including stratification, clustering, and unequal weighting. The variances of the regression parameters were computed using the Taylor series (linearization) method to estimate the sampling errors of estimators based on the complex sample design. All statistical significance testing was 2-sided at $p<0.05$. All estimates were weighted to account for the complex design and nonresponse of the NHIS according to the recommendations from the National Center for Health Statistics.[15]

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Results

Participant Characteristics

The characteristics of 30,728 adult cancer survivors are shown in Table 1 by NHIS survey period. The proportion of adult cancer survivors increased steadily from 4.8% in 2002–2003 to 6.5% in 2016–2018. Significant upward trends were seen for all characteristics including older age, male sex, high education level, public insurance, and history of two or more cancers among cancer survivors since 2002 (all $p<0.01$).

The characteristics of 454,505 individuals without cancer history are shown in Supplement Table S-1.

Trends in Individual Chronic Health Conditions

Table 2 describes the prevalence of chronic conditions among cancer survivors from 2002–2018. The prevalence statistically significantly increased for hypertension (35.9% to 40.6%, $p<0.001$), diabetes (13.4% to 15.3%, $p=0.003$), kidney disease (4.2% to 5.0%, $p=0.03$), liver disease (3.1% to 4.4%, $p=0.001$) and morbid obesity (5.9% to 9.5%, $p<0.001$), after adjusting for age, sex, and race/ethnicity. By contrast, the adjusted prevalence decreased significantly for ischemic heart disease (12.3% to 10.6%, $p=0.001$), COPD (9.4% to 6.9% $p<0.001$), and hepatitis (5.9% to 4.5%, $p=0.04$).

Among participants without a cancer history, we observed similar trends in adjusted prevalence of most chronic conditions (Supplement Table S-2, Figure 2). The decreasing trend in prevalence of ischemic heart disease (p-interaction=0.02) and COPD (p-interaction=0.003) and the increasing trend of liver disease (p-interaction=0.01) were more pronounced among cancer survivors than in individuals without a cancer history (Table 2, Figure 2).

The estimated population sizes of cancer survivors with chronic conditions increased by 50%−200% for almost every condition except for ischemic heart disease and COPD, which both increased by about 30% and stabilized around 2.2 million and 1.4 million respectively since 2010 (Figure 3).

Trends in Multiple Chronic Comorbidities

Cancer survivors with MCC increased significantly from 4.7 million in 2002 to 8.1 million in 2018 (Table 3, Figure 3). After adjusting for age, sex, and race/ethnicity, the prevalence of MCC increased over the study period (43.7% to 46.6%, $p=0.02$). The increases were most prominent among survivors aged 18–44 years old (18.4% to 28.4%, $p<0.001$), male survivors (44.4% to 47.9%, $p=0.006$), and non-Hispanic Black (56.8% to 60.4%, $p=0.004$) survivors. Although not statistically significant, an increasing MCC trend was also observed for most subgroups of cancer survivors such as non-Hispanic Whites and those with public insurance (Table 3).

Compared with individuals without a cancer history, the prevalence of MCC grew more rapidly among younger survivors (cancer:18.4% to 28.4% vs non-cancer: 1.9% to 2.9%, p-interaction =0.0004) and non-Hispanic Black survivors (from 56.8% to 60.4% among cancer

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survivors vs. from 19.7% to 21.8% among non-cancer individuals, p-interaction=0.02) (Table 3, Figure 4). MCC prevalence increased at a similar rate in other subgroups of cancer survivors and corresponding groups of adults without a cancer history (Table 3, Supplement Table S-3).

The estimated population size of cancer survivors with MCC increased by 72% from 4.7 million in 2002 to 8.1 million in 2018. Survivors who were 65 years and older, female, non-Hispanic White, or public insured experienced the largest population increase in MCC (Figure 5).

Discussion

Our analyses demonstrate that in adult cancer survivors in the US from 2002–2018, the prevalence of cardiac disease, COPD, and hepatitis decreased while prevalence of hypertension, diabetes, kidney disease, liver disease, and morbid obesity as well as MCC increased. Our study also found that the prevalence of MCC in young (age 18–44) and non-Hispanic Black survivors grew much more rapidly than their peers without a cancer history, whereas the prevalence of MCC in other subgroups increased at similar rates in cancer survivors and individuals without a cancer history. Given the growing number of cancer survivors and increasing prevalence of MCC, the estimated population size of cancer survivors with MCC increased from 4.7 million in 2002 to 8.1 million in 2018. To our knowledge, this study provides the first national estimation of the changes in prevalence and burden of chronic conditions and MCC among cancer survivors in the past two decades.

The increasing prevalence of comorbidities among cancer survivors may be a result of the aging population, improved cancer survival, cancer treatment toxicities, and shared risk factors such as smoking, physical inactivity, and obesity.[2,3,20,21] A concerning trend is the increasing prevalence of hypertension and diabetes among cancer survivors, which may be related to the rapidly increasing obesity rate in the US.[22] We also found that the general population experienced a similar increase in prevalence of hypertension, diabetes, and obesity, consistent with previous studies.[23,24] Thus, irrespective of a patient's cancer history, our study demonstrates a significant growth of metabolic comorbidities in adults in the US from 2002–2018, highlighting the importance of promoting healthy lifestyles at the population level. Barriers to these broad lifestyle changes include aging, financial hardship, and limited access to health services. Although the general population may experience some of these obstacles, cancer patients in particular are susceptible given their complicated medical histories and treatment-related costs.[2,5,25,26]

The prevalence of kidney and liver diseases also increased over the study period, which may be a result of 1) improved patient survival, especially for those with kidney and liver diseases at cancer diagnosis; 2) treatment-related kidney and liver toxicities from curative chemotherapy or chemo-radiation therapy (e.g., platinum-based treatments); 3) the increasing rate of morbid obesity, which is a shared risk factor for both non-alcoholic steatohepatitis and chronic kidney diseases.[27–29]

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The decreasing prevalence of both ischemic heart disease is likely a result of multiple factors. Prior studies showed that cancer survivors had a high mortality from cardiovascular disease.[30,31] However, recent advances in cancer treatment, such as more precise chemo dosing regimens, improvements in radiation therapy that permit minimal cardiac exposure, and reduction in off-target effects through the wider use of targeted treatments, may be mitigating some of the negative long-term cardiovascular outcomes in cancer patients, especially in those at elevated cardiac risk.[31–35] High-risk patients also benefited from advances of cardio-oncology including better cardiac risk prediction models, more sensitive biomarkers and imaging studies, and early intervention.[36] Cardio-oncology guidelines now recommend clinicians to omit or replace cardiotoxic therapy (e.g., anthracycline) to prevent cardiac dysfunctions for high-risk patients such as the seniors and those with preexisting cardiac diseases.[36] In addition, non-cancer related factors, such as decline in tobacco use, might also contribute to the downtrend in prevalence of ischemic heart disease and COPD in both adult cancer survivors and individuals without a history of cancer, because the decreasing trends were relatively similar for both groups.[35]

Our findings showed that in most subgroups the MCC prevalence among cancer survivors grew at similar rates as individuals without a cancer history. We posit that the overall increase is less likely to be cancer-treatment related but rather is linked to the increasing trend of pre-existing comorbidities and poorly controlled lifestyle factors (e.g. diet and physical activity) among the general population.[24,37] To reduce the incidence of long-term comorbid illnesses and alleviate the burden of MCC, it may be necessary to consider more aggressive preventive interventions on unfavorable lifestyle factors before and after cancer diagnosis. Similar interventions would also likely benefit the general population.

