

Comorbidities and perceived health status in persons with history of cancer in the US

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Abstract

Purpose:

Comorbidities can further challenge prognosis and general wellbeing of cancer patients. This study aimed to assess the association between comorbidities and perceived health status (PHS) of United States persons with cancer.

Methods:

This retrospective study used 2019 Medical Expenditure Panel Survey (MEPS) data and included individuals who were alive throughout the year, aged 18 to 84 years, and had diagnosis for cancer. Using adjusted logistic regression models, we estimated the association of comorbidities (no, few[1/2], and more[3 or more] comorbidities) with PHS. Analyses accounted for the complex design of MEPS.

Results:

The dataset included 28,512 participants, 1,739 of which were eligible for the study. Of these, 11.16%(95%CI 9.64,12.59%); 41.73%(95%CI 39.21,43.96%) and 47.10%(95%CI 44.86,49.73%) reported having no, few, and more comorbidities, respectively. While breast(N = 356), prostate(N = 276) and melanoma(N = 273) were the most common cancers, hypertension(88.3%), hypercholesterolemia(49.5%) and arthritis(48%) were the most prevalent comorbidities. Adjusted logistic regression showed that, compared with those with no comorbidities, persons with few, and more comorbidities had 1.58(95%CI = 0.79,3.15) and 2.27(95%CI = 1.19,4.32) times greater odds of poor PHS. Younger or male patients, those with less formal education, low-income, pain, functional limitation or poor perception of mental health were more likely to regard their health as poor.

Conclusion:

About 88% of persons with history of cancer in US 18–84 years reported at least one comorbidity. Having more comorbidities, along with several other variables, was associated with poor PHS. Comorbidities management must be given special consideration to improve the prognosis and general wellbeing of persons with cancer.

Introduction

Cancer is the second leading cause of death in the United States (US), accounting for about 21% of all deaths in 2019 [1]. The survival rate for all cancers combined is about 68%, but vary by cancer type, with survival highest for prostate cancer (99%) and lowest for pancreatic cancer (8%)[2]. Previous research has shown higher prevalence of comorbidities among persons with cancer compared to those with no history of cancer.[3–5] An investigation of the comorbidities associated with cancer survivors using electronic medical records by Roy and colleagues found that although none were statistically significant, rates of various comorbidities among cancer patients were higher than those among persons with no history of cancer [3]. Smith *et al.*, using the Surveillance, Epidemiology, and End Results Medicare Health Outcomes Survey (SEER-MHOS) data, found statistically significantly higher rates of comorbidities among those diagnosed with cancer compared to those with no cancer [5]. In a population-based cohort study of four cancers, comorbidity was most prevalent among patients with lung cancer and least prevalent among those with Hodgkin lymphoma [4]. Understanding the comorbidity burden among individuals with cancer has the potential of improving clinical support, management, quality of life and ultimately the prognosis of these persons while also improving people's perception of their health status.

While the presence of cancer alters patients' quality of life [6], the potential adverse consequences of other medical conditions pose additional challenges to prognosis and the general wellbeing of persons with cancer [5]. Research in other conditions have found an association of comorbidities with impaired perceived health status [7–9]. In the China Kadoorie Biobank study, researchers found among aging people, the co-existence of multiple conditions increased the chances of self-reporting health as poor [8]. Using the Medical Expenditure Panel Survey (MEPS), Bhattacharjee et al. found among patients with multiple sclerosis, having comorbidities was a significant predictor of poorer perceived health status [9]. In a study that assessed patients with chronic obstructive pulmonary disease (COPD) matched with those without COPD, comorbid conditions were associated with impaired health status, independently of the COPD status [7]. According to Greer *et al.*, a cognitive awareness of illness, especially one that is terminal, is associated with critical treatment decisions and outcomes [10]. Therefore, it is important to evaluate how people with cancer perceive their health status and what role the existence of other conditions play in these perceptions.

Cancer survivors manage acute, extended, and lifelong effects of cancer on their health while striving to prevent recurrence or progression through lifestyle and medical regimens. These challenges, combined with those of chronic health conditions can potentially increase their risk of treatment burden, as well as how they may perceive their general health and wellbeing [11].

In the light of evidence of high prevalence of cancer in the US and the prevalence of comorbidities in persons with history of cancer, this analysis aimed to assess the association between comorbidities and perceived health status of persons with cancer using MEPS (2019) data.

