



Social risk factors among individuals with a history of cancer during the COVID-19 pandemic

Cheryl Kelly¹ · Larissa Lee White¹ · Shauna Goldberg Scott¹ · Heather Spencer Feigelson¹ · Andrea N. Burnett-Hartman¹

Received: 1 April 2022 / Accepted: 8 July 2022 / Published online: 3 August 2022
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

Abstract

Purpose The coronavirus disease (COVID-19) pandemic and its economic consequences may disproportionately impact cancer survivors and their overall health-related quality of life. The objective of this study was to examine whether cancer survivors experienced higher levels of financial strain or food insecurity compared to those without a history of cancer.

Methods Kaiser Permanente Research Bank (KPRB) study participants were invited to complete a series of electronic surveys starting April 2020 to assess the impact of the COVID-19 pandemic. Participants who completed the initial survey and one follow-up survey were included. The odds of financial strain and food insecurity in those with and without a history of cancer were estimated using multinomial logistic regression.

Results Cancer survivors ($n = 16,231$) had lower odds of reporting “somewhat hard” (AOR = 0.77) and “very hard” (AOR = 0.67) financial strain, and food insecurity “sometimes” (AOR = 0.70) and “often” (AOR = 0.55) compared to those with no history of cancer ($n = 88,409$). Non-Hispanic (NH) Black and Hispanic cancer survivors had higher odds compared to NH Whites of reporting financial strain and food insecurity. Smokers and those with multiple comorbidities had higher odds of reporting financial strain and food insecurity among cancer survivors.

Conclusions While cancer survivors overall did not report greater financial strain or food insecurity than individuals without a history of cancer, subsets of cancer survivors are experiencing greater social risks during the pandemic and should be prioritized for screening for social risk factors.

Implications for Cancer Survivors Incorporating screening for social risk factors into care coordination workflows for subsets of cancer survivors should be a priority.

Keywords Cancer survivor · COVID-19 · Social determinants of health · Food insecurity · Financial strain

Introduction

The novel COVID-19 pandemic has far-reaching health and economic consequences. The impact of temporary, and sometimes permanent, business closures caused the unemployment rate to reach 14.8% in April 2020. According to the Center on Budget and Policy Priorities, at the peak of the economic fallout in December 2020, it was estimated that over 35% of adults were having trouble covering usual expenses, 21% were not caught up on rent, and 14% did not have enough food to eat [1]. Individuals

with previous or existing health conditions, and in particular cancer survivors, may be particularly vulnerable to the detrimental economic impacts of COVID-19 [2]. In fact, the Centers for Disease Control and Prevention (CDC) stated “cancer patients and survivors may have a higher risk of getting COVID-19 and other infections. They, and people who live with and take care of them, should take steps to protect their health” [3]. Because cancer survivors are a vulnerable population during the pandemic, they may have been disproportionately impacted because they choose to stay home or leave existing employment in order to protect their health. Given that there are now over 17 million cancer survivors in the USA [4], it is important to understand if this population experienced greater food insecurity or financial strain during the COVID-19 pandemic.

✉ Cheryl Kelly
Cheryl.kelly@kp.org

¹ Institute for Health Research, Kaiser Permanente Colorado, 2550 S Parker Rd, Ste 200, Aurora, CO 80014, USA

Several studies have found evidence of financial hardship among cancer survivors due to the high costs of cancer treatment [5–9]. After treatment completion, many cancer survivors continue to have high costs for medical care [6], and they experience increased difficulties maintaining employment and health insurance [10–13]. Financial strain in cancer survivors is associated with medication nonadherence, failure to receive mental health care, and poor survival outcomes [14–20]. Food insecurity is another consequence of financial strain, and prior studies suggest that cancer survivors who are women, Hispanic, non-Hispanic Black, and with lower incomes are more likely to experience food insecurity [21].

Compared to adults with no prior history of cancer, survivors may be at greater risk for COVID-19 infection, morbidity, and the broad social and economic impacts associated with the pandemic [2, 22–25]. A recent national study of young adult cancer survivors found that negative economic events associated with the COVID-19 pandemic (e.g., income loss, increased debt, and decreased job security) may have exacerbated existing cancer-related financial toxicity and general financial hardship [25]. Moreover, research has shown that those with a history of cancer have more problems finding a new job compared to the general healthy population [26]. Cancer survivors that stayed employed during the pandemic may need to weigh the benefits of working with the increased risk of exposure to a potentially life-threatening illness.