One additional important observation is that young adult survivors did demonstrate a significantly rapidly increasing rate of MCC prevalence compared to their non-cancer peers. In addition to uncontrolled risks factors such as physical inactivity, obesity, and persistent tobacco use[38–40], this finding may also be explained by the fact that survival and life expectancy of adolescent and young adult cancer patients had improved substantially in the past decades and they had an increasing risk of developing chronic conditions given the long-term and delayed treatment effects during their survivorship in young adulthood.[41–43] It highlights the urgent need for age-appropriate survivorship guidelines, patient education, and active surveillance for young cancer survivors.

Prior malignancy and comorbid illnesses can alter physicians' treatment decisions and clinical outcomes for both cancers and non-cancer diseases in cancer survivors.[11] However, most current guidelines of cancer treatment still consider the active cancer as a single illness to manage but lack consideration for the complex interrelations between cancer and other chronic diseases.[44] As a result, patients are often not able to receive optimal treatments for their cancers and other chronic diseases.[8] These comorbid diseases may also exclude these survivors from clinical trials if their original cancer recurs or they develop an additional primary malignancy. Future efforts are warranted to carefully evaluate and improve the current guidelines on cancer treatment taking into consideration the prevalent comorbid conditions.

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The rising MCC among cancer survivors, especially young adult survivors, poses a challenge to their primary care physicians (PCPs). As cancer prognoses improve, PCPs are playing an increasingly pivotal role in survivorship care coordination, health education, and identification and co-management of cancer treatment-related complications.[20] PCPs are also critical to assisting cancer survivors improve their health-related quality of life, and alleviating the long-term psychosocial distress from cancers or treatments.[45] Multidisciplinary care is frequently warranted for cancer survivors given their complex health profile involving PCPs and specialists, potentially from different health networks.[20] Further substantial efforts are needed to support PCPs to transform the care model for cancer survivors, especially in underserved communities.[46]

This study has several strengths. First, NHIS is nationally representative, making our results generalizable to the entire US adult cancer survivor population. The US CDC has used NHIS to estimate the burden of chronic conditions and MCC in the general public.[47] Second, this study analyzes the national data since 2002 to reveal the temporal trends and patterns of chronic conditions and MCC among adult cancer survivors and their peers without a cancer history. With a large number of cancer survivors and consistent ascertainment of cancer history and chronic conditions across the survey years, we were able to estimate the trends in MCC burden by various sociodemographic factors.

There were several limitations to our study. First, the NHIS collected only 10 chronic conditions, which left other conditions (e.g., dementia, vascular disease, HIV infection) unaccounted for, leading to a potential underestimation of MCC. Second, chronic conditions were self-reported in our study, which could potentially lead to underreporting of medical conditions. However, previous studies have endorsed the validity of self-reported chronic conditions in comparison with conditions based on chart review in cancer patients.[48] Third, we were not able to consider cancer treatment and sequence of cancer and comorbidity diagnoses in our analysis as this information was unavailable. Fourth, our study is subject to ascertainment bias given that certain chronic conditions may be more frequently screened for in the cancer survivor population. Fifth, comorbidity burden may be underestimated due to sampling bias because patients with MCC may be less likely to participate in the NHIS interviews. In addition, the NHIS does not interview those in long-term care institutions (nursing homes, hospitals, etc.), who likely have more chronic conditions than the general population. Our study did not analyze the trends in Asians/Pacific Islanders due to limited sample size. Several conditions (e.g., insulin-dependent diabetes, active asthma, arthritis) showed a slightly increasing trend in individuals without a cancer history but were unchanged among cancer survivors. This may be due to insufficient power for cancer survivors and warrants future monitoring. Lastly, since the survey captures mostly long-term survivors of cancers with relatively better prognosis, we could not estimate chronic condition burden among shorter-term survivors and cancer patients under active treatment.

Conclusion

Our findings suggest that comorbid illnesses and MCC are an emerging public health burden for cancer survivors, particularly younger cancer survivors. Our study emphasizes the importance of collaboration between oncologists and primary care physicians, and the

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significant need for effective risk factor interventions in the rapidly growing adult cancer survivor population in the US.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Author disclosures:

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Data Availability

The data underlying this article are available in National Center for Health Statistics, National Health Interview Survey, at https://www.cdc.gov/nchs/nhis/index.htm