Methods

Study design

Data from the nationally representative Medical Expenditures Panel Survey (MEPS) 2019 was used to conduct a retrospective study. The study was approved by the University of Arizona Institutional Review Board (Number 34824; Date October 18, 2021).

Data source

Important information on US civilians, non-institutionalized individuals, their families, healthcare providers and employers are collected by the Agency for Healthcare Research and Quality (AHRQ) in MEPS [12]. The survey oversamples minority groups and persons with disabilities to achieve nationally representative estimates. Using the original National Health Interview Survey (NHIS) sampling framework, participants' health-related data are collected. This information includes their physical and mental health conditions, as well as different types of healthcare service utilization and treatments. For the purposes of this study, the household component (MEPS-HC) and the Medical Conditions (MEPS-MC) files were utilized. The MEPS-HC questionnaire includes data on factors ranging from socio-demographic characteristics, health status, healthcare resource use and expenditures, employment, and income. Participants' self-reported medical conditions are recorded in the MEPS-HC files utilizing either International Classification of Diseases, 9th Edition, Clinical Modification (ICD-9-CM) codes or Clinical Classification System (CCS) codes. The MEPS-MC was used to identify comorbidities.

For each panel, data are collected for two calendar years [12]. Machlin and colleagues found the overall sensitivity, in terms of consistency between the self-reported and healthcare provider reported chronic conditions in the MEPS, to be 74% [13].

Study population

The study population consisted of all adults (age 18-84years) who had a diagnosis of cancer and were alive during the specific survey calendar year. We identified persons with history of cancer using respondents' response to the question "Have you ever been told by a doctor or other health professional that you had cancer or a malignancy of any kind?".

Respondents were considered cancer survivors and eligible if they reported they had been diagnosed with cancer (excluding non-melanomatous skin cancers) and identified with at least one type of cancer included in the MEPS.

Measures

Outcome:

The dependent variable of interest for this study was perceived health status which was assessed by respondents' rating of their health according to the categories excellent, very good, good, fair, and poor. For this study, perceived health status was dichotomized into good (comprising of responses excellent, very good and good) and poor (comprising responses fair and poor).

Exposure:

The independent variable assessed was the presence of comorbidities. Comorbidities were based on the AHRQ priority conditions on which MEPS collects information [14]. Specific comorbidities assessed were those determined by previous studies to influence cancer treatment and prognosis: hypertension, heart disease, high cholesterol, emphysema, chronic bronchitis, diabetes, arthritis, asthma and stroke [3–5]. We organized comorbidities into cardiometabolic (hypertension, heart disease, high cholesterol, diabetes and stroke), respiratory (emphysema, chronic bronchitis and asthma), musculoskeletal (arthritis and joint pain) and substance use (alcoholism and tobacco use)[9, 15, 16].

Participants were categorized based on the number of comorbidities reported: no other conditions besides cancer; those who reported few comorbidities and those who reported more comorbidities (determined using the median split method). Using an adaptation of Colinet's simplified comorbidities score (SCS) [17], we calculated a Modified Colinet comorbidity score for all participants. This approach identifies the main comorbidities and attaches weights based on their prognostic significance [17].

Covariates:

We used the Andersen's Behavioral Model (ABM) of Health Services Use to examine the association of predisposing, enabling, needs, and external environmental factors with participants' perceived health status.[18] Using this model, demographic factors such as age (18–44 years/45–64 years/65–84 years), gender (male/female) and race/ethnicity (white/other) were considered predisposing; educational status, marital status, income and insurance type were added as enabling factors; and physical function (based on participants' responses to whether they had any limitations in physical functioning), pain (responses to whether they had pain that limits normal work) and mental health status (how they perceived their mental health) were considered needs factors. Region of residence was included as environmental factors [18].

Statistical analyses

We presented descriptive characteristics of participants as weighted percentages with 95% confidence intervals. Logistic regression models were used to assess the association between comorbidities (numbers and types of comorbidities, mean modified Colinet comorbidity scores) and perceived health status. Unadjusted models included the independent (comorbidities) and dependent (perceived health status) variables only. While adjusted logistic regression models included all prespecified covariates in addition to the independent variable (predisposing, enabling, needs and external environmental factors). For each logistic regression model, odds ratios and 95% confidence intervals were computed. We evaluated the fit of our models using the Hosmer-Lemeshow test.

