






## Association of Medical Financial Hardship and Mortality Among Cancer Survivors in the United States

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### Abstract

**Background:** Cancer survivors frequently experience medical financial hardship in the United States. Little is known, however, about long-term health consequences. This study examines the associations of financial hardship and mortality in a large nationally representative sample of cancer survivors. **Methods:** We identified cancer survivors aged 18-64 years ( $n = 14\,917$ ) and 65-79 years ( $n = 10\,391$ ) from the 1997-2014 National Health Interview Survey and its linked mortality files with vital status through December 31, 2015. Medical financial hardship was measured as problems affording care or delaying or forgoing any care because of cost in the past 12 months. Risk of mortality was estimated with separate weighted Cox proportional hazards models by age group with age as the timescale, controlling for the effects of sociodemographic characteristics. Health insurance coverage was added sequentially to multivariable models. **Results:** Among cancer survivors aged 18-64 years and 65-79 years, 29.6% and 11.0%, respectively, reported financial hardship in the past 12 months. Survivors with hardship had higher adjusted mortality risk than their counterparts in both age groups: 18-64 years (hazard ratio [HR] = 1.17, 95% confidence interval [CI] = 1.04 to 1.30) and 65-79 years (HR = 1.14, 95% CI = 1.02 to 1.28). Further adjustment for health insurance reduced the magnitude of association of hardship and mortality among survivors aged 18-64 years (HR = 1.09, 95% CI = 0.97 to 1.24). Adjustment for supplemental Medicare coverage had little effect among survivors aged 65-79 years (HR = 1.15, 95% CI = 1.02 to 1.29). **Conclusion:** Medical financial hardship was associated with mortality risk among cancer survivors in the United States.

In the United States, cancer patients and survivors are more likely to report medical financial hardship, including problems affording care, distress, and delaying or forgoing needed care because of cost, than their counterparts without a cancer history (1,2). Approximately 54% of survivors aged 18-64 years and 42% of survivors aged 65 years and older report having experienced some form of medical financial hardship at any time following their cancer diagnosis (3). Cancer survivors also report nonmedical financial sacrifices because of their cancer, such as changes in spending and use of savings (3). Medical financial hardship is associated with worse health-related quality of life (4,5), but less is known about other health consequences.

A single study conducted in Washington State found that cancer patients who filed for bankruptcy protection had higher mortality risk than similar cancer patients who did not (6).

Bankruptcy is rare, however, and even though cancer patients were more likely to file for bankruptcy than those without a cancer history (7), it does not fully encompass the multiple domains of medical financial hardship, including problems with care affordability and delaying or forgoing care because of cost (2). Additionally, the study could not explore the role of health insurance coverage, one of the strongest and most consistent correlates of medical financial hardship (8,9) and predictors of mortality risk (10). Further, findings from Washington State may not be generalizable to the rest of the country, which is more racially and ethnically diverse. In this study, we examined the association of medical financial hardship and mortality among cancer survivors with sequential adjustment for health insurance coverage using a large nationally representative cohort.

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## Methods

### Study Population

Cancer survivors aged 18-79 years were identified from the 1997-2014 National Health Interview Survey (NHIS), an annual cross-sectional household survey of the civilian noninstitutionalized population. The NHIS linked mortality files (11) were used to measure vital status for NHIS respondents through December 31, 2015, the most recently available data, and provided 1-18 years of follow-up. Adults aged 80 years and older were excluded because the NHIS does not report single year of age separately for this age group. Quarter and year of death were available for those who died. The sample was stratified into 2 age groups (18-64 years:  $n = 14\,917$ ; 65-79 years:  $n = 10\,391$ ) reflecting differences in employment, comorbidity burden, and age eligibility for Medicare insurance in the 2 age groups. Virtually all adults aged 65 years and older had health insurance coverage through Medicare because of age eligibility; adults younger than 65 years are eligible for Medicare coverage only through disability or specific health conditions.

