Association between Types of Chronic Conditions and Cancer Stage at Diagnosis among Elderly Medicare Beneficiaries with Prostate Cancer

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Abstract

The current retrospective observational study was conducted to examine the association between types of chronic conditions and cancer stage at diagnosis among elderly Medicare beneficiaries with prostate cancer using the Surveillance, Epidemiology, and End Results (SEER)-Medicare linked database. The study cohort consisted of elderly men (≥ 66 years) with prostate cancer diagnosed between 2002 and 2009 ($N=103,820$). Cancer stage at diagnosis (localized versus advanced) was derived using the American Joint Committee on Cancer classification. Chronic conditions were identified during the year before cancer diagnosis and classified as: (1) only cardiometabolic (CM); (2) only mental health (MH); (3) only respiratory (RESP); (4) CM + MH; (5) CM + RESP; (6) MH + RESP; (7) CM + MH + RESP; and (8) none of the 3 types of conditions. Chi-square tests and multivariable logistic regressions were used to test the unadjusted and adjusted associations between types of chronic conditions and cancer stage at diagnosis. The highest percentage (5.8%) of advanced prostate cancer was observed among elderly men with none of the 3 types of chronic conditions (CM, RESP, MH). In the adjusted logistic regression, those with none of the 3 types of chronic conditions were 44% more likely to be diagnosed with advanced prostate cancer compared to men with all the 3 types of chronic conditions. Elderly men without any of the selected chronic conditions were more likely to be diagnosed with advanced prostate cancer; therefore, strategies to reduce the risk of advanced prostate cancer should be targeted toward elderly men without these conditions.

Introduction

CHRONIC CONDITIONS ARE HIGHLY PREVALENT AMONG elderly men diagnosed with prostate cancer in the United States. Nearly one third (30.5%) of elderly men with incident prostate cancer have at least 1 preexisting chronic condition out of 16 chronic conditions included in the Charlson Comorbidity Index.¹ With regard to the types of chronic conditions, cardiometabolic conditions (diabetes and cardiovascular diseases) were the most common preexisting chronic conditions (18.1%), followed by respiratory conditions (eg, chronic obstructive pulmonary disease [COPD]) (9.8%),¹ and mental health conditions (eg, depression) (9%) among elderly men with prostate cancer.² A greater number of preexisting chronic conditions or higher chronic condition score can affect prostate cancer stage at diagnosis.^{3–8} How-

ever, the association between preexisting chronic conditions and cancer stage at diagnosis may differ by types of chronic conditions because of the differential pathophysiological pathways of underlying diseases and prostate cancer. For example, the presence of cardiovascular disease may increase the risk of prostate cancer as it shares common risk factors for the development of aggressive prostate cancer, such as the presence of high cholesterol level and obesity.^{9,10}

Few studies have investigated the relationship between specific types of chronic conditions and cancer stage at diagnosis. Findings from these studies suggest that the association between preexisting chronic conditions and cancer stage at diagnosis depends on the types of chronic conditions. For example, 3 studies in the United States using population-based data found that the presence of diabetes was associated with an increase in the risk of advanced stage

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or grade of prostate cancer at diagnosis.^{11–13} With respect to mental health conditions, a retrospective study found that elderly men with depression were not more likely to be diagnosed with a higher grade of prostate cancer compared to those without depression.⁹ Although these studies have highlighted the relationship between specific chronic conditions and cancer stage at diagnosis, many of these studies are outdated, single-institution database studies and suffer from the risk of detection bias because screening for prostate cancer was not included as one of the independent variables.^{5–7} Furthermore, none of these studies examined the association between types of chronic condition combinations and cancer stage at diagnosis among elderly men. Understanding the association between types of chronic conditions and cancer stage at diagnosis is critical for patient-centered care and individualized treatment.¹⁴

Based on a review of the literature to date, it can be concluded that a knowledge gap exists in how specific combinations of conditions affect the cancer stage at diagnosis. Examining associations between combinations of chronic conditions and cancer stage at diagnosis is important because such analyses can inform practitioners on the management of cancer care in the presence of chronic conditions. Therefore, the primary objective of the current study is to examine the associations between types of preexisting chronic conditions and cancer stage at diagnosis among fee-for-service Medicare beneficiaries with incident prostate cancer. It was expected that those with multiple chronic conditions would be less likely to be diagnosed with advanced prostate cancer than those without multiple chronic conditions.