A recent commentary noted that the pandemic and its economic consequences may disproportionately impact cancer survivors [23]. However, there remains limited data on financial strain and food insecurity among cancer survivors during the COVID-19 pandemic and if they were disproportionately at risk compared to individuals without a history of cancer. The objective of this study was to examine whether cancer survivors were more likely to experience financial strain or food insecurity compared to those without a history of cancer.

Methods

Study setting

Study participants were members of the KPRB, a biorepository that includes electronic health record (EHR) information, lifestyle surveys, and biospecimens (saliva or blood) from Kaiser Permanente (KP) adult health plan members (<https://researchbank.kaiserpermanente.org/>). Beginning recruitment in September 2015, the KPRB builds on the Research Program on Genes, Environment, and Health cohort [27] and uses email, direct mail, and in-person outreach to invite all adult KP members to join. The KPRB

includes members from all 8 KP regions nationwide, including Colorado, Georgia, Hawaii, mid-Atlantic States (District of Columbia, Maryland, Virginia), Northern California, Southern California, Northwest Oregon, and Washington state. In addition to general recruitment of all adult KP members, the KPRB conducts enhanced recruitment for recently diagnosed cancer patients and cancer survivors [28]. All participants provided written informed consent. This study was reviewed and approved by the Institutional Review Board (IRB) at KP Mid-Atlantic States, which is the IRB of record for the KPRB.

KPRB intake survey and COVID-19 pandemic surveys

After consent, KPRB members were invited to complete a self-administered electronic or paper-based survey that covered demographic factors, including race and ethnicity and social determinants of health [29–31]. In addition to the intake survey, the KPRB sent a series of electronic surveys via email starting in April 2020 to assess the impact of the COVID-19 pandemic on KPRB members. These surveys were sent to all KPRB participants who were also KP health plan members as of April 1, 2020. The initial COVID-19 pandemic survey collected information on COVID-infection, household characteristics, and potential COVID-related risk factors, including cigarette smoking history, using a standardized instrument based on Behavioral Risk Factors Surveillance Survey assessments of nicotine use [32]. Among those who completed the initial COVID-19 pandemic survey, the KPRB sent up to 11 follow-up surveys from May 2020 to January 2021 to evaluate the impact of the COVID-19 pandemic on KPRB members. These follow-up surveys included standardized instruments to collect data on financial strain and food insecurity [33–35].

Electronic Health Record (EHR) data

Each KP region captures EHR data for research using a standardized, structured common data model, known as the virtual data warehouse (VDW) [36, 37]. The VDW includes comprehensive data on patient characteristics, diagnoses, medical procedures, and medication use dating back at least 2 decades. For most KP regions, the VDW also includes tumor registry data. These tumor registries employ North American Association of Central Cancer Registries (NAACCR) protocols to identify, confirm, and abstract common data elements for each cancer case occurring within the health system [38].

We used the VDW and associated tumor registry data to collect data on cancer history (cancer diagnoses, time since diagnosis, and stage at diagnosis). We also used the VDW as an additional source of information on demographic

characteristics including age, sex, race, and ethnicity (when these were missing in survey data).

Inclusion and exclusion criteria

We included KPRB participants who completed the COVID-19 pandemic initial survey and their first survey during the follow-up period where financial strain and food insecurity were reported ($n = 129,483$). To ensure ascertainment of adjudicated cancer history information, we excluded those from KP regions with unavailable tumor registry data, including those from KP Georgia and KP Southern California ($n = 20,220$), those with < 12 months of prior KP health plan enrollment ($n = 1189$), those who had a prior non-breast in situ or benign/borderline cancer diagnosis ($n = 3176$) or an invasive cancer diagnosis within the 12 months prior to initial COVID-19 pandemic survey completion ($n = 145$), or those who had missing age, sex, or survey completion date ($n = 113$).