### Measures

Cancer survivors were identified by a NHIS question about ever being told by a doctor or health professional that they had cancer or a malignancy of any kind. Medical financial hardship was defined with questions asked consistently in the NHIS throughout the study period and included problems affording prescription medicine, mental health care and/or counseling, or dental care or delaying or forgoing any medical care because of cost (Supplementary Table 1, available online, lists exact wording of questions). Sociodemographic characteristics included sex, race and ethnicity (Asian and others [ie, Native American and Alaska Natives, multiple races, Hispanic Black, and unknown race and/or ethnicity], Hispanic, non-Hispanic Black, non-Hispanic White), educational attainment, marital status, geographic region, and number of comorbid conditions (0, 1, 2,  $\geq 3$ ). Conditions included arthritis, asthma, diabetes, emphysema, heart disease (angina, coronary heart disease, heart attack, other heart condition and/or disease), high cholesterol, hypertension, and stroke. Measures related to cancer available in the NHIS included cancer site (breast, colorectal, prostate, and other), number of cancer diagnoses (1,  $\geq 2$ ), and years since first cancer diagnosis at the time of the survey ( $\leq 2$ ,  $> 2$  and  $\leq 5$ ,  $> 5$  and  $\leq 10$ ,  $> 10$ ). Health insurance coverage was measured separately for those aged 18-64 years (any private, public only, uninsured) and 65-79 years (Medicare and private, Medicare Advantage or health maintenance organization, Medicare and public, Medicare only/other). Among cancer survivors aged 18-64 years with private coverage, information about high deductible health plans and health savings accounts was collected in NHIS survey years 2007 to 2014 only. All measures were self-reported. Because of the long time period included in the study, we accounted for economic and other secular trends with survey year categories (1997-2000, 2001-2005, 2006-2009, and 2010-2014).

### Statistical Analyses

Sample characteristics were compared by financial hardship status within age group with Wald  $\chi^2$  tests. Kaplan-Meier survival curves were evaluated visually to ensure proportionality,

and adjusted hazard ratios (HRs) for the associations of financial hardship with mortality were estimated with weighted Cox proportional hazards models in time-to-event analyses by age group (ie, 18-64 years, 65-79 years). Age at survey was used as the timescale, as recommended for analyses of household survey-mortality data linkages (12). This approach is equivalent to controlling for single year of age. Multivariable models included sex, race and ethnicity, educational attainment, marital status, geographic region, number of comorbid conditions, cancer site, number of cancer diagnoses, years since first cancer diagnosis, and survey year era. Health insurance coverage was added sequentially to multivariable models to assess its effect on associations between financial hardship and mortality. To assess more distal effects of financial hardship and mortality, sensitivity analyses restricted samples in both age groups to survivors diagnosed more than 5 years prior to the survey. Sensitivity analyses were also conducted to estimate the robustness of associations to unmeasured confounding, based on the E-value methodology. The E-value represents the minimum strength of association that an unmeasured confounder could have with both the exposure and outcome to explain a specific exposure-outcome association, conditional on the measured covariates (13). Statistical analysis was performed in SAS 9.4 (SAS Institute, Inc. Cary North Carolina), and sample weights were based on those for NHIS-linked mortality files. Statistical comparisons were 2-sided, and statistical significance was defined as a P value less than .05. All data from the NHIS and NHIS linked mortality files were de-identified and are publicly available.

## Results

Financial hardship in the 12 months prior to the survey was reported by 29.6% of survivors aged 18-64 years and 11.0% of survivors aged 65-79 years. Cancer survivors who reported financial hardship were statistically significantly more likely to be younger, female, racial and ethnic minorities, and unmarried and have more health conditions and lower educational attainment compared with cancer survivors without financial hardship in both age groups (Table 1). Most were diagnosed with cancer 5 or more years prior to the survey in both age groups. Among cancer survivors aged 18-64 years, those with financial hardship were much less likely to have private health insurance coverage (42.0% vs 80.7%) and more likely to be uninsured (31.2% vs 4.4%) than survivors without hardship. Among survivors aged 18-64 years with private health insurance coverage, those with financial hardship were more likely to have high deductible health plans without health savings accounts than survivors without hardship (26.5% vs 16.1%). Among older survivors, those with financial hardship were less likely to have Medicare and private supplemental coverage (42.9% vs 61.1%) and more likely to have Medicare coverage only, without additional coverage (26.8% vs 16.7%).