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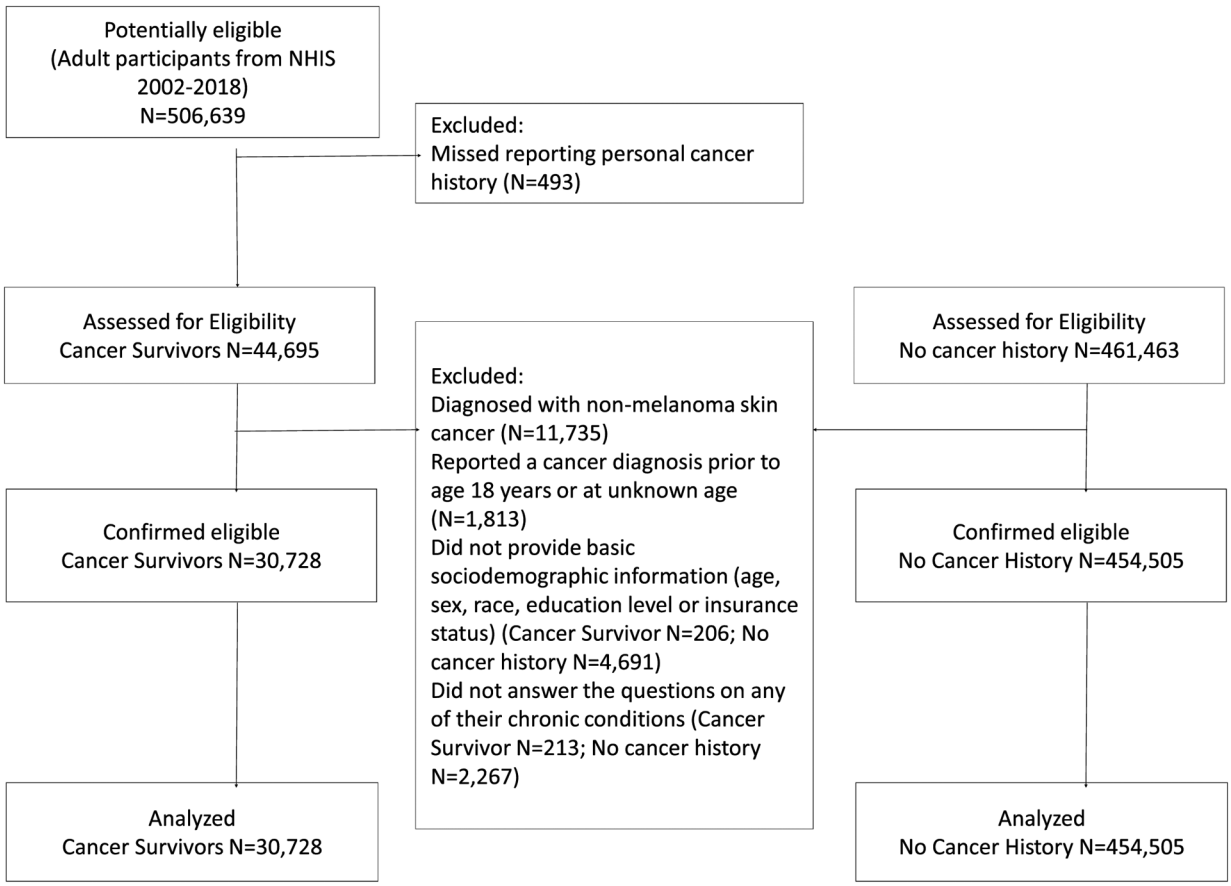

Figure 1.
Flowchart of the study population inclusion/exclusion and analyses.

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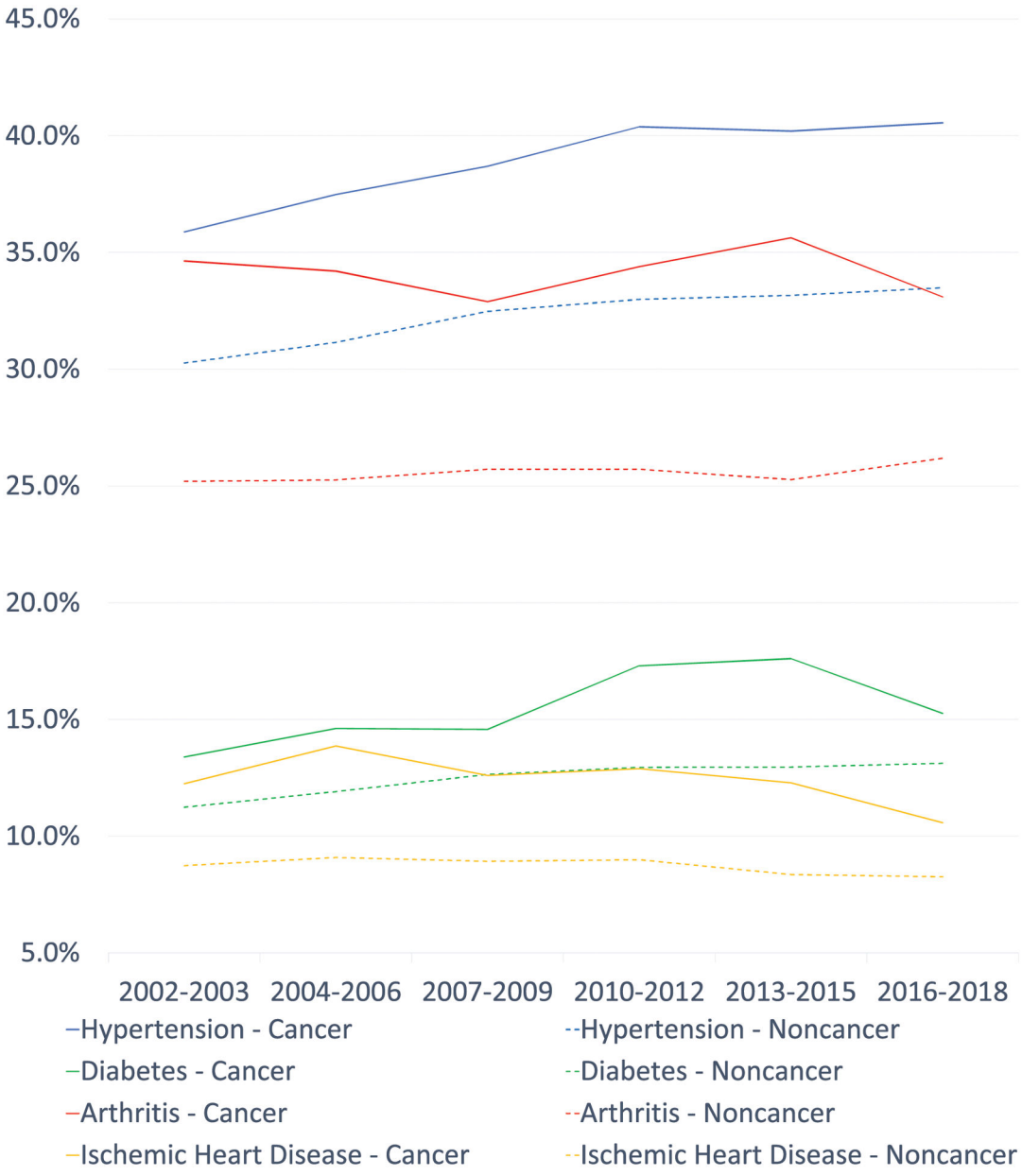