Method

Study design

This study used a retrospective cohort design. The date of diagnosis of prostate cancer was considered as the index date. Preexisting conditions were identified during the year before the index date as depicted in Figure 1.

Data sources

The current study utilized data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Cancer Registries linked with Medicare insurance claims. SEER data are considered to be the most comprehensive and high-quality population-based data on cancer

incidence, initial cancer treatment, and vital status. At present, SEER data, comprising 18 population-based cancer registries, cover 24% of the US population.¹⁵ Cases of cancers are provided in a customized file, the Patient Entitlement and Diagnosis Summary File (PEDSF). Nearly 98% of cases of cancers are ascertained from medical records. Medicare is the primary health insurer for 97% of the US population age 65 years and older.¹⁶ A total of 93% of men aged 65 years and older in SEER have been linked to Medicare population enrollment records.^{16,17} At present, SEER data are released for those cases of cancer diagnosed until 2009 and their associated claims until 2010. The current study utilized cases of prostate cancer diagnosed between 2002 and 2009 and their linked Medicare claims between 2000 and 2010. Data were included for elderly male (aged 66 years and older) fee-for-services Medicare beneficiaries.

The current study was approved by the West Virginia University Institutional Review Board in 2015. It was approved under the expedited category, which involves use of de-identified data and the requirement for consent is waived.

Study cohort

The study cohort was based on men diagnosed with incident prostate cancer between January 1, 2002, and December 31, 2009 (N=358,439). Elderly men diagnosed with multiple cancers (N=65,794), diagnosed with prostate cancer at the time of autopsy or on the death certificate (N=2944), younger than 66 years of age (N=97,159), who had unclear vital status (N=8353), did not have continuous fee-for-service enrollment in Medicare Part A and B during the observation period (N=74,993), and who had missing information on cancer stage at diagnosis, race, income, education, or county of residence (N=5395) were excluded. Thus, the final cohort consisted of 103,820 elderly men with incident prostate cancer. Online Appendix 1 (available at www.liebertpub.com/pop) depicts the study cohort selection steps.

Key dependent variables

Cancer stage at diagnosis (localized versus advanced stage). American Joint Committee on Cancer Tumor-Node-Metastases (TNM) classifications for staging of prostate cancer were used. Based on the TNM systems, cases were classified into 2 categories: localized and advanced prostate

FIG. 1. Schematic diagram of the study design for the current study.

cancer at diagnosis. Localized prostate cancer was classified as cancer with T1 to T2 clinical stage with no regional lymph node (NX-N0) or distant metastasis (M0). Advanced prostate cancer was classified as cancer with T3 or T4 clinical stage with or without regional lymph node (N1) or distant metastasis (M1).¹⁸