Among adults aged 18-64 years and 65-79 years, 14.8% and 32.8% died during the observation period, respectively (data not shown). Cancer survivors with financial hardship had higher mortality risk than survivors without financial hardship in the younger (HR = 1.17, 95% confidence interval [CI] = 1.04 to 1.30) and older (HR = 1.14, 95% CI = 1.02 to 1.28) age groups in adjusted analyses (Table 2). Sociodemographic factors statistically significantly associated with higher mortality risk in both age groups were male sex, not being married or partnered, non-Hispanic Black race and ethnicity, and lower educational

**Table 1.** Characteristics of cancer survivors by age group and reported financial hardship within 12 months of survey

Sample characteristics <sup>a</sup>	Cancer survivors aged 18-64 y			Cancer survivors aged 65-79 y		
	Hardship <sup>b</sup> (n = 4813)	No hardship <sup>b</sup> (n = 10 104)	P <sup>c</sup>	Hardship <sup>b</sup> (n = 1435)	No hardship <sup>b</sup> (n = 9956)	P <sup>c</sup>
Weighted percentage	29.6	70.4		11.0	89.0	
Age group, y						
18-29	10.4	6.6	<.001	—	—	
30-39	15.2	10.4		—	—	
40-49	25.9	21.6		—	—	
50-64	48.6	61.4		—	—	
65-69	—	—		40.5	33.7	<.001
70-74	—	—		34.3	34.0	
75-79	—	—		25.3	32.3	
Time since diagnoses						
≤2 y	16.3	18.3	<.001	16.9	15.2	.001
>2 y and ≤5 y	26.3	30.2		26.3	30.6	
>5 y and ≤10 y	20.1	20.0		19.5	22.0	
≥10 y	37.4	31.4		37.3	32.2	
Selected cancer sites						
Female breast	14.2	19.7	<.001	22.3	21.4	
Prostate	3.4	7.4		17.5	23.9	
Colorectal	4.4	5.5		8.8	10.0	
Others	78.0	67.4		51.4	44.7	
Number of cancers diagnosed						
Only 1 cancer	90.6	93.3	<.001	88.4	89.5	.30
≥2 cancers	9.4	6.7		11.6	10.5	
Number of health conditions <sup>d</sup>						
0 conditions	39.1	50.9	<.001	18.0	26.3	<.001
1 condition	32.7	31.5		28.6	36.6	
2 conditions	15.5	11.3		25.0	20.0	
≥3 conditions	12.7	6.4		28.4	17.2	
Sex						
Male	24.0	35.3	<.001	38.2	50.5	<.001
Female	76.0	64.7		61.8	49.5	
Race and ethnicity						
Asian and others <sup>e</sup>	3.0	3.3	<.001	3.3	1.9	<.001
Hispanic	8.9	5.8		6.8	3.8	
Non-Hispanic Black	9.4	7.6		12.3	6.3	
Non-Hispanic White	78.7	83.3		77.5	88.0	
Current marital status						
Married	55.6	72.1	<.001	49.7	67.6	<.001
Not married <sup>f</sup>	44.4	27.9		50.3	32.4	
Education						
Less than high school	18.5	10.1	<.001	32.0	19.3	<.001
High school graduate	31.3	28.0		28.9	32.3	
Some college or more	50.2	61.9		39.0	48.4	
Health insurance coverage						
Aged 18-64 y, any private	42.0	80.7	<.001			
HDHP and has, 2007 to 2014 <sup>g</sup>	956	3419				
HDHP without HSA	26.5	16.1				
HDHP with HSA	5.8	8.1				
LDHP	52.4	63.5				
Unknown	15.3	12.3				
Aged 18-64 y, public only	26.8	15.0				
Aged 18-64 y, uninsured or missing	31.2	4.4				
Aged 65-79 y, Medicare and private				42.9	61.1	<.001
Aged 65-79 y, Medicare Advantage/HMO				15.8	11.0	
Aged 65-79 y, Medicare and public				14.5	11.2	
Aged 65-79 y, Medicare only/other				26.8	16.7	
Era, survey years						
1997-2000	14.7	18.7	<.001	12.9	18.7	<.001
2001-2005	22.7	26.3		24.4	24.2	
2006-2009	26.1	23.3		25.6	22.3	

(continued)