Outcomes of interest

The two main outcomes for this study were financial strain and food insecurity assessed from May 2020 to January 2021 in the COVID-19 pandemic follow-up surveys. Financial strain was measured using a measure from the Institute of Medicine's 2014 report on Capturing Social and Behavioral Domains and Measures in Electronic Health Records ("Over the past month, how hard has it been for you to pay for the very basics like food?") [34]. Response options are on a 3-point scale, including not hard at all or no (reference), somewhat hard, and very hard. Food insecurity was measured using the 2-item Hunger Vital Sign ("You worried whether your food would run out before you got money to buy more" and "The food you bought just didn't last and you didn't have money to get more") [35]. Response options are on a 3-point scale, including never true (reference), sometimes true, and often true.

Statistical analysis

The odds of financial strain and food insecurity in those with and without a history of cancer diagnosed at least 12 months prior to initial COVID-19 survey completion were estimated using multinomial logistic regression. We focused on those with a history of cancer diagnosed at least 12 months prior to initial COVID-19 survey completion because our analyses were aimed at cancer survivors who had completed their primary treatment for cancer. The multinomial logistic regression coefficients and 95% confidence intervals (CIs) were estimated as adjusted odds ratios (AORs). All models were adjusted

for age, sex, race/ethnicity, KP region, smoking status (never, former, current), and Charlson comorbidity score (a weighted score to predict risk of death within 1 year of hospitalization for those with 16 specific comorbid conditions) [39]. For financial strain in model 1, we compared those who responded (a) somewhat hard vs. not hard at all and (b) very hard vs. not hard at all in participants with and without a history of cancer at any point during the follow-up period. For food insecurity in model 2, we compared those who responded (a) sometimes true vs. never true and (b) often true vs. never true in participants with and without a history of cancer at any point during the follow-up period. For financial strain in model 3, we compared those who responded (a) somewhat hard vs. not hard at all and (b) very hard vs. not hard at all in cancer survivors across demographic characteristics at any point during the follow-up period. For food insecurity in model 4, we compared those who responded (a) sometimes true vs. never true and (b) often true vs. never true in cancer survivors across demographic characteristics at any point during the follow-up period. A p -value of ≤ 0.05 was considered statistically significant, and all p -values were adjusted for multiple comparisons utilizing the stepdown Bonferroni method. All models were estimated using SAS 9.4 (SAS Institute Inc., Cary, NC).

Results

Analyses included 16,231 individuals with a history of cancer and 88,409 without a history of cancer. Most of the population were between the ages of 65 and 79 (50%), female (63%) and were non-Hispanic (NH) White (82%) (Table 1). Fifty-one percent of individuals in this study were diagnosed with cancer more than 10 years ago, while 22% were diagnosed 2–5 years ago. Sixty-three percent never smoked, and 48% had a Charlson comorbidity score of zero (diagnosis of cancer is not included in the Charlson score). Compared to those without a history of cancer, cancer survivors tended to be older, current or former smokers, and had 3 or more comorbidities. About 79% and 77% of the population did not experience financial strain or food insecurity, respectively.

Financial strain and food insecurity in cancer survivors compared to those without a history of cancer

Compared to individuals without a history of cancer, cancer survivors had lower odds of experiencing "somewhat hard" (AOR = 0.77, 95% CI = 0.73, 0.80) and "very hard" (AOR = 0.67; 95% CI = 0.57,

Table 1 Study population by demographic characteristics and outcomes of interest ($n = 104,640$)