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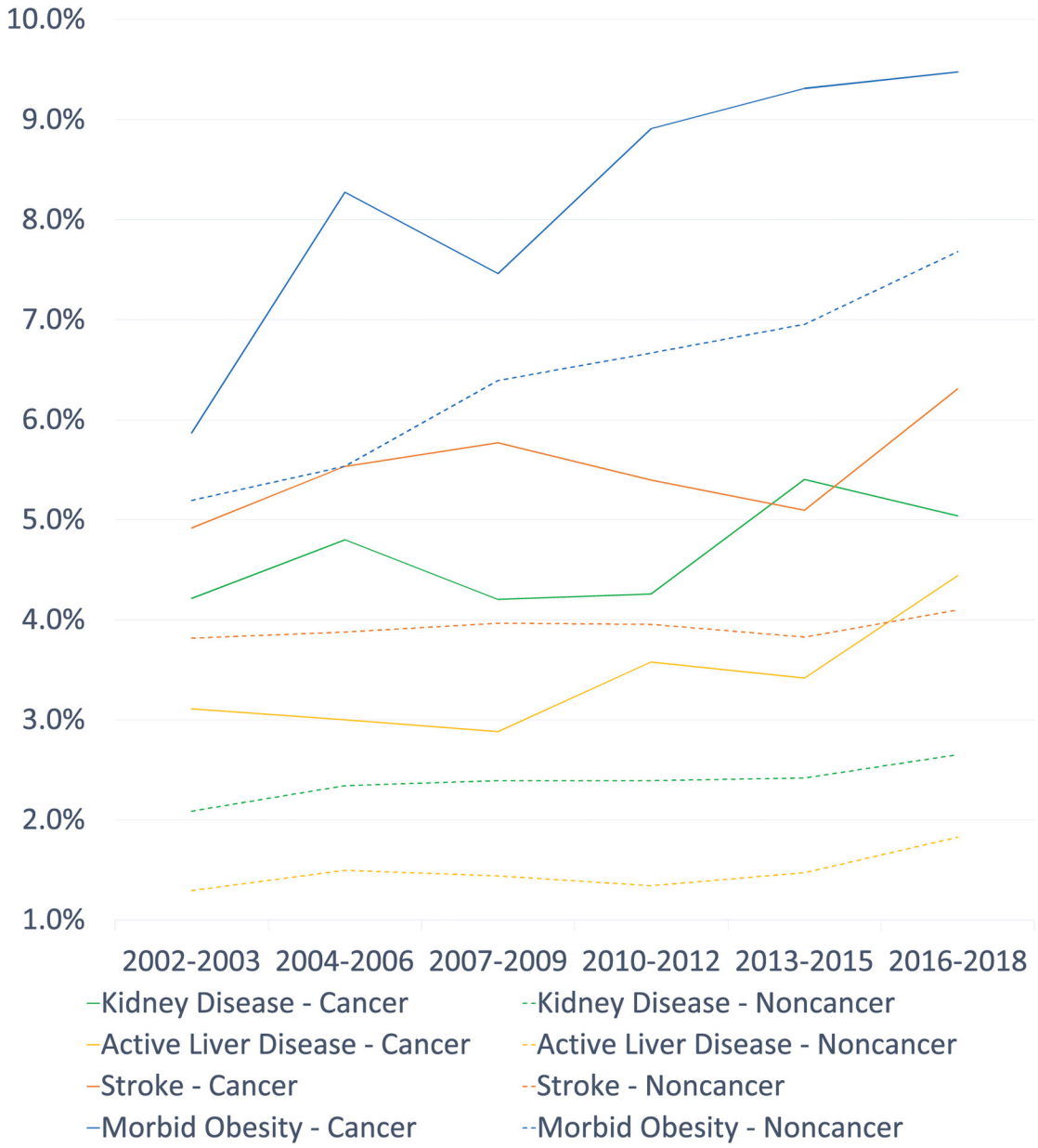

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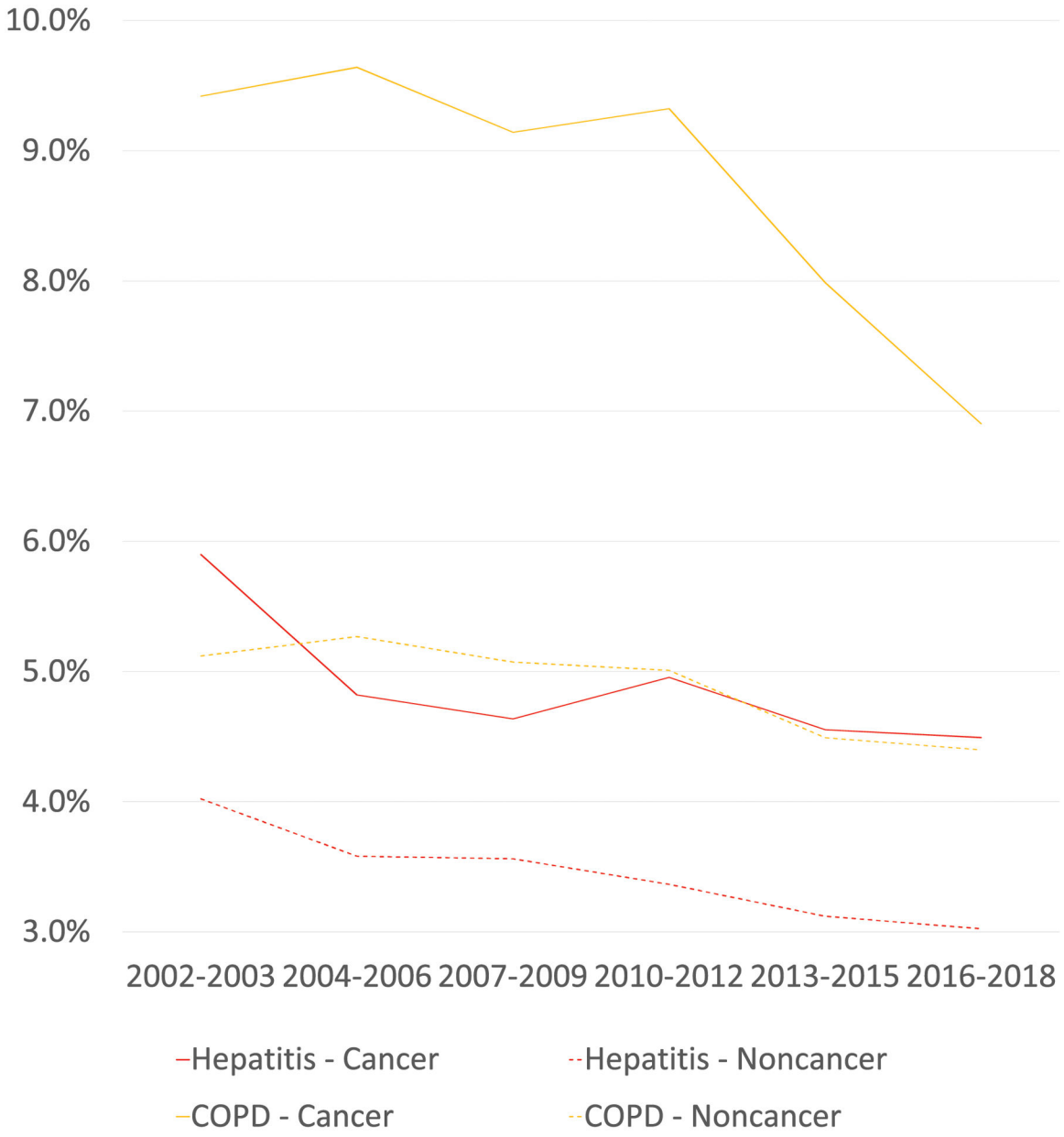

Figure 2.