An alpha of 0.05 was set *a priori*. All analyses were conducted with SAS on Demand for Academics and the SAS survey procedures were employed to account for the complex MEPS design and for generation of national-level estimates.

Results

The study participants' selection process is outlined in Fig. 1. Of 28,512 participants in the 2019 MEPS dataset, 1,739 were eligible for the study representing a weighted population of 18,269,046. The weighted percentage was 11.16% (95% CI 9.64, 12.59%); 41.73% (95% CI 39.21, 43.96%) and 47.10% (95% CI 44.86, 49.73%) for those who reported having no comorbidities; few comorbidities (1 or 2) and more comorbidities (3 or more comorbidities), respectively.

Participants' characteristics are presented in Table 1. The most common cancer was breast cancer (N = 356) followed by prostate cancer (N = 276) and melanoma (N = 273), the least being bladder cancer (N = 40). Most of the participants reported more than 2 comorbidities, but rates were highest for prostate (60.2%), bladder (59.4%) and lung cancer (58.6%) patients. The mean modified Colinet score for all participants was 1.9 out of a possible 11. Patients with lung cancer had the highest mean modified Colinet score of 3.6; those with lymphoma the lowest score of 1.1. Amongst people who rated their health status as good, 41.9%, had 3 or more comorbidities, compared to 65.0% of those who rated their health status as poor.

Table 1

Characteristics of persons with history of cancer in the United States aged 18–84 years stratified by no comorbidities, less than 3 comorbidities and 3 or more comorbidities

Factors	Count of comorbidities			P-value	Modified Colinet score ^b , Mean (Standard error)
	None	1 or 2	3 or more		
	Weighted % ^a (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)		1.9 (0.1)
Cancer type:					
Bladder (N = 40)	8.1 (0.0, 16.3)	32.5 (16.3, 48.6)	59.4 (42.4, 76.4)		2.9 (0.28)
Prostate (N = 276)	4.0 (1.6, 6.4)	35.2 (28.9, 42.8)	60.2 (53.2, 67.1)		1.7 (0.1)
Breast (N = 356)	14.6 (10.0, 19.3)	45.5 (39.3, 51.8)	39.8 (33.9, 45.8)		1.5 (0.1)
Colon (N = 109)	14.5 (5.8, 23.3)	41.8 (30.4, 53.2)	43.7 (33.3, 54.0)		2.0 (0.2)
Lymphoma (N = 66)	11.1 (2.7, 19.5)	47.1 (32.8, 61.5)	41.8 (28.4, 55.2)		1.1 (0.1)
Lung (N = 60)	4.4 (0.0, 10.2)	37.0 (23.6, 50.5)	58.6 (44.4, 72.7)		3.6 (0.2)
Cervix (N = 137)	12.4 (6.3, 18.6)	42.1 (30.9, 53.3)	45.5 (34.8, 56.2)		3.5 (0.3)
Uterus (N = 70)	3.3 (0.0, 7.2)	50.2 (36.5, 63.8)	46.5 (33.1, 60.0)		2.0 (0.2)
Melanoma (N = 273)	11.2 (9.3, 13.1)	40.1 (33.7, 46.4)	48.7 (41.9, 55.5)		1.7 (0.2)
Others (N = 425)	12.2 (8.2, 16.1)	42.2 (36.7, 47.7)	45.6 (40.6, 50.7)		2.0 (0.1)
Perceived health status				< 0.0001	
Good	13.4 (11.3, 15.5)	44.7 (41.6, 47.9)	41.9 (38.7, 45.0)		1.7 (0.1)
Poor	3.5 (1.7, 5.3)	31.4 (26.0, 36.9)	65.0 (59.6, 70.5)		2.7 (0.2)
Predisposing factors:				< 0.0001	
Age (years)					
18–44	25.5 (17.5, 31.6)	49.4 (39.4, 59.3)	25.5 (17.0, 34.1)		2.2 (0.2)
45–64	16.1 (12.9, 19.2)	47.6 (42.8, 52.5)	36.3 (31.8, 40.8)		2.0 (0.1)