Table 1. (continued)

Sample characteristics <sup>a</sup>	Cancer survivors aged 18-64 y			Cancer survivors aged 65-79 y		
	Hardship <sup>b</sup> (n = 4813)	No hardship <sup>b</sup> (n = 10 104)	P <sup>c</sup>	Hardship <sup>b</sup> (n = 1435)	No hardship <sup>b</sup> (n = 9956)	P <sup>c</sup>
2010-2014	36.5	31.8		37.1	34.8	
Region						
Northeast	14.7	20.3	<.001	15.1	19.8	<.001
Midwest	22.9	25.4		24.0	24.4	
South	40.7	35.3		40.6	36.8	
West	21.7	19.0		20.4	18.9	

No value is given because analyses are stratified by age group. <sup>a</sup>Data from 1997-2014 National Health Interview Survey (NHIS) linked to NHIS mortality files with vital status through December 31, 2015. Adults with missing race and ethnicity, marital status, educational attainment, or insurance coverage (ages 18-64 years: n = 87 and ages 65 years and older: n = 105) were dropped from the sample. HDHP = high deductible health plan; HMO = health maintenance organization; HSA = health savings account; LDHP = low deductible health plan.

<sup>b</sup>Financial hardship in past 12 months measured as problems affording prescription medicine, mental health care and/or counseling, or dental care or delaying or forgoing any medical care because of cost (Supplementary Table 1, available online, lists exact wording of questions).

<sup>c</sup>Two-sided Wald  $\chi^2$  tests used to assess statistical significance of differences in distributions of sample characteristics.

<sup>d</sup>Not married includes widowed, divorced, separated, or never married.

<sup>e</sup>Cancer survivors aged 18-64 years with any private health insurance coverage who responded to the NHIS in 2007 to 2014; 956 reported medical financial hardship, and 3419 did not report medical financial hardship.

Table 2. Association of financial hardship with mortality among cancer survivors with sequential adjustment for health insurance coverage

Sample characteristics <sup>a</sup>	Adjusted model		Adjusted model and health insurance	
	HR (95% CI)	P <sup>b</sup>	HR (95% CI)	P <sup>b</sup>
Ages 18-64 y, (n = 14 917)				
Financial hardship within 12 mo of survey <sup>c</sup>				
Financial hardship	1.17 (1.04 to 1.30)	.006	1.09 (0.97 to 1.24)	.15
No financial hardship	Referent		Referent	
Health insurance coverage				
Public only	—	—	1.61 (1.41 to 1.84)	<.001
Uninsured or missing	—	—	1.12 (0.92 to 1.36)	.26
Any private	—	—	Referent	
Time since diagnoses				
≤2 y	Referent		Referent	
>2 y and ≤5 y	0.63 (0.55 to 0.72)	<.001	0.63 (0.55 to 0.72)	<.001
>5 y and ≤10 y	0.50 (0.43 to 0.59)	<.001	0.50 (0.42 to 0.59)	<.001
≥10 y	0.41 (0.36 to 0.48)	<.001	0.41 (0.36 to 0.48)	<.001
Selected cancer sites				
Prostate	0.42 (0.33 to 0.54)	<.001	0.43 (0.33 to 0.55)	<.001
Colorectal	1.19 (0.94 to 1.50)	.15	1.20 (0.94 to 1.51)	.14
Others	1.33 (1.15 to 1.53)	<.001	1.31 (1.14 to 1.52)	<.001
Female breast	Referent		Referent	
Number of cancers diagnosed				
≥2 cancers	1.94 (1.66 to 2.26)	<.001	1.88 (1.61 to 2.19)	<.001
Only 1 cancer	Referent		Referent	
Number of health conditions <sup>d</sup>				
1 condition	0.99 (0.88 to 1.12)	.91	0.97 (0.86 to 1.10)	.66
2 conditions	1.21 (1.05 to 1.39)	.008	1.13 (0.98 to 1.30)	.10
≥3 conditions	1.43 (1.22 to 1.67)	<.001	1.30 (1.11 to 1.53)	.001
0 conditions	Referent		Referent	
Sex				
Female	0.66 (0.59 to 0.75)	<.001	0.67 (0.59 to 0.76)	<.001
Male	Referent		Referent	
Race and ethnicity				
Asian and others <sup>e</sup>	0.90 (0.64 to 1.27)	.55	0.84 (0.60 to 1.19)	.33
Hispanic	1.07 (0.88 to 1.30)	.52	1.03 (0.84 to 1.25)	.81
Non-Hispanic Black	1.49 (1.28 to 1.73)	<.001	1.40 (1.20 to 1.63)	<.001
Non-Hispanic White	Referent		Referent	
Current marital status				
Not married <sup>f</sup>	1.42 (1.27 to 1.58)	<.001	1.29 (1.16 to 1.45)	<.001
Married	Referent		Referent	