Variable	No history of cancer ($n = 88,409$) ($n, \%$)	History of cancer ($n = 16,231$) ($n, \%$)	Total population ($n = 104,640$) ($n, \%$)
Age group (years)			
18–49	13,256 (15%)	492 (3%)	13,748 (13%)
50–64	23,310 (26%)	2743 (17%)	26,053 (25%)
65–79	42,389 (48%)	9616 (59%)	52,005 (50%)
80+	9454 (11%)	3380 (21%)	12,834 (12%)
Sex			
Female	56,094 (63%)	9598 (59%)	65,692 (63%)
Male	32,315 (37%)	6633 (41%)	38,948 (37%)
Race/ethnicity^a			
White	71,403 (81%)	14,107 (87%)	85,510 (82%)
Black	2752 (3%)	432 (3%)	3184 (3%)
Asian	6499 (7%)	810 (5%)	7309 (7%)
Native Hawaiian/other Pacific Islander	532 (1%)	75 (< 1%)	607 (1%)
American Indian/Alaska Native	544 (1%)	47 (< 1%)	591 (< 1%)
Hispanic	5472 (6%)	712 (4%)	6184 (6%)
Other	165 (< 1%)	24 (< 1%)	189 (< 1%)
Unknown	1042 (1%)	24 (< 1%)	1066 (1%)
Kaiser Permanente region			
Colorado	7041 (8%)	1269 (8%)	8310 (8%)
Hawaii	2212 (3%)	497 (3%)	2709 (3%)
Mid-Atlantic	4767 (5%)	668 (4%)	5435 (5%)
Northern California	67,341 (76%)	12,145 (75%)	79,486 (76%)
Oregon/Washington	7048 (8%)	1652 (10%)	8700 (8%)
Smoking status			
Never	56,496 (64%)	9279 (57%)	65,775 (63%)
Former	29,346 (33%)	6505 (40%)	35,851 (34%)
Current	2348 (3%)	384 (3%)	2732 (3%)
Missing	219 (< 1%)	63 (< 1%)	282 (< 1%)
Charlson comorbidity score			
0	46,798 (53%)	3581 (22%)	50,379 (48%)
1	19,050 (21%)	2271 (14%)	21,321 (20%)
2	10,322 (12%)	3222 (20%)	13,544 (13%)
3+	12,239 (14%)	7157 (44%)	19,396 (19%)
Financial strain			
Not hard at all	69,169 (78%)	12,955 (80%)	82,124 (79%)
Somewhat hard	3452 (4%)	534 (3%)	3986 (4%)
Very hard	304 (< 1%)	39 (< 1%)	343 (< 1%)
No response	15,484 (18%)	2703 (17%)	18,187 (17%)
Food Insecurity			
Never true	68,156 (77%)	12,827 (79%)	80,983 (77%)
Sometimes true	4313 (5%)	680 (4%)	4993 (5%)
Often true	721 (1%)	86 (1%)	807 (1%)
No response	15,219 (17%)	2638 (16%)	17,857 (17%)

^aRace categories include non-Hispanic individuals with Hispanic individuals included as their own category

0.78) financial strain relative to “not hard at all” financial strain (Table 2). Similarly, cancer survivors also had lower odds of experiencing food insecurity

“sometimes” (AOR = 0.70; 95% CI = 0.65, 0.75) and “often” (AOR = 0.55; 95% CI = 0.45, 0.67) relative to “never” food insecure.

Table 2 Adjusted model for financial strain and food insecurity by cancer history (2020–2021; $n = 104,640$)

	Financial strain		Very hard vs. not hard at all	
	Somewhat hard vs. not hard at all	<i>p</i> -value ^b	OR ^a (95% CI)	<i>p</i> -value ^b
History of cancer	0.77 (0.73, 0.80)	< 0.0001	0.67 (0.57, 0.78)	< 0.0001
No history of cancer	Ref			
	Food insecurity		Often true vs. never true	
	Sometimes true vs. never true	<i>p</i> -value ^b	OR ^a (95% CI)	<i>p</i> -value ^b
History of cancer	0.70 (0.65, 0.75)	< 0.0001	0.55 (0.45, 0.67)	< 0.0001
No history of cancer	Ref			

^aAdjusted model includes age (continuous), sex, race/ethnicity, Kaiser Permanente region, smoking status, and Charlson comorbidity score

^b*p*-value was adjusted for multiple comparisons using the stepdown Bonferroni method. Boldface indicates statistical significance ($p < 0.05$)

Financial strain comparisons among cancer survivors

Among cancer survivors, financial strain was inversely associated with age; compared to those who experienced no financial strain, AOR = 0.97 (95% CI = 0.96, 0.97) for “somewhat hard” and AOR = 0.93 (95% CI = 0.92, 0.94) for “very hard” (Table 3). Males with a history of cancer had lower odds than females of experiencing “somewhat hard” financial strain (AOR = 0.72; 95% CI = 0.66, 0.79).