^a Row percentage

^b Range of Modified Colinet score: 0–11

Factors	Count of comorbidities			P-value	Modified Colinet score ^b , Mean (Standard error)
	None Weighted % ^a (95% CI)	1 or 2 Weighted % (95% CI)	3 or more Weighted % (95% CI)		
					1.9 (0.1)
65–84	4.8 (3.3, 6.3)	35.9 (32.3, 39.6)	59.3 (55.4, 63.1)		1.8 (0.1)
Gender				< 0.0001	
Male	8.4 (5.9, 11.0)	37.0 (32.8, 41.1)	54.6 (50.4, 58.8)		2.0 (0.1)
Female	13.1 (10.7, 15.5)	45.1 (41.2, 49.0)	41.8 (38.3, 45.3)		1.9 (0.1)
Race				0.1393	
White	11.6 (9.6, 13.6)	42.3 (39.3, 45.4)	46.1 (43.0, 49.1)		1.9 (0.1)
Other	8.4 (4.4, 12.4)	38.2 (31.3, 45.2)	53.4 (46.2, 60.5)		1.9 (0.1)
Enabling factors:				< 0.0001	
Education					
< high school	5.2 (1.6, 8.9)	28.8 (21.7, 35.9)	66.0 (58.6, 73.3)		3.0 (0.2)
Completed high school	7.9 (4.4, 11.3)	44.2 (38.8, 49.5)	48.0 (42.7, 53.2)		2.2 (0.1)
Beyond high school	13.5 (11.1, 15.8)	43.0 (39.5, 46.5)	43.5 (39.9, 47.1)		1.6 (0.1)
Marital status:				0.6811	
Married	11.8 (9.6, 14.0)	41.4 (37.6, 45.1)	46.8 (43.0, 50.7)		1.7 (0.1)
Other	10.3 (7.7, 12.8)	42.3 (38.0, 46.5)	47.5 (43.4, 51.6)		2.3 (0.1)
Income status:				0.0002	
Low income	9.3 (6.4, 12.2)	35.3 (30.3, 40.3)	55.4 (50.3, 60.5)		2.6 (0.1)
Middle income	8.4 (5.4, 11.5)	41.9 (36.7, 47.0)	49.7 (44.0, 55.3)		2.1 (0.1)
High income	13.5 (10.7, 16.3)	45.1 (41.1, 49.0)	41.4 (37.5, 45.4)		1.5 (0.9)
Health insurance type:				< 0.0001	

^a Row percentage

^b Range of Modified Colinet score: 0–11

Factors	Count of comorbidities			P-value	Modified Colinet score ^b , Mean (Standard error)
	None Weighted % ^a (95% CI)	1 or 2 Weighted % (95% CI)	3 or more Weighted % (95% CI)		
					1.9 (0.1)
Private	14.6 (12.1, 17.2)	44.4 (40.8, 47.9)	41.0 (37.6, 44.5)		1.6 (0.1)
Public	5.0 (3.4, 6.6)	36.5 (31.7, 41.3)	58.5 (53.5, 63.5)		2.4 (0.1)
Uninsured	9.7 (0.0, 19.7)	53.0 (31.7, 74.2)	37.3 (16.9, 57.7)		3.1 (0.4)
Need factors:				< 0.0001	
Physical function					
Limited	1.6 (0.4, 2.9)	28.0 (23.1, 32.9)	70.3 (65.5, 75.3)		2.6 (0.2)
Not limited	14.2 (11.9, 16.4)	46.1 (42.7, 49.5)	39.8 (36.5, 43.0)		1.7 (0.1)
Pain:				< 0.0001	
Yes	2.6 (0.7, 4.4)	32.7 (27.4, 38.1)	64.7 (59.0, 70.4)		2.3 (0.1)
No	13.6 (11.1, 16.1)	46.0 (42.4, 49.6)	40.4 (36.9, 43.9)		1.8 (0.1)
Mental health status:				< 0.0001	
Good	12.5 (10.6, 14.4)	43.7 (40.6, 46.7)	43.8 (40.8, 46.9)		1.8 (0.1)
Poor	1.6 (0.0, 3.3)	28.2 (21.3, 35.0)	70.2 (63.1, 77.3)		2.9 (0.2)
External factors:				0.3921	
Region					
Northeast	7.9 (4.9, 11.0)	46.2 (41.0, 51.5)	45.8 (40.6, 51.1)		1.7 (0.1)
Midwest	12.4 (7.8, 17.0)	41.3 (35.6, 47.0)	46.3 (41.0, 51.9)		2.2 (0.1)
South	10.8 (8.1, 13.5)	39.9 (34.7, 45.1)	49.3 (44.2, 54.6)		2.1 (0.1)
West	13.2 (9.6, 16.8)	41.5 (35.7, 47.4)	45.3 (39.0, 51.5)		1.6 (0.2)
^a Row percentage					
^b Range of Modified Colinet score: 0–11					

The prevalence of various co-existing medical conditions among US adults with history of cancer were examined. Hypertension (88.3%), hypercholesterolemia (49.5%), and arthritis (48.0%) were the most prevalent conditions, with emphysema (4.1%), angina (4%) and chronic bronchitis (3.1%) the least common (Supplementary Table 1).