Key independent variable

Types of preexisting chronic conditions. Chronic conditions were identified using 1 inpatient or 2 outpatient claims with *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnostic codes and procedure codes during the year before diagnosis of prostate cancer. Several criteria were used to define clinically meaningful combinations of chronic conditions, including high prevalence, specific organ domains, common pathophysiology, and synergistic management of chronic conditions.¹⁹ Based on prior literature, the conceptual model of chronic conditions measurement, and clinician input, 12 chronic conditions were selected. These 12 chronic conditions were among the 20 conditions selected by the US Department of Health and Human Services for research, policy, program, and practice²⁰; they also were also highly prevalent among elderly men with prostate cancer. These conditions were grouped into 3 broad categories using specific organ domains, common pathophysiology, and synergistic management: cardiometabolic conditions (diabetes, coronary artery disease, congestive heart failure, and cardiac arrhythmia), mental health conditions (anxiety, bipolar disorders, depression, schizophrenia, post-traumatic stress disorders, and psychosis), and respiratory conditions (COPD and asthma). Such types of classifications have been used in many studies.^{21–23} These 3 types of chronic conditions were then classified into 8 mutually exclusive categories: (1) cardiometabolic conditions only; (2) mental health conditions only; (3) respiratory conditions only; (4) cardiometabolic and mental health conditions; (5) cardiometabolic and respiratory conditions; (6) mental health and respiratory conditions; (7) all 3 types of conditions; and (8) none of the 3 types of conditions. (See Online Appendix 2, available at www.liebertpub.com/pop). The all 3 types of chronic conditions category was used as a reference group because those with all types of chronic conditions may have common risk factors for the development of all the 3 types of chronic conditions.

Other independent variables

All the independent variables were measured during the 1 year before prostate cancer diagnosis. The Anderson Healthcare Behavior and Utilizations Model (ABM)²⁴ was used to classify the potential independent factors associated with advanced prostate cancer. According to the ABM, health care behaviors are determined by individuals and societal characteristics and these are characteristics are classified into 4 types of factors: (1) predisposing, (2) enabling, (3) need, and (4) external environment characteristics.

Predisposing characteristics. Predisposing characteristics represent the set of an individual's characteristics that predispose the individual to the risk of advanced prostate cancer. In the current study, demographic factors (age, race/ethnicity, and marital status) were included as predisposing

characteristics. Age at the time of diagnosis was identified from the PEDSF file and was categorized into 2 groups (66 to 74 years, and ≥ 75 years). Race/ethnicity and marital also was derived from the PEDSF file and categorized into 4 groups: white, African American, Hispanic, and other. Marital status was derived from the PEDSF file and categorized into 4 groups: married, divorced/separated, unmarried, and other.

Enabling characteristics. Enabling characteristics are the set of an individual's or societal factors that enable the individual to use the services that may reduce the risk of advanced prostate cancer. For the current study, enabling characteristics were census tract-level income, census tract-level education, primary care visits, and prostate cancer screening. Healthcare Common Procedure Coding System codes of 84152, 84154, 84153, G0103¹⁷ represented the prostate-specific antigen (PSA) test; and these codes were used to identify prostate cancer screening.

Need characteristics. Need characteristics are the set of an individual's characteristics that determines the need to use the services that may reduce the risk of diagnosis of advanced prostate cancer. A very small percentage of men ($<5\%$) had 42 conditions²⁵ other than the cardiometabolic, mental health, and respiratory conditions. These conditions were classified into 2 categories, "0–1 condition" and " ≥ 2 conditions."

External environment characteristics. External environment characteristics comprised an individual's resident-level county, region, county-level radiation oncology units, and urology units, which provides the opportunity to seek care in order to reduce the risk of advanced prostate cancer. The 18 regions of SEER were categorized into 4 groups: (1) Northeast, which included 2 registries from Connecticut and New Jersey; (2) South, which included 5 registries from Atlanta, Greater Georgia, Kentucky, Louisiana, and rural Georgia; (3) North-Central, which included 2 registries from Detroit and Iowa; and (4) West, which included registries from Arizona, Alaska, Greater California, Cherokee Nation, Hawaii, Los Angeles, New Mexico, San Francisco-Oakland, San Jose-Monterey, Seattle-Puget Sound, and Utah.²⁶

County-level health care resources were derived from Area Health Resource files (AHRF), which is a nationwide county-level health resource files for the United States. The file provides information for approximately 6000 county-level variables including health care facilities, health professionals, resource scarcity, health status, economic activity, health training programs, and socioeconomic characteristics.²⁶ The number of radiation oncology units and urology units in counties were used to present county-level health care resources. SEER-Medicare files were matched with the AHRF using Federal Information Processing Standards state and county codes.²⁶ For the purposes of these analyses, the quartiles of radiation oncology units and urology units were calculated.