NH Black, NH native Hawaiian/other Pacific Islander, and Hispanic individuals had greater odds than NH White individuals of experiencing “somewhat hard” financial strain (AOR = 1.90; 95% CI = 1.52, 2.38, AOR = 1.90; 95% CI = 1.25, 2.88, and AOR = 1.70; 95% CI = 1.42, 2.03, respectively). Hispanic individuals also had greater odds than NH White individuals of experiencing “very hard” financial strain (AOR = 2.81; 95% CI = 1.77, 4.46).

Among cancer survivors, former or current smokers, as well as those with and more comorbidities had greater odds of experiencing financial strain. Compared to never smokers, former and current smokers had greater odds of experiencing “somewhat hard” (AOR = 1.50; 95% CI = 1.37, 1.63 and AOR = 2.32; 95% CI = 1.85, 2.91, respectively) and “very hard” financial strain (AOR = 1.71; 95% CI = 1.27, 2.29 and AOR = 3.27; 95% CI = 1.73, 6.19, respectively). Relative to a Charlson comorbidity score of zero, cancer survivors with a score of 1, 2, or 3 or more had greater odds of experiencing “somewhat hard” financial strain (AOR = 1.33; 95% CI = 1.14, 1.56; AOR = 1.40; 95% CI = 1.22, 1.61; and AOR = 2.10; 95% CI = 1.86, 2.37, respectively). Relative to a Charlson comorbidity score of zero, survivors with a score of 3 or more had greater odds of experiencing “very hard” financial strain (AOR = 3.16; 95% CI = 2.07, 4.82).

Food insecurity comparisons among cancer survivors

Our analysis of food insecurity yielded similar results to our analysis of financial strain (Table 4). Older age was inversely associated with experiencing food insecurity “sometimes” and “often” (AOR = 0.96; 95% CI = 0.95, 0.96 and AOR = 0.93; 95% CI = 0.93, 0.94, respectively). Compared to females, males experienced lower odds of food insecurity “sometimes” (AOR = 0.78; 95% CI = 0.74, 0.81). Compared to NH White individuals, NH Black, NH Asian, and Hispanic individuals experienced greater odds of food insecurity “sometimes” (AOR = 2.99; 95% CI = 2.72, 3.29; AOR = 1.58; 95% CI = 1.46, 1.71; AOR = 2.54; 95% CI = 2.37, 2.73, respectively).

Compared to never smokers, former and current smokers had greater odds of experiencing food insecurity “sometimes” (AOR = 1.36; 95% CI = 1.29, 1.42 and AOR = 3.12, 95% CI = 2.84, 3.43, respectively). Current smokers had greater odds of experiencing food insecurity “often” compared to never smokers (AOR = 4.49; 95% CI = 3.66, 5.51, respectively). Like financial strain, those with comorbidities had greater odds of experiencing food insecurity. Relative to a Charlson comorbidity score of zero, cancer survivors with a score of 1, 2, or 3 or more had greater odds of experiencing food insecurity “sometimes” (AOR = 1.67; 95% CI = 1.57, 1.77; AOR = 2.07; 95% CI = 1.93, 2.22; and AOR = 3.06; 95% CI = 2.87, 3.25, respectively). Similarly, relative to a Charlson comorbidity score of zero, survivors with a score of 1 or 3 or more had greater odds of experiencing food insecurity “often” (AOR = 2.31; 95% CI = 1.97, 2.71; AOR = 5.68; 95% CI = 4.80, 6.72, respectively).

Table 3 Adjusted model for financial strain among those with cancer history by demographic characteristics (2020–2021, $n = 16,231$)