(continued)

Table 2. (continued)

Sample characteristics <sup>a</sup>	Adjusted model		Adjusted model and health insurance	
	HR (95% CI)	p <sup>b</sup>	HR (95% CI)	p <sup>b</sup>
Education				
Less than high school	1.63 (1.42 to 1.87)	<.001	1.46 (1.27 to 1.69)	<.001
High school graduate	1.33 (1.19 to 1.49)	<.001	1.30 (1.16 to 1.46)	<.001
Some college or more	Referent		Referent	
Era				
1997-2000	Referent		Referent	
2001-2005	0.97 (0.86 to 1.10)	.67	0.96 (0.85 to 1.09)	.55
2006-2009	0.73 (0.63 to 0.86)	<.001	0.72 (0.61 to 0.84)	<.001
2010-2014	0.57 (0.48 to 0.68)	<.001	0.55 (0.46 to 0.66)	<.001
Region				
Midwest	1.01 (0.85 to 1.21)	.88	1.00 (0.84 to 1.19)	.99
South	1.06 (0.90 to 1.24)	.51	1.03 (0.88 to 1.21)	.68
West	0.95 (0.80 to 1.13)	.57	0.92 (0.78 to 1.10)	.37
Northeast	Referent		Referent	
Ages 65-79 y (n = 11 391)				
Financial hardship within 12 mo of survey <sup>c</sup>				
Financial hardship	1.14 (1.02 to 1.28)	.02	1.15 (1.02 to 1.29)	.02
No financial hardship	Referent		Referent	
Health insurance coverage				
Medicare Advantage/HMO	—	—	0.98 (0.88 to 1.09)	.73
Medicare and other public	—	—	0.95 (0.80 to 1.12)	.54
Medicare only/other	—	—	1.24 (1.08 to 1.42)	.003
Medicare and private	—	—	Referent	
Time since diagnoses				
≤2 y	Referent		Referent	
>2 y and ≤5 y	0.76 (0.68 to 0.85)	<.001	0.76 (0.68 to 0.85)	<.001
>5 y and ≤10 y	0.60 (0.53 to 0.67)	<.001	0.60 (0.53 to 0.67)	<.001
≥10 y	0.55 (0.49 to 0.62)	<.001	0.55 (0.49 to 0.62)	<.001
Selected cancer sites				
Prostate	0.84 (0.72 to 0.99)	.04	0.84 (0.71 to 0.98)	.03
Colorectal	1.05 (0.89 to 1.23)	.58	1.04 (0.89 to 1.23)	.61
Others	1.50 (1.34 to 1.68)	<.001	1.49 (1.34 to 1.67)	<.001
Female breast	Referent		Referent	
Number of cancers diagnosed				
2 or 3 cancers	1.33 (1.18 to 1.49)	<.001	1.33 (1.18 to 1.49)	<.001
Only 1 cancer	Referent			
Number of health conditions <sup>d</sup>				
1 condition	1.07 (0.96 to 1.20)	.22	1.07 (0.95 to 1.20)	.25
2 conditions	1.33 (1.18 to 1.50)	<.001	1.32 (1.17 to 1.48)	<.001
≥3 conditions	1.78 (1.59 to 2.01)	<.001	1.75 (1.56 to 1.97)	<.001
0 condition	Referent		Referent	
Sex				
Female	0.71 (0.65 to 0.78)	<.001	0.71 (0.65 to 0.78)	<.001
Male	Referent		Referent	
Race and ethnicity				
Asian and others <sup>e</sup>	0.89 (0.66 to 1.19)	.42	0.87 (0.65 to 1.17)	.36
Hispanic	0.85 (0.71 to 1.02)	.09	0.82 (0.69 to 0.99)	.04
Non-Hispanic Black	1.25 (1.09 to 1.43)	.002	1.22 (1.07 to 1.40)	.004
Non-Hispanic White	Referent			
Current marital status				
Not married <sup>f</sup>	1.16 (1.07 to 1.25)	<.001	1.14 (1.05 to 1.23)	.001
Married	Referent		Referent	
Education				
Less than high school	1.27 (1.15 to 1.40)	<.001	1.26 (1.14 to 1.39)	<.001
High school graduate	1.18 (1.07 to 1.31)	.001	1.18 (1.07 to 1.30)	.001
Some college or more	Referent			
Survey era, y				
1997-2000	Referent		Referent	
2001-2005	0.98 (0.90 to 1.07)	.66	0.97 (0.89 to 1.06)	.48
2006-2009	0.90 (0.80 to 1.02)	.09	0.89 (0.79 to 1.00)	.06
2010-2004	0.63 (0.55 to 0.72)	<.001	0.62 (0.54 to 0.71)	<.001