Age-sex-race/ethnicity-adjusted prevalence of chronic conditions among cancer survivors and individuals without a cancer history in the US [a]

[a] Data estimates were aggregated at 6 study periods

COPD stands for chronic obstructive pulmonary disease

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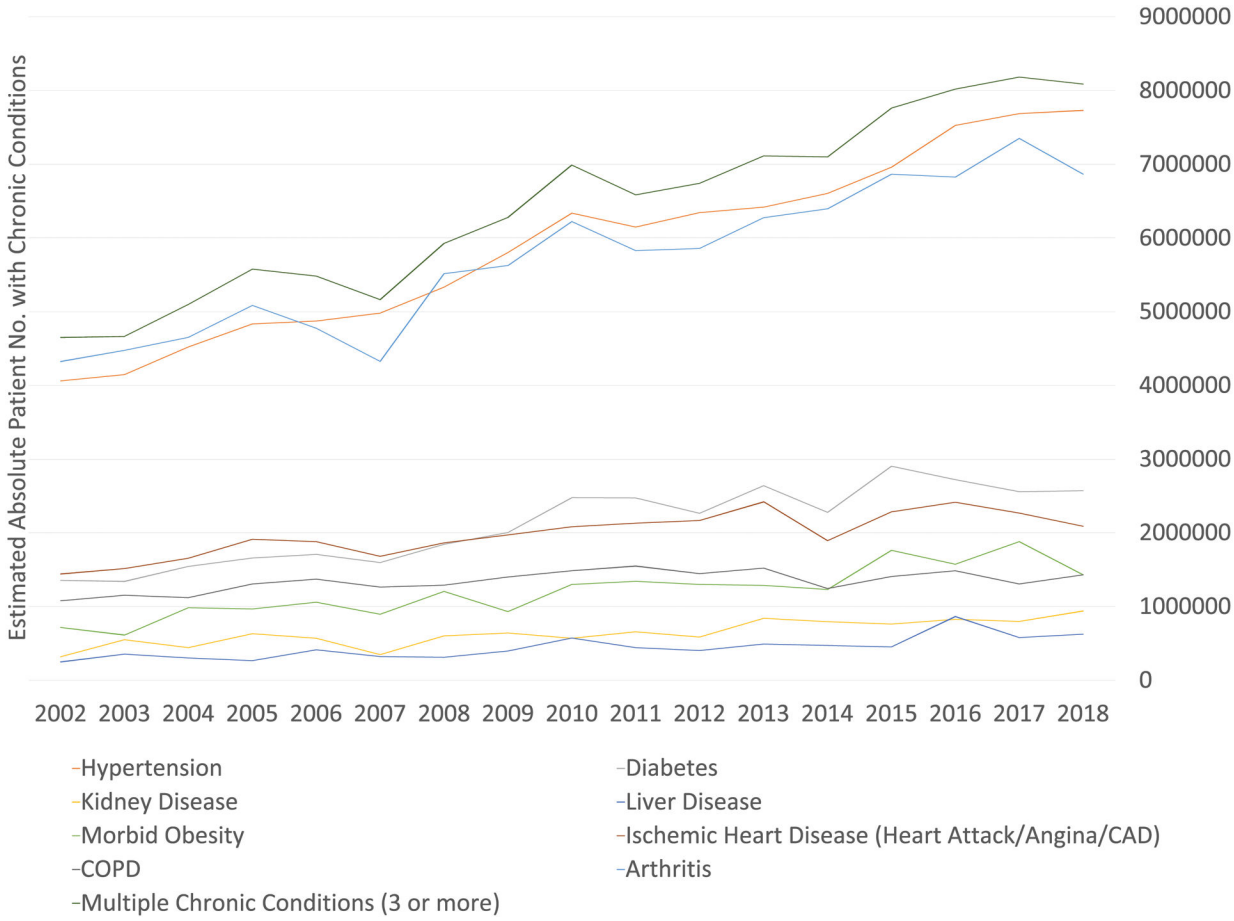

Figure 3.

Estimated Population Sizes of Cancer Survivors with Chronic Conditions in the US [a]

[a] The absolute population with chronic conditions was estimated using National Health Interview Survey complex survey design and weights.

COPD stands for chronic obstructive pulmonary disease

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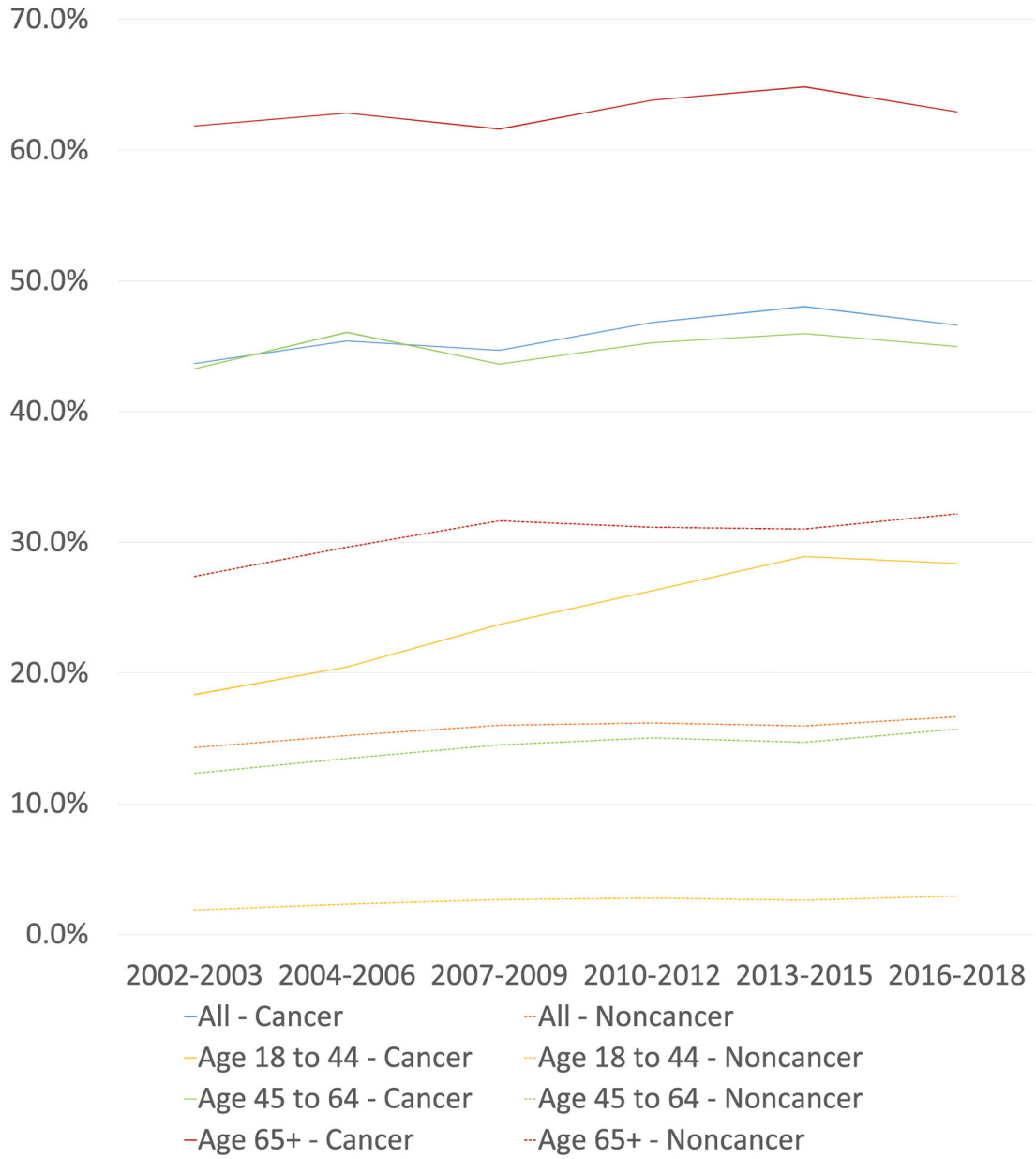