	Somewhat hard vs. not hard at all		Very hard vs. not hard at all	
	OR ^a (95% CI)	<i>p</i> -value ^b	OR ^a (95% CI)	<i>p</i> -value ^b
Age (years)	0.97 (0.96, 0.97)	< 0.0001	0.93 (0.92, 0.94)	< 0.0001
Sex				
Female	Ref		Ref	
Male	0.72 (0.66, 0.79)	< 0.0001	1.05 (0.78, 1.40)	0.7644
Race/ethnicity ^c				
White	Ref		Ref	
Black	1.90 (1.52, 2.38)	< 0.0001	2.19 (0.52, 4.28)	0.3670
Asian	0.94 (0.77, 1.15)	0.5629	0.59 (0.28, 1.23)	0.1552
Native Hawaiian/other Pacific Islander	1.90 (1.25, 2.88)	0.0125	1.71 (0.56, 5.23)	0.3449
American Indian/Alaska Native	1.68 (0.89, 3.16)	0.1100	4.40 (0.00, 14.66)	1.0000
Hispanic	1.70 (1.42, 2.03)	< 0.0001	2.81 (1.77, 4.46)	0.0012
Other	1.53 (0.61, 3.86)	0.3661	7.67 (0.93, 63.46)	0.0587
Smoking status				
Never	Ref		Ref	
Former	1.50 (1.37, 1.63)	< 0.0001	1.71 (1.27, 2.29)	0.0004
Current	2.32 (1.85, 2.91)	< 0.0001	3.27 (1.73, 6.19)	0.0003
Charlson comorbidity score				
0	Ref		Ref	
1	1.33 (1.14, 1.56)	0.0098	2.27 (0.91, 3.83)	0.0561
2	1.40 (1.22, 1.61)	< 0.0001	1.60 (0.20, 2.63)	0.9980
3+	2.10 (1.86, 2.37)	< 0.0001	3.16 (2.07, 4.82)	< 0.0001

^aAdjusted model includes age (continuous), sex, race/ethnicity, Kaiser Permanente region, smoking status, and Charlson comorbidity score

^b*p*-value was adjusted for multiple comparisons using the step-down Bonferroni method. Boldface indicates statistical significance ($p < 0.05$)

^cRace categories include non-Hispanic individuals with Hispanic individuals included as their own category

Table 4 Adjusted model for food insecurity among those with cancer history by demographic characteristics (2020–2021, $n = 16,231$)

	Sometimes true vs. never true		Often true vs. never true	
	OR ^a (95% CI)	<i>p</i> -value ^b	OR ^a (95% CI)	<i>p</i> -value ^b
Age (years)	0.96 (0.95, 0.96)	< 0.0001	0.93 (0.93, 0.94)	< 0.0001
Sex				
Female	Ref		Ref	
Male	0.78 (0.74, 0.81)	0.0362	0.80 (0.70, 1.36)	0.7523
Race/ethnicity ^c				
White	Ref		Ref	
Black	2.99 (2.72, 3.29)	< 0.0001	4.06 (0.72, 5.05)	0.1418
Asian	1.58 (1.46, 1.71)	< 0.0001	1.44 (0.32, 1.79)	0.1505
Native Hawaiian/other Pacific Islander	2.75 (0.00, 3.34)	1.0000	4.23 (0.60, 6.39)	0.3256
American Indian/Alaska Native	2.23 (0.00, 2.76)	1.0000	5.17 (0.73, 7.48)	0.7271
Hispanic	2.54 (2.37, 2.73)	< 0.0001	2.68 (0.00, 3.21)	1.0000
Other	1.14 (0.67, 1.92)	0.8751	0.62 (0.09, 4.46)	0.7271
Smoking status				
Never	Ref		Ref	
Former	1.36 (1.29, 1.42)	< 0.0001	1.33 (0.74, 1.52)	0.7177
Current	3.12 (2.84, 3.43)	< 0.0001	4.49 (3.66, 5.51)	0.0006
Charlson comorbidity score				
0	Ref		Ref	
1	1.67 (1.57, 1.77)	0.0015	2.31 (1.97, 2.71)	0.0031
2	2.07 (1.93, 2.22)	0.0001	3.31 (0.00, 3.99)	1.0000
3+	3.06 (2.87, 3.25)	< 0.0001	5.68 (4.80, 6.72)	< 0.0001

^aAdjusted model includes age (continuous), sex, race/ethnicity, Kaiser Permanente region, smoking status, and Charlson comorbidity score

^b*p*-value was adjusted for multiple comparisons using the step-down Bonferroni method. Boldface indicates statistical significance ($p < 0.05$)

^cRace categories include non-Hispanic individuals with Hispanic individuals included as their own category