(continued)

Table 2. (continued)

Sample characteristics <sup>a</sup>	Adjusted model		Adjusted model and health insurance	
	HR (95% CI)	p <sup>b</sup>	HR (95% CI)	p <sup>b</sup>
Region				
Midwest	1.05 (0.93 to 1.19)	.46	1.05 (0.93 to 1.19)	.42
South	1.03 (0.92 to 1.16)	.61	1.02 (0.91 to 1.15)	.75
West	0.94 (0.83 to 1.08)	.38	0.94 (0.82 to 1.07)	.36
Northeast	Referent		Referent	

No value is given because health insurance coverage is added sequentially to multivariable models. <sup>a</sup>Data from 1997-2014 National Health Interview Survey (NHIS) linked to NHIS mortality files with vital status through December 31, 2015. All models used age as the timescale and adjusted for financial hardship measure, time since diagnosis, major cancer site, multiple cancer status, number of health conditions, sex, race and ethnicity, marital status, educational attainment, survey year, and region. CI = confidence interval; HMO = health maintenance organization; HR = hazard ratio.

<sup>b</sup>Two-sided test of statistical significance of differences in hazards from multivariable Cox proportion hazards model.

<sup>c</sup>Financial hardship in past 12 months measured as problems affording prescription medicine, mental health care and/or counseling, or dental care or delaying or forgoing any medical care because of cost (Supplementary Table 1, available online, lists exact wording of questions).

<sup>d</sup>Conditions included arthritis, asthma, cancer, diabetes, emphysema, heart disease (angina, coronary heart disease, heart attack, other heart condition or disease), high cholesterol, hypertension, and stroke.

<sup>e</sup>Other race and ethnicity includes Native American and Alaska Natives, multiple races, Hispanic Black, and unknown race and/or ethnicity.

<sup>f</sup>Not married includes widowed, divorced, separated, or never married.

attainment. Health and cancer characteristics associated with higher mortality risk were having more health conditions, multiple cancer diagnoses, and more recent cancer diagnosis in relation to survey.

Further adjustment for health insurance coverage reduced the magnitude and statistical significance of the association of financial hardship and mortality among younger cancer survivors (HR = 1.09, 95% CI = 0.97 to 1.24). Further adjustment for supplemental Medicare coverage had little effect on association of hardship and mortality in the older age group (HR = 1.15, 95% CI = 1.02 to 1.29) (Table 2).

Associations between financial hardship and mortality changed little in sensitivity analyses restricted to survivors diagnosed with cancer at least 5 years prior to the survey (Supplementary Table 2, available online). To estimate the robustness of associations between financial hardship and mortality for unmeasured confounding, E-values were calculated and ranged from 1.42 to 1.68 for the main analyses and for the sensitivity analyses restricted to longer-term survivors diagnosed with cancer at least 5 years prior to the survey (Supplementary Table 3, available online). An unmeasured confounder would need to have an association of at least this magnitude to explain the association between medical financial hardship and mortality after controlling for other covariates in multivariable analyses.