The year of cancer diagnosis also was included as one of the independent variables.

Statistical analyses

Significant differences in types of preexisting chronic conditions and advanced prostate cancer diagnosis were

TABLE 1. CHARACTERISTICS OF ELDERLY MEDICARE BENEFICIARIES WITH PROSTATE CANCER SURVEILLANCE, EPIDEMIOLOGY, AND END RESULTS (SEER)-MEDICARE LINKED DATABASE, 2002–2010

	Total	%
All	103,820	
Types of chronic conditions		
CM only	36,719	35.4
MH only	1940	1.9
RESP only	5421	5.2
CM + MH	2169	2.1
CM + RESP	8216	7.9
MH + RESP	416	0.4
None	48,009	46.2
All three	930	0.9
Predisposing Characteristics		
Age at diagnosis, years		
66–74	62,020	59.7
≥75	41,800	40.3
Race/ethnicity		
White	84,787	81.7
African American	11,679	11.2
Hispanic/Latino	2148	2.1
Others	5206	5.0
Marital status		
Unmarried	6954	6.7
Married	69,628	67.1
Divorced/Separated	13,599	13.1
Others	13,639	13.1
Enabling Characteristics		
Quartile of median census 2000 income		
\$7–\$34,522	25,920	25.0
\$34,523–\$46,224	25,959	25.0
\$46,229–\$62,764	25,947	25.0
\$62,767–\$200,008	25,994	25.0
Quartile of median census 2000 education		
0–8.52	25,946	25.0
8.53–15.16	26,057	25.1
15.17–26.09	25,821	24.9
26.1–100	25,996	25.0
PSA screening		
Yes	84,681	81.6
No	19,139	18.4
Visit to a PCP		
Yes	76,632	73.8
No	27,188	26.2
Need Characteristics		
Number of chronic conditions		
≤1	63,217	60.9
>1	40,603	39.1
External-Environment Characteristics		
SEER-Regions		
Northeast	20,726	20.0
South	25,185	24.3
North-Central	12,907	12.4
West	45,002	43.3
Quartile of radiation oncology		
0 to 1	27,475	26.5
2 to 6	23,281	22.4
7 to 22	27,014	26.0
23 to 147	26,050	25.1

(continued)

TABLE 1. (CONTINUED)

	Total	%
Quartile of urology centers		
0 to 3	25,677	24.7
4 to 16	25,467	24.5
17 to 44	27,053	26.1
45 to 343	25,623	24.7
Year of diagnosis		
2002–2005	53,412	51.4
2006–2009	50,408	48.6
Cancer Stage at Diagnosis		
Stage		
Localized	98,264	94.6
Advanced	5556	5.4

Notes: Based on the data of 103,820 elderly men aged ≥66 years diagnosed with prostate cancer between 2002 and 2009 using SEER-linked Medicare data.

CM=cardiometabolic conditions; MH=mental health conditions; PCP=primary care physician; PSA=prostate-specific antigen test; RESP=respiratory conditions.

tested using chi-square tests. Multivariable binary logistic regressions were used to test the association between types of chronic conditions and advanced prostate cancer diagnosis after controlling for the predisposing, enabling, need, and external environment characteristics. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC) in 2015.

Results

Study population

Table 1 summarizes the characteristics of the study cohort (N=103,820). A majority of men were diagnosed with prostate cancer between age 66 and 74 years. The study cohort was primarily white and married. Nearly three quarters of men had a primary care visit and had a PSA screening during the baseline period.

Study population by types of chronic conditions

Table 2 reports the characteristics of the study population by types of chronic conditions. Overall, 53.8% of the study population had either cardiometabolic, mental health, or respiratory conditions during the year before prostate cancer diagnosis and 46.2% of the study population had none of these conditions. The majority of men had only cardiometabolic conditions, followed by men with both cardiometabolic and respiratory conditions, only respiratory conditions, cardiometabolic and mental health conditions, only mental health conditions, and mental health conditions and respiratory conditions. Significant differences in the predisposing, enabling, need, and external environment factors by types of chronic conditions were observed among elderly men with incident prostate cancer.