Discussion

To our knowledge, this is the first study to assess financial strain and food insecurity during the COVID-19 pandemic among cancer survivors compared to individuals without a history of cancer. It was hypothesized that cancer survivors would be disproportionately impacted by social risk factors during the pandemic compared to individuals without a history of cancer; however, we did not observe this in our older population of mostly long-term survivors (51% diagnosed with cancer > 10 years ago). In fact, cancer survivors had lower odds of reporting financial strain or food insecurity compared to those with no history of cancer. We did observe important differences among cancer survivors; males and NH Whites had lower odds of reporting financial strain and food insecurity compared to women and other racial/ethnic groups. Smokers and those with multiple comorbidities had higher odds of reporting financial strain and food insecurity. Considering 59% of the study population with a history of cancer was between the ages of 65 and 79 and of those individuals, 51% were diagnosed more than 10 years ago, many participants may no longer be experiencing financial strain or food insecurity due to the financial or social impacts of their previous cancer diagnosis. However, the literature suggests that after treatment completion, many cancer survivors continue to have high costs for medical care [5], and they experience increased difficulties maintaining employment and health insurance [9–12]. Given cancer survivors were considered a vulnerable population during the pandemic and were told to take extra steps to protect their health, even survivors who had completed their treatment 10+ years ago may have still been impacted.

These results suggest the pandemic may have disproportionately impacted historically minoritized populations, with NH Black, NH native Hawaiian/other Pacific Islander, and Hispanic individuals having greater odds of experiencing some level of financial strain compared to NH White individuals. This aligns with the literature on cancer survivors that has found women, Hispanic, and non-Hispanic Black individuals are more likely to experience food insecurity,²⁰ regardless of a pandemic. These disparities mirror the disparities highlighted during the pandemic among the general population with Black, Hispanic, and other individuals of color experiencing the greatest social risks [1].

Despite cancer survivors in this sample not reporting greater financial strain or food insecurity than individuals without a history of cancer, we did find that subsets of cancer survivors are experiencing greater social risks during the pandemic. There has been a large push in

recent years for health care settings to screen individuals for social risk factors, such as financial strain and food insecurity, and refer individuals to community resources [40–48]. Because providers have other medical needs to address with cancer survivors, screening for social risk factors may not be a priority in this population; however, incorporating screening for social risks into care coordination workflows should be a priority. A recent review of the literature on addressing social risks in health care settings describes the momentum to address social risks in routine care [49]. While there is no consensus on which patients should be screened or how to identify patients to screen, there are recommendations to screen all patients [49, 50]. Because cancer survivors are vulnerable to economic instability challenges especially during a pandemic, ensuring this population is included in screening for social risks is important.

Limitations

This study includes a large sample of survey respondents from six different regions in the USA during the first year of the COVID-19 pandemic and uses validated, standard survey instruments to assess important social determinants of health that are difficult to capture through electronic health records or other objective data sources. Despite these strengths, our results should be interpreted considering the following limitations. First, the cancer history exposure variable comes from a tumor registry that has a lag of 1–2 years. Therefore, we may have misclassified a few individuals as not being cancer survivors who were diagnosed with cancer within a year or two of the study. Second, this population is not representative of all cancer survivors; all study participants were insured at the time of their initial survey completion and NH Whites are overrepresented. Further, while this large cohort has many strengths, the study is focused on cancer survivors who were diagnosed > 1 year ago and not recently diagnosed cancer patients. Therefore, our results are not generalizable to recently diagnosed cancer patients and cancer patients with long-term survival (e.g. > 10 years) are likely overrepresented in our sample due to survivor bias. Third, the survey is self-report and asks sensitive questions. There may be a stigma associated with answering some of the questions where individuals do not report food insecurity or financial strain when, in fact, they have some level of need. However, this stigma would be present in both exposure groups (individuals with cancer and without cancer) suggesting this bias is non-differential. Future research might consider assessing the predictors of financial hardship and food insecurity among cancer survivors and the general population.

Conclusions

While this study did not find that cancer survivors were significantly more likely than individuals without a history of cancer to experience financial strain or food insecurity, we did find that the pandemic may have disproportionately impacted historically minoritized populations, with NH Black, NH native Hawaiian/other Pacific Islander, and Hispanic individuals more likely to report experiencing some level of financial strain compared to NH White individuals.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11764-022-01235-7>.

Acknowledgements Data and support for this study were provided by the Kaiser Permanente Research Bank (KPRB), which includes the Kaiser Permanente Research Program on Genes, Environment, and Health (RPGEH), funded by the Robert Wood Johnson Foundation, the Wayne and Gladys Valley Foundation, The Ellison Medical Foundation, and the Kaiser Permanente Community Benefits Program.