## Discussion

In this large, nationally representative cohort study, we found that cancer survivors who reported medical financial hardship had statistically significantly higher mortality risk than survivors without financial hardship in the United States. These findings were consistent in sensitivity analyses restricted to long-term cancer survivors diagnosed more than 5 years before they completed the NHIS survey. Our nationally representative findings provide complementary evidence to findings from a single-state study showing higher mortality risk among cancer patients who filed for bankruptcy (6). Although filing for bankruptcy protection is relatively rare, medical financial hardship, including delaying or forgoing care because of cost, is common

among cancer survivors (1,3,14). As the patient out-of-pocket burden associated with cancer treatments continues to increase (15,16), our findings also add to accumulating evidence of adverse associations between medical financial hardship and health (4,5). Efforts to develop and implement policies and interventions for mitigating financial hardship as part of oncology practice and survivorship care are needed.

Improving options for comprehensive health insurance coverage can be an important policy-level lever for addressing medical financial hardship, as studies have shown that gains in health insurance coverage are associated with declines in financial hardship (17,18). Furthermore, health insurance coverage is strongly associated with survival following cancer diagnosis (19,20). When health insurance coverage was added sequentially to our multivariable models, the mortality risk associated with financial hardship was reduced, and the association was no longer statistically significant among survivors aged 18-64 years. The sequential addition of supplemental Medicare health insurance to models had little effect on associations between hardship and mortality risk in the population aged older than 65 years. Because health insurance coverage is associated with lower prevalence of financial hardship and better access to care, these observed differences in mortality by age group likely reflect the relative protective effects of near universal Medicare coverage for many health-care services in age-eligible adults aged 65 years and older. Employer-sponsored private health insurance is the main type of coverage for adults aged younger than 65 years in the United States, and cancer survivors are more likely than their counterparts without a cancer history to report work limitations, even many years following cancer diagnosis (21,22), which can adversely affect income, asset accumulation, and access to private insurance coverage. In our study, cancer survivors aged 18-64 years who reported medical financial hardship were substantially less likely to report private insurance coverage than their counterparts in the same age group without hardship (40.2% vs 80.7%) and more likely to report public coverage (26.8% vs 15.0%), reflecting eligibility through very low income, disability, or both. Additionally, nearly one-third of survivors with financial hardship were uninsured compared with less than 5% without hardship. Previous research has shown that efforts to expand health insurance coverage



options, such as Medicaid expansion under the Affordable Care Act, are associated with reductions in financial hardship among cancer survivors (17). Less is known about the longer-term health effects of coverage expansions; this will be an important area for additional research.

Growing evidence suggests that health insurance benefit design and patient cost sharing, including deductibles, copayments, and coinsurance, are associated with medical financial hardship (23-26). Higher patient cost sharing can adversely affect treatment adherence, especially for oral medications (23,24,26), which are frequently covered by insurers on a specialty tier, with the highest coinsurance (ie, patient responsibility for a percentage of the medication price) requirements. Medicare Part D coverage for oral prescription drugs was introduced in 2006; prior to that time, many Medicare beneficiaries did not have oral prescription drug coverage. More recent growth in expensive oral anticancer prescription drugs will likely increase patient out-of-pocket burden, even for patients with Medicare Part D coverage. The Affordable Care Act introduced requirements for limits on patient out-of-pocket costs for private Marketplace and Medicare Advantage plans, but Medicare fee-for-service Part B or Part D do not have caps on patient out-of-pocket spending. Other studies have shown that Medicare supplemental coverage, both private and public, are associated with lower out-of-pocket cost burden (27,28) and lower prevalence of financial hardship among beneficiaries aged 65 years and older (27). Information about patient cost sharing was not consistently collected in the NHIS, and as a result, we could not evaluate the associations of health insurance benefit design, medical financial hardship, and health outcomes in this study. Additional longitudinal research is warranted.