The prevalence of comorbidities among patients with history of various types of cancers is presented in Supplementary Table 2. Cardiometabolic comorbidities were most prevalent among patients with breast (18.5%) and prostate (17.7%) cancers and least prevalent among patients with lung cancer (3.5%).

From the unadjusted logistic regression, there was statistically significantly higher odds of perceiving health as poor with increasing modified Colinet score (OR 1.14, 95% CI 1.09, 1.20). This remained statistically significant after adjusting for prespecified covariates (OR 1.10, 95% CI 1.07, 1.12). Compared to participants aged 65–84 years, those aged 18–44 years and 44–64 years had 0.73 (95% CI 0.61, 0.87) and 1.21 (95% CI 1.03, 1.42) times the odds of perceiving health as poor, respectively. Participants were more likely to perceive their health as poor if they were male (OR 1.14, 95% CI 1.01, 1.29); had less than high school education (OR 1.56, 95% CI 1.28, 1.90); were of low- (OR 1.64, 95% CI 1.37, 1.95) or middle-income (OR 1.39, 95% CI 1.17, 1.64). Patients with functional limitation (OR 3.24, 95% CI 2.76, 3.79); pain (OR 3.25, 95% CI 2.84, 3.72), as well as those who perceived their mental health as poor (OR 12.15, 95% CI 10.37, 14.25) were also more likely to perceive their health as poor (Table 2).

Table 2

Results of logistic regression showing association between Modified Colinet Score and poor perceived health status among persons with history of cancer aged 18–84 years in the United States.

	Unadjusted OR	Adjusted OR
Modified Colinet Score ^a	1.14 (1.09, 1.20)	1.10 (1.07, 1.12)
Predisposing factors:		
Age 18–44 vs 65–84 years		0.73 (0.61, 0.87)
Age 44–64 vs 65–84 years		1.21 (1.03, 1.42)
Male vs Female		1.14 (1.01, 1.29)
White vs other races		0.90 (0.77, 1.05)
Enabling factors:		
Less than high school vs Beyond high school		1.56 (1.28, 1.90)
Completed high school vs Beyond high school		1.14 (0.99, 1.31)
Married vs Other		1.10 (0.97, 1.25)
Low-income vs High-income		1.64 (1.37, 1.95)
Middle-income vs High-income		1.39 (1.17, 1.64)
Private vs uninsured health insurance coverage		0.85 (0.64, 1.15)
Public vs uninsured health insurance		1.00 (0.76, 1.40)
Needs factors:		
Functional limitation yes vs no		3.24 (2.76, 3.79)
Pain vs no pain		3.25 (2.84, 3.72)
Poor vs good perceived mental health		12.15 (10.37, 14.25)
External factors:		
Northeast vs West census region		0.98 (0.79, 1.22)
Midwest vs West census region		0.96 (0.81, 1.15)
South vs West census region		0.98 (0.83, 1.14)
^a Possible range 0–11		

Table 3 shows the results of logistic regression assessing the association of the number of comorbidities with perceived health status. Compared to participants with no comorbidities, those who had 1 or 2 comorbidities were 2.66 (95% CI 1.49, 4.77) times more likely to perceive their health as poor while those with 3 or more comorbidities had 5.89 times odds of perceiving their health as poor (95% CI 3.39, 10.24). After adjusting for other variables, we found that, compared to those with no comorbidities, participants with 1 or 2 comorbidities (OR 1.58, 95% CI 0.79, 3.15) and those with 3 or more comorbidities (OR 2.27, 95% CI 1.19, 4.32) were more likely to think their health as poor. Participants aged 18–44 years (OR 2.52, 95% CI 1.35, 4.69) and those aged 44–64 years (OR 1.58, 95% CI 1.04, 2.40); those with low income (OR 1.14, 95% CI 1.12, 1.72); those with functional limitation (OR 1.80, 95% CI 1.23, 2.62); those with pain (OR 4.30, 95% CI 2.92, 6.33), and

those who perceived their mental health as poor (OR 8.83, 95% CI 5.63, 13.85) were all more likely to perceive their health as poor rather than good.