Figure 4.

Age-sex-race/ethnicity-adjusted prevalence of multiple chronic conditions (3 or more) by age group among cancer survivors and individuals without a cancer history in the US [a]

[a] Data estimates were aggregated at 6 study periods

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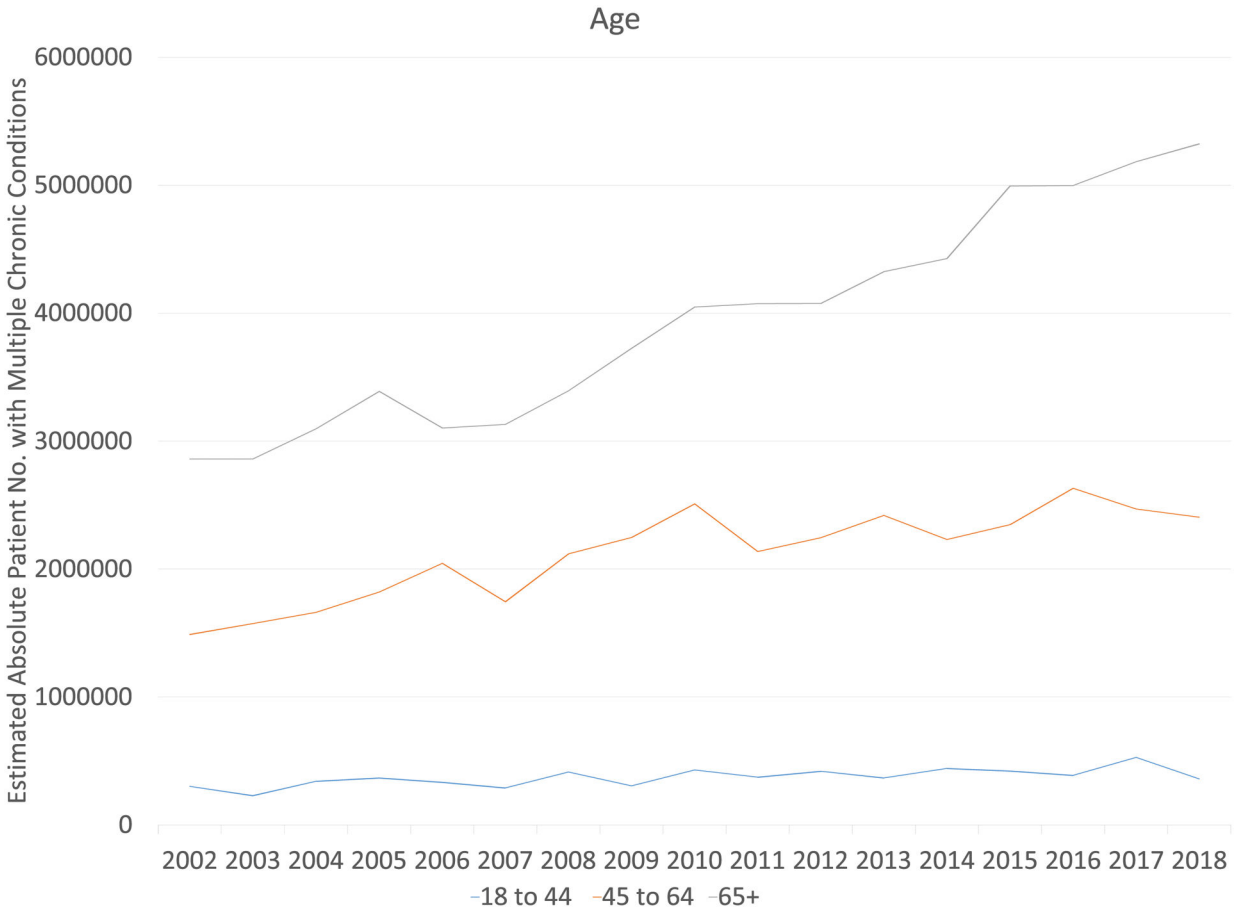