Types of chronic conditions and cancer stage at diagnosis

Table 3 describes the relationship between the types of chronic conditions and cancer stage at diagnosis. Overall,

TABLE 2. CHARACTERISTICS OF ELDERLY MEDICARE BENEFICIARIES WITH PROSTATE CANCER BY TYPES OF CHRONIC CONDITIONS SURVEILLANCE, EPIDEMIOLOGY, AND END RESULTS (SEER)-MEDICARE LINKED DATABASE, 2002–2010

	None		CM Only		MH only		RESP Only		CM+ MH		CM + RESP		MH + RESP		All Three		Sig.
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
Overall	48,009	46.2	36,719	35.4	1,940	1.9	5,421	5.2	2,169	2.1	8,216	7.9	4,416	0.4	930	0.9	
Predisposing Characteristics																	
Age at diagnosis, years																	
66–74	31,152	64.9	20,270	55.2	1,228	63.3	3,258	60.1	1,173	54.1	4,170	50.8	2,525	60.6	517	55.6	***
≥75	16,857	35.1	16,449	44.8	712	36.7	2,163	39.9	996	45.9	4,046	49.2	1,643	39.4	413	44.4	
Race/ethnicity																	
White	39,460	82.2	29,827	81.2	1,686	86.9	4,415	81.4	1,813	83.6	6,469	78.7	3,543	85.1	763	82.0	***
African American	5,379	11.2	4,143	11.3	159	8.2	581	10.7	198	9.1	1,079	13.1	363	8.7	104	11.2	
Others	3,170	6.6	2,749	7.5	95	4.9	425	7.8	158	7.3	668	8.1	263	6.2	63	6.8	***
Marital status																	
Unmarried	3,283	6.8	2,167	5.9	218	11.2	414	7.6	193	8.9	554	6.7	473	11.3	78	8.4	***
Married	33,078	68.9	24,782	67.5	1,178	60.7	3,461	63.8	1,282	59.1	5,121	62.3	2,226	54.3	500	53.8	
Divorced/Separated	5,934	12.4	4,565	12.4	317	16.3	788	14.5	369	17.0	1,324	16.1	903	21.6	212	22.8	
Others	5,714	11.9	5,205	14.2	227	11.7	758	14.0	325	15.0	1,217	14.8	533	12.7	140	15.1	
Enabling Characteristics																	
Quartile of median census 2000 income																	
\$7–\$34,522	11,533	24.0	8,625	23.5	502	25.9	1,624	30.0	627	28.9	2,540	30.9	1,383	33.2	331	35.6	***
\$34,523–\$46,224	11,864	24.7	9,086	24.7	528	27.2	1,436	26.5	522	24.1	2,178	26.5	1,093	26.2	236	25.4	
\$46,229–\$62,764	12,052	25.1	9,456	25.8	453	23.4	1,262	23.3	509	23.5	1,900	23.1	1,003	24.0	215	23.1	
\$62,767–\$200,008	12,560	26.2	9,552	26.0	457	23.6	1,099	20.3	511	23.6	1,598	19.4	693	16.6	148	15.9	
Quartile of median census 2000 education																	
0–8.52	13,111	27.3	9,001	24.5	508	26.2	1,135	20.9	529	24.4	1,426	17.4	853	20.4	151	16.2	***
8.53–15.16	12,186	25.4	9,337	25.4	490	25.3	1,319	24.3	523	24.1	1,919	23.4	903	21.6	193	20.8	
15.17–26.09	11,512	24.0	9,331	25.4	473	24.4	1,374	25.3	506	23.3	2,263	27.5	1,113	27.2	249	26.8	
26.1–100	11,200	23.3	9,050	24.6	469	24.2	1,593	29.4	611	28.2	2,608	31.7	1,283	30.8	337	36.2	***
PSA screening																	
Yes	36,251	75.5	32,144	87.5	1,632	84.1	4,642	85.6	1,852	85.4	7,044	85.7	3,573	85.8	759	81.6	
No	11,758	24.5	4,575	12.5	308	15.9	779	14.4	317	14.6	1,172	14.3	593	14.2	171	18.4	
Visit to PCP																	
Yes	32,188	67.0	28,848	78.6	1,568	80.8	4,221	77.9	1,847	85.2	6,798	82.7	3,563	85.6	806	86.7	
No	15,821	33.0	7,871	21.4	372	19.2	1,200	22.1	322	14.8	1,418	17.3	603	14.4	124	13.3	
Need Characteristics																	
Number of Other chronic conditions																	
≤1	36,724	76.5	21,031	57.3	1,035	53.4	1,945	35.9	708	32.6	1,618	19.7	803	19.2	76	8.2	***
>1	11,285	23.5	15,688	42.7	905	46.6	3,476	64.1	1,461	67.4	6,598	80.3	3,336	80.8	854	91.8	