Table 3
Results of logistic regression showing association between number of comorbidities and poor perceived health status among persons with history of cancer aged 18–84 years in the United States.

	Unadjusted	Adjusted
1 or 2 comorbidities vs No comorbidities	2.66 (1.49, 4.77)	1.58 (0.79, 3.15)
3 or more comorbidities vs No comorbidities	5.89 (3.39, 10.24)	2.27 (1.19, 4.32)
Predisposing factors:		
Age 18–44 vs 65–84 years		2.52 (1.35, 4.69)
Age 44–64 vs 65–84 years		1.58 (1.04, 2.40)
Male vs Female		1.29 (0.91, 1.83)
White vs other races		0.94 (0.62, 1.43)
Enabling factors:		
Less than high school vs Beyond high school		1.60 (0.99, 2.56)
Completed high school vs Beyond high school		1.07 (0.72, 1.61)
Married vs Other		0.94 (0.69, 1.61)
Low-income vs High-income		1.14 (1.12, 1.72)
Middle-income vs High-income		0.86 (0.54, 1.36)
Private vs uninsured health insurance coverage		0.79 (0.30, 2.13)
Public vs uninsured health insurance		0.84 (0.33, 2.14)
Need factors:		
Functional limitation yes vs no		1.80 (1.23, 2.62)
Pain vs no pain		4.30 (2.92, 6.33)
Poor vs good perceived mental health		8.83 (5.63, 13.85)
External factors:		
Northeast vs West census region		1.36 (0.84, 2.20)
Midwest vs West census region		1.40 (0.88, 2.21)
South vs West census region		1.28 (0.86, 1.92)

Participants with cardiometabolic comorbidities had 1.03 times odds of perceiving their health as poor compared to those without cardiometabolic comorbidities, but this association was not statistically significant (95% CI 0.43, 2.46). Patients with respiratory (OR 2.18, 95% CI 1.60, 3.00), musculoskeletal (OR 1.83, 95% CI 1.36, 2.46) and substance use comorbidities (OR 1.89, 95% CI 1.27, 2.82) were statistically significantly more likely to perceive their health as poor compared with those who did not have these conditions (Table 4). With covariates adjusted for, participants who reported substance use were statistically significantly more likely to think their health poor (OR 1.40, 95% CI 1.84, 1.66).

Table 4

Odds ratio for relationship between types of comorbidities and poor perceived health status among persons with history of cancer aged 18–84 years in the United States.

Type of comorbidity	Unadjusted Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
Cardiometabolic (Yes vs No)	1.03 (0.43, 2.46)	0.59 (0.17, 2.13)
Respiratory (Yes vs No)	2.18 (1.60, 3.00)	1.15 (0.77, 1.71)
Musculoskeletal (Yes vs No)	1.83 (1.36, 2.46)	1.00 (0.61, 1.32)
Substance use (Alcohol and tobacco use) (Yes vs No)	1.89 (1.27, 2.82)	1.40 (1.84, 1.66)

Discussion

In this retrospective study, we found that the most prevalent cancer in the US in 2019 was breast cancer and most persons with history of cancer reported having 3 or more comorbidities, the most common being hypertension. Among participants, having comorbidities significantly increased the risk of perceiving health as poor. While most diseases influenced cancer patients' perception of their health, substance use had the strongest impact, highlighting the importance of examining associations between specific diseases and cancer where perceived health status is concerned. Other factors that were associated with perceiving health as poor included being male, as well as having a younger age, less than a high school education, low- or middle-income, functional limitation, pain, or poor perception of mental health.

Persons with history of cancer reported high prevalence of at least one comorbidity. This is consistent with findings of previous studies [4, 5]. Smith *et al.*, in their analysis of the physical and mental health of Americans who completed the SEER MHOS between 1998 and 2002 found that among cancer patients, prevalence of at least one comorbidity ranged between 84 and 88% [5]. Similarly, an analysis of the England cancer registry showed that prevalence of at least one other medical condition among cancer patients was about 56% [4]. On further exploration of our data, we found that persons with history of prostate and lung cancers had the most comorbidities (96%). This is similar to the findings by Roy *et al.* that also found the prevalence of comorbidities to be highest in patients with lung cancer [3]. In terms of the modified Colinet score, persons with lung cancer had the highest (3.6 out of 11). Our findings can be explained by the fact that in the estimation of the modified Colinet scale, the highest weight is ascribed to tobacco consumption[17] – a strong predictive characteristic among persons with lung cancer [19].