Medical financial hardship was measured at a single point in time in our study, and little information is available to inform understanding of mechanisms through which cancer survivors experiencing hardship have increased risk of death. Financial hardship may adversely affect health through chronic stress and accelerated aging (29). Additionally, individuals who experience medical financial hardship may make trade-offs between health care and housing or healthy diets and be more likely to develop acute and chronic conditions, which increase mortality risk. Prior research has shown that medical financial hardship and worry about daily needs and food insecurity are independently associated with worse self-rated health and more emergency department visits (30). Insurance coverage, also only measured at a single point in time, is associated with both hardship (1,14) and mortality (31), and insurance coverage eligibility and benefit design likely play important roles in the observed associations between medical financial hardship and mortality. Patient cost sharing, which varies by insurance plan type, can have adverse effects on receipt of preventive services, care for acute and chronic conditions, and health outcomes (26,32). Adults in the United States often change their health insurance coverage throughout their working lives and may also experience periods of uninsurance (33). Additional longitudinal research is warranted to better understand the central role of insurance coverage and coverage continuity in relation to financial hardship and health outcomes. These data will inform development of interventions to minimize adverse consequences of financial hardship for health among cancer survivors.

A key strength of this study is the large national cohort of cancer survivors, created by linking 18 years of the NHIS survey data (1997-2014) to NHIS mortality data through December 31, 2015, where the exposure of medical financial hardship was measured at the time of the survey, prior to the study outcome,

mortality. This study also has limitations, including lack of information about cancer stage, treatment(s), treatment response, and timing of treatments, which may confound the association between financial hardship and mortality. However, our sensitivity analyses of long-term survivors diagnosed more than 5 years before the NHIS survey were consistent with the main analyses, suggesting that initial cancer treatment response is less likely to be an important unmeasured confounder of observed associations between financial hardship and mortality risk. Our findings were relatively robust to modest unmeasured confounders in E-value analyses of our main analyses and sensitivity analyses restricted to long-term survivors, more than 5 years postdiagnosis at the time of the survey. Some of the confidence intervals for some E-values included 1.0, however.

Though we included the number of chronic conditions collected and available in the NHIS in our multivariable analyses, the list of conditions is not exhaustive, and we could not quantify the severity of conditions. Incomplete risk adjustment for other conditions is another potential limitation. Additionally, measures of hardship were limited to questions available in all NHIS years; we could not evaluate stress and worry about medical bills, key measures of medical financial hardship (34). Information about wealth and assets, which may be protective against medical financial hardship, were not consistently available in the NHIS. Our observation period spanned nearly 20 years, and even though we attempted to account for secular trends in our multivariable models, we may not have been able to fully account for changes in cancer diagnoses and treatment patterns, health insurance coverage options, and other economic factors. Our evaluation of the role of health insurance coverage was limited by the level of detail and consistency of health insurance coverage measures in the NHIS in the multiple years included in this study; evaluation of the role of high deductible insurance plans, generosity of supplemental Medicare coverage, and other features of coverage benefit design on the association between financial hardship and mortality risk will be important for future research. Like most studies using household survey data, the majority of cancer survivors in our sample was mostly longer-term cancer survivors, surveyed many years after their cancer diagnosis. Household surveys are less likely to identify survivors with a history of cancers with poor prognosis, who may be especially vulnerable to financial hardship because of treatment intensity. For example, a recent study of metastatic colorectal cancer patients found that three-quarters reported major financial hardship (defined as major debt, loans, selling or refinancing house, or 20% decline in income) within 12 months of receiving treatment (35), a substantially higher proportion with hardship than in our study. As a result, our findings may underestimate the magnitude of the association between financial hardship and mortality for some populations of patients receiving treatment for cancer and cancer survivors. Future research evaluating medical financial hardship and health conducted in cohorts with detailed information about potential unmeasured confounders in this study, especially about cancer stage and treatment(s), as well as detailed information about socioeconomic characteristics and health insurance coverage, is needed.

In conclusion, we found that medical financial hardship was associated with increased risk of mortality among cancer survivors. Health insurance coverage played a critical role in this association for adults aged 18-64 years, underscoring the importance of insurance and access to care for nonelderly adults. Older adults, aged 65 years and older, are almost universally insured by the Medicare program, and further adjustment

for supplemental coverage had little effect on the association between financial hardship and higher mortality risk. Ongoing efforts to identify and mitigate medical financial hardship for cancer survivors in the United States are warranted.

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## Data Availability

The National Health Interview Survey and National Health Interview Survey Linked Mortality files are publicly available from the National Center Health Statistics.

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