(continued)

TABLE 2. (CONTINUED)

	None		CM Only		MH only		RESP Only		CM+ MH		CM + RESP		MH + RESP		All Three		Sig.
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
External Environment Characteristics																	
SEER-Regions																	
Northeast	8712	18.1	8347	22.7	342	17.6	953	17.6	439	20.2	1679	20.4	61	14.7	193	20.8	***
South	11,735	24.4	8450	23.0	535	27.6	1538	28.4	507	23.4	2020	24.6	129	31.0	271	29.1	
North-Central	5404	11.3	4810	13.1	208	10.7	641	11.8	280	12.9	1361	16.6	61	14.7	142	15.3	
West	22,158	46.2	15,112	41.2	855	44.1	2289	42.2	943	43.5	3156	38.4	165	39.7	324	34.8	
Quartile of urology centers																	***
0 to 3	12,241	25.5	8290	22.6	531	27.4	1593	29.4	511	23.6	2089	25.4	130	31.3	292	31.4	***
4 to 16	11,985	25.0	9035	24.6	477	24.6	1314	24.2	521	24.0	1839	22.4	112	26.9	184	19.8	
17 to 44	12,295	25.6	10,000	27.2	491	25.3	1274	23.5	548	25.3	2141	26.1	86	20.7	218	23.4	
45 to 343	11,488	23.9	9394	25.6	441	22.7	1240	22.9	589	27.2	2147	26.1	88	21.2	236	25.4	
Quartile of radiation oncology																	***
0 to 1	12,994	27.1	8991	24.5	554	28.6	1686	31.1	558	25.7	2254	27.4	140	33.7	298	32.0	***
2 to 6	10,852	22.6	8305	22.6	452	23.3	1205	22.2	437	20.1	1739	21.2	105	25.2	186	20.0	
7 to 22	12,555	26.2	9931	27.0	486	25.1	1287	23.7	569	26.2	1909	23.2	82	19.7	195	21.0	
23 to 147	11,608	24.2	9492	25.9	448	23.1	1243	22.9	605	27.9	2314	28.2	89	21.4	251	27.0	***
Year of diagnosis																	
2002–2005	25,127	52.3	18,344	50.0	951	49.0	2926	54.0	1039	47.9	4343	52.9	210	50.5	472	50.8	
2006–2009	22,882	47.7	18,375	50.0	989	51.0	2495	46.0	1130	52.1	3873	47.1	206	49.5	458	49.2	

Notes: Based on 103,820 elderly men aged ≥66 years diagnosed with incident prostate cancer between 2002 and 2009. Significant group differences by types of chronic conditions combinations were based on Chi-square tests.

CM=cardiometabolic conditions; MH=mental health conditions; PCP=primary care physician; PSA=prostate-specific antigen test; RESP=respiratory conditions.