The most comorbid conditions were hypertension, hypercholesterolemia, and arthritis. This finding aligned with previous studies [3, 5, 11]. Studies have found some associations between cancer and these conditions.[20–23] Hypertension is a risk factor for certain cancers such as renal and prostate cancer [24], and for chemotherapy-induced cardiotoxicity which also significantly impairs cancer management if poorly controlled [21]. It has also been found that certain cancer treatments such as tyrosine kinase inhibitors are associated with hypertension incidence [24]. In addition, hypertension negatively impacts the perceived general wellbeing and quality of life of patients [25, 26]. Elevated serum cholesterol has been implicated in the development of certain cancers[22] with hypercholesterolemia suggested to affect cancer development [27]. Patients with arthritis undergoing cancer therapy have been found to be at increased risk of treatment complications [23]. With evidence of interrelations between cancer and other conditions, the importance of optimizing control of comorbidities among cancer patients in order to improve their overall prognosis cannot be overemphasized.

Results from this study provide important information about the impact of chronic diseases on patients' perceived health status. The likelihood of perceiving health as poor increased with increasing number of comorbidities and modified Colinet score among participants, consistent with the literature [11, 28]. This is premised on the fact that cancer patients with comorbidities may be especially vulnerable to increased disease burden arising from managing the signs, symptoms and secondary issues due to the cancer, along with those accompanying their other medical conditions. Anderson and

colleagues propound that the association between comorbidities and general health among cancer patients is facilitated by various factors including the psychosocial impact of patients' self-management and self-efficacy [11]. With increasing disease burden, cancer patients experience difficulties in managing their treatments and keeping up with self-care activities for health maintenance. The weight from this is subsequently linked; not only with non-adherence and poorer outcomes but with psychological, emotional and social limitations all of which impair patients' thoughts of their general health [28].

Younger or male cancer patients, as well as those with less than a high school education, low- or middle-income, functional limitation, pain or poor perception of mental health were more likely to perceive their health as poor. Among younger patients, this may be due to the additional stressors that these patients face compared to older patients. There are longer potential years of disease symptoms, financial burden from the disease and protracted anxiety about the future [29]. In addition, younger patients are likely to lose productive time resulting from doctor visits, follow-up appointments, time taken off to recover, among others that could lead to salary losses. In addition, younger persons, in their reproductive years, are more likely to be concerned about fertility issues that may arise from cancer treatment or have younger children for whom they are responsible. The psychological stress over time could have a toll on both their physical and mental well-being. Here also, there is a likelihood that older patients may expect more decline whereas younger ones may be struggling with having to deal with cancer at their age. In contrast to other population-based studies [30, 31], we found statistically significant association between being male and perceiving health as poor. Gender may play a role in how cancer patients, especially those with comorbidities, perceive their health and the need for better understanding of these dynamics and implementing gender-specific interventions to mitigate them. Cancer patients with lower education may be faced with health literacy challenges that could affect their understanding and management of their disease [28], leading also to poorer quality of life and perceived health status. The financial burden associated with cancer management, along with those with treating comorbidities and the potential loss of income compounds patients' issues. This disproportionately affects patients with low income levels for whom access to treatment, and resources for addressing the associated mental and physical stress may be impaired. For patients with the additional strain of pain, functional limitation or poor perception of their mental health, the cumulative distress from juggling these with cancer can account for poorer outcomes, feelings of helplessness and potentially leave them thinking their general health as poor.

These findings suggest a need for a multidisciplinary approach in the management of cancer that includes - among others - the oncologist, primary care physician, pharmacist, clinical psychologist, physical and occupational therapists. A holistic strategy that does not only look at cancer symptoms but those of other co-occurring medical conditions, while incorporating patient counseling and support can potentially improve patients' prognosis significantly. This may help ease patients' treatment burden, enhance their self-efficacy, improve adherence and ultimately, quality of life and their perception of their health status.