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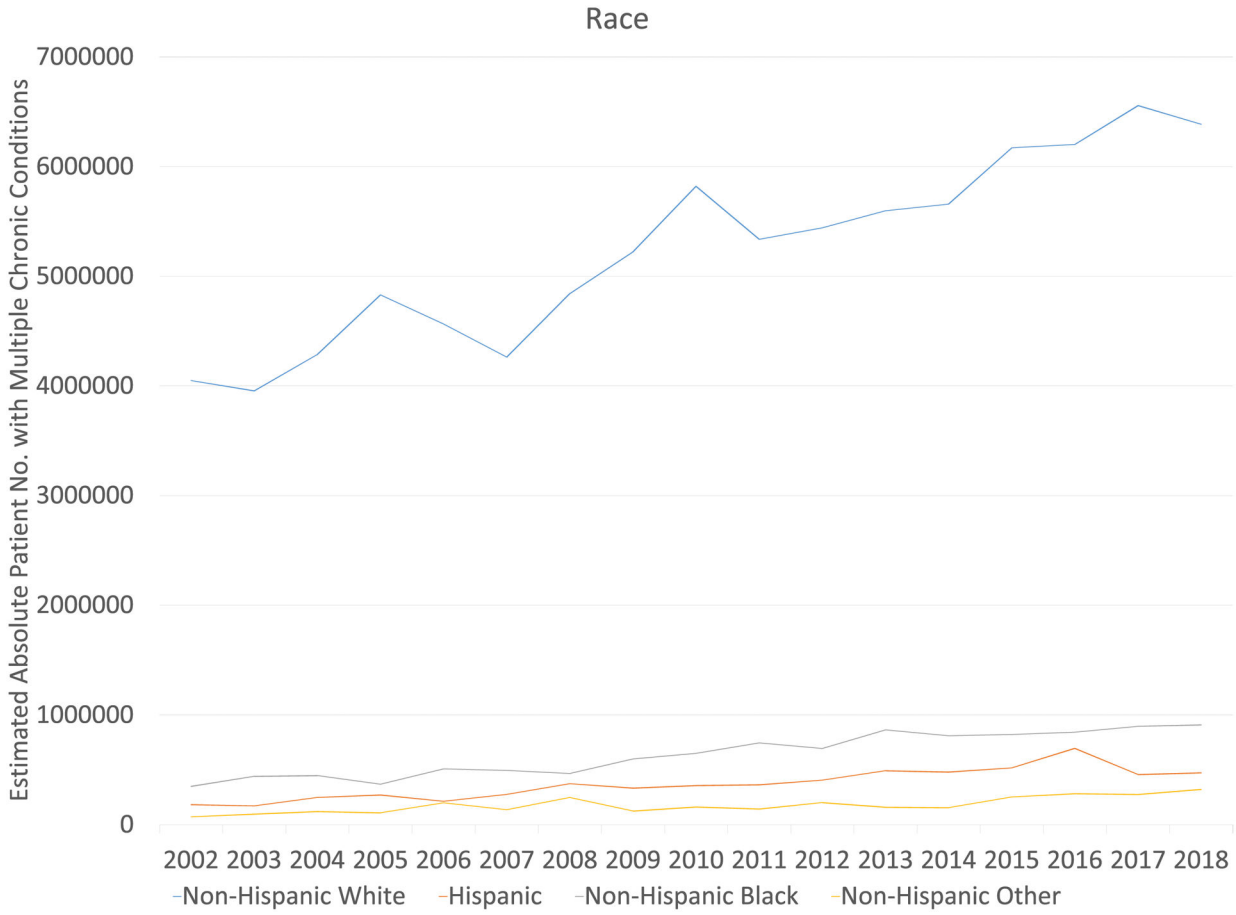

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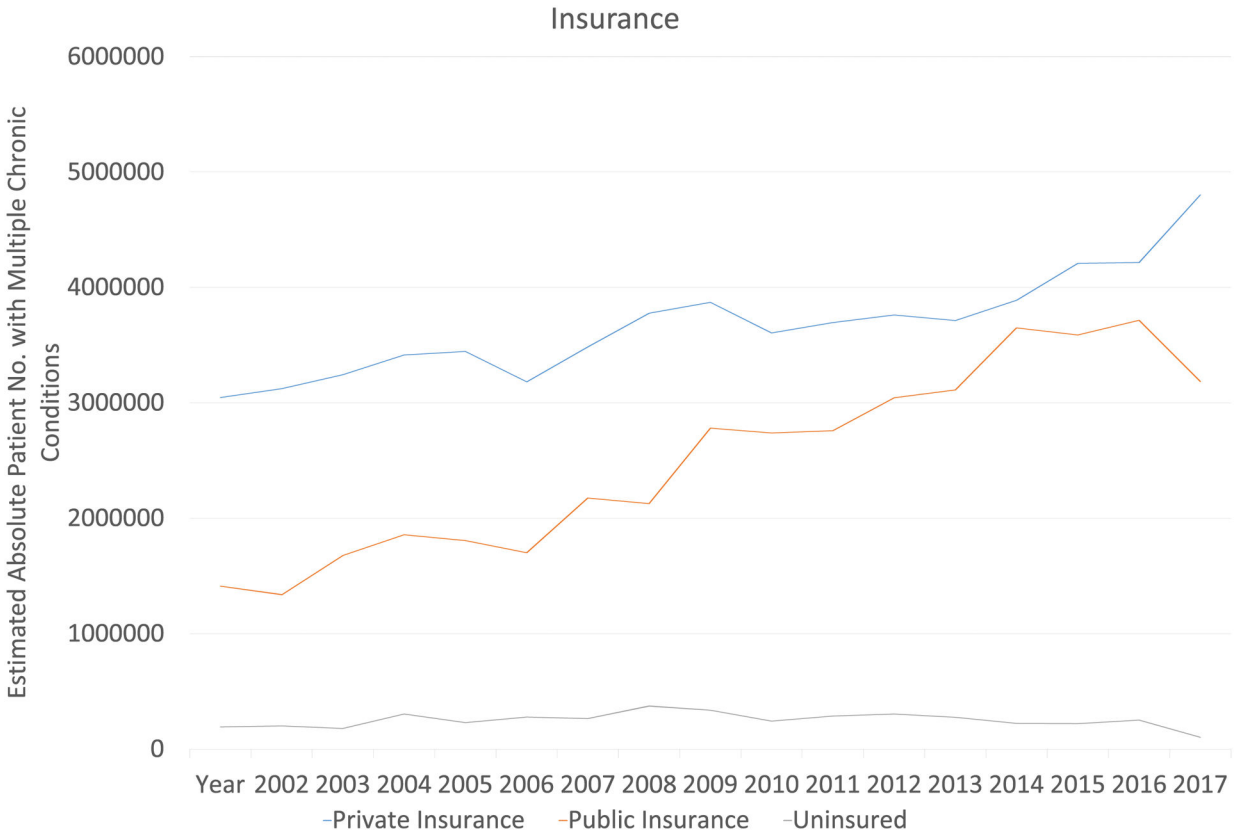

Figure 5.

Estimated Population Sizes of Cancer Survivors with Multiple Chronic Conditions (3 or more) by Demographic and Clinical Factors in the US[a]

[a] The weighted population with multiple chronic conditions was estimated based on National Health Interview Survey complex survey design and weights.

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Table 1.