*** $P < .001$; ** $.001 \leq P < .01$; * $.01 \leq P < .05$

TABLE 3. NUMBER AND PERCENT WITH ADVANCED PROSTATE CANCER AND ADJUSTED ODDS RATIOS (AOR) AND 95% CONFIDENCE INTERVALS FROM LOGISTIC REGRESSIONS FOR ADVANCED STAGE DIAGNOSIS AMONG ELDERLY MEDICARE BENEFICIARIES WITH PROSTATE CANCER SURVEILLANCE, EPIDEMIOLOGY, AND END RESULTS (SEER)-MEDICARE LINKED DATABASE, 2002–2010

	Cancer Stage				Sig.	Logistic Regressions on Advanced Prostate Cancer Diagnosis		
	Localized		Advanced			AOR	95% CI	Sig.
	N	%	N	%				
Types of Chronic Conditions								
None	45,209	94.2	2800	5.8	***	1.44	[1.03–2.00]	*
CM only	34,916	95.1	1803	4.9		1.29	[0.93–1.80]	
MH only	1838	94.7	102	5.3		1.33	[0.90–1.95]	
RSP only	5151	95.0	270	5.0		1.32	[0.93–1.88]	
CM + MH	2086	96.2	83	3.8		0.89	[0.60–1.33]	
CM + RSP	7783	94.7	433	5.3		1.37	[0.97–1.92]	
MH + RSP	393	94.5	23	5.5		1.24	[0.71–2.17]	
All Three	888	95.5	42	4.5		Ref		

Notes: Based on 103,820 elderly men aged ≥ 66 years diagnosed with prostate cancer between 2002 and 2009. Significant differences by types of chronic conditions were based on the log-likelihood test using a logistic regression for adjusted models and chi-square tests for difference in the rates of stages by types of chronic conditions. Adjusted model controlled for predisposing (age, race/ethnicity, marital status), enabling (income, education, access to care, cancer screening), need (number of other chronic conditions), and external environment factors (county-level radiation unit, urology units, regions, year of diagnosis).

CM=cardiometabolic conditions; MH=mental health conditions; RSP=respiratory conditions; Ref=reference group; Sig=level of significance.

*** $P < .001$; ** $.001 \leq P < .01$; * $.01 \leq P < .05$

94.6% of the study cohort were diagnosed with localized prostate cancer and 5.4% were diagnosed with advanced prostate cancer. Significant relationships between types of chronic conditions and cancer stage at diagnosis were observed. As compared to men with all 3 types of chronic conditions, a lower percentage of men with cardiometabolic and respiratory conditions were diagnosed with advanced prostate cancer.

Table 3 also reports adjusted odds ratios (AOR) and 95% confidence intervals (CI) from the logistic regression on cancer stage at diagnosis. After adjusting for predisposing, enabling, need, and external environment factors among elderly men with prostate cancer, elderly men with none of the 3 conditions were 44% more likely to be diagnosed with advanced prostate cancer compared to those with all the 3 types of chronic conditions. Furthermore, elderly men with a PSA screening test during the year before diagnosis were 55% less likely to be diagnosed with advanced prostate cancer compared to those without a PSA screening test during the year before diagnosis of prostate cancer (AOR = 0.45, 95% CI = 0.43–0.48).

Discussion

One in 2 elderly men (54%) with incident prostate cancer had a preexisting chronic condition from the list of selected cardiometabolic, mental health, and respiratory conditions. The most prevalent types of chronic conditions were cardiometabolic and respiratory chronic conditions (15%). These findings suggest that elderly men with prostate cancer have significant disease burden prior to the diagnosis of prostate cancer.