Limitations

Our findings must be interpreted in the light of some limitations. As with all survey-based studies, data used were self-reported by participants and may be subject to response bias. Owing to the retrospective nature of our study, only data on collected variables were available for analysis. Thus, we were unable to examine other factors that may have influenced our findings such as the stage of cancer and treatments being received, among others. Our study did not match participants with persons with no history of cancer. Future studies exploring this may provide additional important information on the association. We also noticed a smaller proportion of patients with lung cancer than experienced in practice. This may be due to poor survival rates of such patients resulting in their death before the data collection period. Despite these limitations, we believe our study offers important information to what is known about how comorbidities are associated with perceived health status among cancer patients.

Conclusion

Among persons with history of cancer in the US in 2019, those with at least one comorbid condition have an increased likelihood of perceiving their health as poor. This association increases with increasing number of comorbidities. Among these patients, the odds of poor health status perception increased with increasing modified Colinet scores, having substance use issues, being younger or male, as well as having less formal education, low income, pain, functional limitation, or poor perceived health status. This study supports the need for oncologists and physicians to assess the presence and impact of other medical comorbidities and develop supportive care interventions. Future research should extend these findings to more specific measures of HRQOL and examine other cancer-specific variables such as type, stage, and treatment.

Declarations

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Competing interests

The authors have no relevant financial or non-financial interests to disclose.

Author contributions

All authors contributed to the study conception and design. Data analysis was performed by Mavis Obeng-Kusi and Briana Choi. The first draft of the manuscript was written by Mavis Obeng-Kusi and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Data Availability

The datasets used for this study are from the publicly available MEPS database available at <https://www.meps.ahrq.gov/mepsweb/>.

Ethics approval

The study was approved by the University of Arizona Institutional Review Board (Number 34824; Date October 18, 2021).

Consent to participate

This was a retrospective analysis of publicly available survey data. The research did not involve human subjects who needed to consent.

Consent to publish

This was a retrospective analysis of publicly available survey data. The research did not involve human subjects who needed to consent.

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Figures

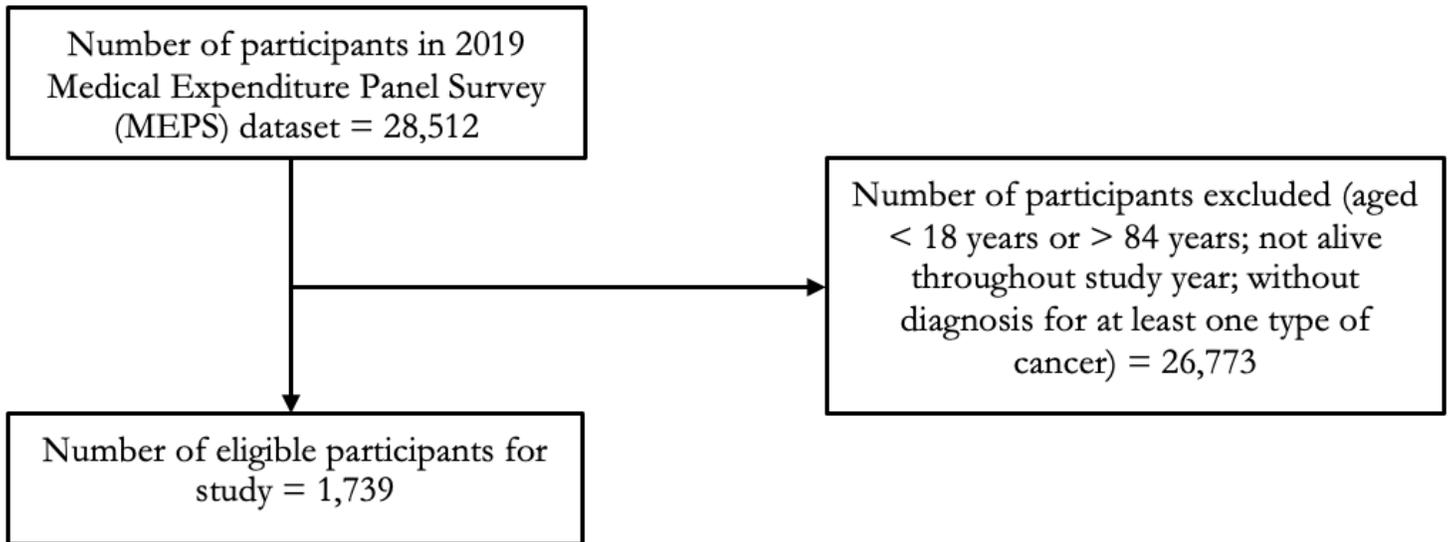


Figure 1

Study participants' selection process.

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