Sample Characteristics of Cancer Survivors by Period

		2002–2003	2004–2006	2007–2009	2010–2012	2013–2015	2016–2018
Sample size[a]		3,056	4,613	4,121	5,773	6,754	6,411
Weighted population size, 1,000s[b]		9,630	10,805	11,668	13,024	13,599	15,353
Age (years), %[c]							
18 to 44		14.6	15.3	11.9	11.7	10.3	9.6
45 to 54		16.1	15.8	16.5	14.9	12.3	12.7
45 to 64		20.5	21.1	23.3	23.9	24.8	23.4
65 to 74		23.5	21.7	23.6	24.2	26.7	28.4
75+		25.2	26.1	24.6	25.4	25.9	25.9
Female, %		62.4	61.3	62.3	59.5	60.0	59.7
Education, %							
Less than High School		19.7	18.6	16.5	13.9	13.5	11.7
High School/GED		31.7	30.5	30.1	29.1	29.0	25.6
More than High School		48.6	50.8	53.4	57.0	57.5	62.8
Race, %							
Non-Hispanic White		86.7	85.2	82.8	82.2	81.1	80.1
Hispanic		4.5	5.1	6.1	5.8	7.2	7.2
Non-Hispanic Black		6.6	7.2	7.8	8.8	8.7	8.5
Non-Hispanic Other		2.2	2.5	3.3	3.2	2.9	4.2
Married, %		59.3	60.5	58.9	57.8	58.2	59.1
Insurance, %							
Private Insurance		69.6	66.7	66.1	61.1	58.5	60.7
Public Insurance[d]		24.2	27.1	27.0	32.8	36.9	36.1
Uninsured		6.2	6.2	6.8	6.1	4.6	3.2
Poverty status (FPL[e]), %							
Less than 100 %		8.3	7.7	8.8	9.3	9.6	8.2
100–199%		14.1	16.7	15.6	15.7	16.6	15.2
200–399%		24.5	22.5	24.5	27.6	27.9	28.0
400% or above		25.8	28.6	35.9	33.6	36.1	40.6
Unknown		27.3	24.6	15.3	13.7	9.8	7.9
Current Smoking, %		19.0	17.9	17.6	16.0	14.1	12.8
History of two or more cancers, %		9.0	8.8	9.1	9.4	9.9	10.6

[a] Cochran-Armitage trend tests showed statistically significant trends in proportions of all sample characteristics (all $P < .01$).

[b] The estimated size of populations of cancer survivors were estimated using National Health Interview Survey complex survey design and survey weights.

[c] All percentage presented are weighted.

[d] Public insurance included self-reported Medicaid, Medicare, military health care/Veterans Affairs insurance, Medi-Gap, and Indian Health Service insurance.

[e] FPL stands for federal poverty level.

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Table 2.

Trends in Each Chronic Conditions from 2002 to 2018 in US Adult Cancer Survivors

	Population size (2012), 1,000s	Population size (2018), 1,000s	Prevalence[a] (2002–2003)	Prevalence[a] (2016–2018)	Average annual prevalence change[b]	p-Trend[b]	p for interaction[c]
Hypertension	4,062	7,730	35.90%	40.60%	0.296	<0.001	0.22
Diabetes	1,356	2,570	13.40%	15.30%	0.149	0.003	0.38
Insulin-dependent diabetes	413	695	4.30%	4.00%	0.027	0.36	0.27
Stroke	555	1,263	4.90%	6.30%	0.052	0.14	0.30
Heart Disease	2,481	3,767	20.60%	18.40%	−0.166	0.007	0.02
Ischemic Heart Disease	1,441	2,089	12.30%	10.60%	−0.169	0.001	0.02
Other heart disease	1,588	2,543	12.80%	11.90%	−0.056	0.29	0.15
Lung Disease	1,589	2,624	14.30%	14.20%	−0.051	0.33	0.04
COPD[d]	1,078	1,431	9.40%	6.90%	−0.181	<0.001	0.003
Active Asthma	851	1,617	8.30%	10.10%	0.063	0.14	0.46
Kidney Disease	319	940	4.20%	5.00%	0.066	0.03	0.21
Liver Disease	248	625	3.10%	4.40%	0.087	0.001	0.01
Hepatitis	474	622	5.90%	4.50%	−0.062	0.04	0.98
Arthritis	4,323	6,865	34.60%	33.10%	0.026	0.72	0.45
Morbid Obesity	716	1,429	5.90%	9.50%	0.209	<0.001	0.50

[a] Prevalence was adjusted for age, sex, and race/ethnicity, using general linear regressions.

[b] Average annual prevalence change and p-trend were estimated with survey year included in the model as a continuous variable adjusting age, sex, and race/ethnicity using general linear regressions among cancer survivors.

[c] P value for the interaction term between cancer status (yes/no) and year of survey.

[d] COPD stands for chronic obstructive pulmonary disease.

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Table 3.

Trends in Multiple Chronic Conditions (MCC, 3 or more) From 2002 to 2018 in US Adults Cancer Survivors, by Sociodemographic Factors

	Population size (2012), 1,000s	Population size (2018), 1,000s	Prevalence[a] (2002–2003)	Prevalence[a] (2016–2018)	Average annual prevalence change[b]	p-Trend[b]	p for interaction[c]
All	4,651	8,089	43.7%	46.6%	0.170	0.02	0.17
Age							
18 to 44	302	360	18.3%	28.4%	0.799	<0.001	<0.001
45 to 64	1,489	2,405	43.3%	45.0%	0.060	0.64	0.43
65+	2,860	5,324	61.9%	62.9%	0.108	0.23	0.21
Gender							
Male	1,940	3,308	44.4%	47.9%	0.312	0.006	0.17
Female	2,711	4,780	43.6%	46.0%	0.080	0.39	0.54
Race							
Non-Hispanic White	4,048	6,386	43.1%	45.6%	0.135	0.08	0.58
Hispanic	183	473	39.8%	45.9%	0.354	0.17	0.30
Non-Hispanic Black	349	909	56.8%	60.4%	0.671	0.004	0.02
Non-Hispanic Other	71	321	38.3%	40.1%	−0.376	0.38	0.46
Insurance							
Private Insurance	3,047	4,802	41.4%	42.2%	0.028	0.75	0.88
Public Insurance[d]	1,413	3,184	52.6%	56.0%	0.183	0.12	0.56
Uninsured	192	103	34.6%	40.1%	0.459	0.13	0.17

[a] Prevalence was adjusted for age, sex, and race/ethnicity, using general linear regressions.

[b] Average annual prevalence change and p-trend were estimated with survey year included in the model as a continuous variable adjusting age, sex, and race/ethnicity using general linear regressions among cancer survivors.

[c] P value for the interaction term between cancer status (yes/no) and year.

[d] Public insurance included self-reported Medicaid, Medicare, military health care/Veterans Affairs insurance, Medi-Gap, and Indian Health Service insurance.