In this study cohort, 1 in 10 elderly men with prostate cancer was diagnosed with advanced prostate cancer. Esti-

mates from this study are consistent with the published literature on rates of advanced prostate cancer.^{7,27,28} In the current study, it was observed that elderly men without the commonly prevalent chronic conditions had advanced prostate cancer at diagnosis. These study findings add to the conflicting hypotheses and findings of the relationship between the presence of chronic conditions and risk of advanced prostate cancer at diagnosis. One of the hypotheses is that individuals with chronic conditions may be less likely to be diagnosed with advanced prostate cancer because of increased contact with the health care system for care of their chronic conditions.²⁹ Conversely, the theory of competing demand postulates that the care of chronic conditions may take attention away from early symptoms of cancer and that individuals with chronic conditions may be more likely to be diagnosed with advanced prostate cancer. The role of competing demands for care of chronic conditions on advanced prostate cancer at diagnosis has been documented. For example, men with prostate cancer and preexisting congestive heart failure were more likely to be diagnosed with advanced prostate cancer compared to those without congestive heart failure.^{3,30} Although the current study found that elderly men with chronic conditions other than cardiometabolic, respiratory, or mental health conditions were 43% more likely to be diagnosed with advanced prostate cancer, future research studies should examine the impact of less common conditions such as inflammatory-related conditions, smoking associated disorders, and sexually transmitted disease on prostate cancer risk, as these conditions also share common risk factors for developing prostate cancer.

Closer examination of the current study results suggested that elderly men who had a PSA screening test during the year before prostate cancer diagnosis were less likely to

have advanced prostate cancer compared to those without a PSA screening test during the year before prostate cancer diagnosis. Furthermore, a significantly lower proportion of elderly men with none of the 3 types of chronic conditions had a PSA screening or visit(s) to a primary care physician during the year before diagnosis of cancer compared to those with the 3 chronic conditions. Taken together, these findings suggest that contact with the health care system may help improve screening for some patients and reduce the risk of advanced prostate cancer. The study's findings are consistent with the systematic review from the European Association of Urology, in which PSA screening reduced the risk of advanced prostate cancer.³¹

However, PSA screening for prostate cancer has been controversial in the United States. For example, the US Preventive Services Task Force recommends against routine PSA screening for younger men aged 50 to 69 because the harms of PSA screening outweigh the benefits in terms of reducing the risk of mortality and advanced prostate cancer diagnosis.³² In light of the controversies surrounding PSA screening, American Urological Association³³ and American College of Physicians³⁴ guidelines recommend that PSA screening should be considered through a shared-decision making process between the provider and the patient. Therefore, the current study findings suggest the need for routine PSA screening for those with none of the 3 common types of chronic conditions among elderly fee-for-service Medicare beneficiaries.

This study has many strengths. Historically, the role of chronic conditions in cancer has been examined using comorbidity indices or number of chronic conditions. The current study is the first to provide comprehensive information on the role of specific types of chronic conditions and their combinations in prostate cancer diagnosis. This study used the largest population-based registry to assess the association between the types of chronic conditions and cancer stage at diagnosis among elderly men with prostate cancer. This study is timely and is aligned with the goals of the Office of Cancer Survivorship and the Institute of Medicine regarding the management of prostate cancer in the presence of preexisting chronic conditions.

The study findings must be interpreted in the context of limitations. As the current study used observational data, the causal associations between the presence of types of chronic conditions and cancer stage at diagnosis could not be determined. The study population was restricted to men ≥ 66 years of age; therefore, the findings cannot be generalizable to younger men with prostate cancer. Although, this study identified the presence of chronic conditions using validated codes from the literature, the clinical severity and seriousness of chronic conditions could not be determined. Furthermore, the current study utilized registry-linked administrative claims data, which either have no information or limited validity of codes to identify body mass index, exercise, and smoking status, which may be associated with severity of cancer stage at diagnosis.

Conclusion

Elderly men without cardiometabolic, mental health, or respiratory conditions were more likely to have advanced prostate cancer at diagnosis. Therefore, strategies to reduce

the risk of diagnosing prostate cancer at an advanced stage need to target the subgroup without these conditions. Future research studies are needed to examine the relationship between cancer stage at diagnosis and common conditions, such as inflammation-related conditions, smoking associated disorders, and sexually transmitted disease, on prostate cancer risk, as these conditions also share common risk factors for developing prostate cancer.

Author Disclosure Statement

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