Author contribution Dr. Kelly led the conceptualization of the study and the writing of the manuscript. Dr. White conducted all statistical analyses for the study and helped write sections of the manuscript. Ms. Scott facilitated data acquisition and provided critical revisions to the manuscript. Drs. Burnett-Hartman and Feigelson helped in conceptualizing the study, writing sections of the manuscript, and critically revising the manuscript. All authors reviewed and approved the final version of the manuscript.

Funding Data and support for this study were provided by the Kaiser Permanente Research Bank (KPRB), which includes the Kaiser Permanente Research Program on Genes, Environment, and Health (RPGEH), funded by the Robert Wood Johnson Foundation, the Wayne and Gladys Valley Foundation, The Ellison Medical Foundation, and the Kaiser Permanente Community Benefits Program.

Data availability Access to data used in this study may be obtained by application to the KPRB at: <https://www.kp.org/researchbank/researchers>.

Declarations

Ethics approval This study was reviewed and approved under IRB # 182281–1 by the KP Mid-Atlantic States IRB, which is the IRB of record for the KPRB.

Competing interests The authors declare no competing interests.

References

1. Hardship is below December 2020 peak, yet still widespread. Accessed January 20, 2022. <https://www.cbpp.org/hardship-is-below-december-2020-peak-yet-still-widespread-3>.
2. Baddour K, Kudrick LD, Neopaney A, et al. Potential impact of the COVID-19 pandemic on financial toxicity in cancer survivors. *Head Neck*. 2020. <https://doi.org/10.1002/hed.26187>.
3. Staying Well During COVID-19. A guide for cancer patients and their caregivers and family members. Accessed June 7, 2022. <https://www.cdc.gov/cancer/survivors/staying-well-during-covid-19.htm>.
4. Miller KD, Nogueira L, Mariotto AB, et al. Cancer treatment and survivorship statistics, 2019. *CA: Cancer J Clin*. 2019;69(5):363–85. <https://doi.org/10.3322/caac.21565>.
5. Banegas MP, Guy GP Jr, de Moor JS, et al. For working-age cancer survivors, medical debt and bankruptcy create financial hardships. *Policy Anal Brief H Ser*. 2016;35(1):54–61. <https://doi.org/10.1377/hlthaff.2015.0830>.
6. Han X, Zhao J, Zheng Z, de Moor JS, Virgo KS, Yabroff KR. Medical financial hardship intensity and financial sacrifice associated with cancer in the United States. *Cancer Epidemiol Biomarkers Prev*. 2020;29(2):308–17. <https://doi.org/10.1158/1055-9965.Epi-19-0460>.
7. Yabroff KR, Dowling EC, Guy GP Jr, et al. Financial hardship associated with cancer in the United States: findings from a population-based sample of adult cancer survivors. *J Clin Oncol*. 2016;34(3):259–67. <https://doi.org/10.1200/JCO.2015.62.0468>.
8. Whitney RL, Bell JF, Reed SC, et al. Predictors of financial difficulties and work modifications among cancer survivors in the United States. *J Cancer Surviv*. 2016;10(2):241–50. <https://doi.org/10.1007/s11764-015-0470-y>.
9. Ramsey S, Blough D, Kirchoff A, et al. Washington State cancer patients found to be at greater risk for bankruptcy than people without a cancer diagnosis. *Policy Anal Brief H Ser*. 2013;32(6):1143–52. <https://doi.org/10.1377/hlthaff.2012.1263>.
10. Politi MC, Grant RL, George NP, et al. Improving Cancer Patients' Insurance Choices (I Can PIC): a randomized trial of a personalized health insurance decision aid. *J Oncol*. 2020. <https://doi.org/10.1634/theoncologist.2019-0703>.
11. Kent EE, de Moor JS, Zhao J, Ekwueme DU, Han X, Yabroff KR. Staying at one's job to maintain employer-based health insurance among cancer survivors and their spouses/partners. *JAMA Oncol*. 2020;6(6):929–32. <https://doi.org/10.1001/jamaoncol.2020.0742>.
12. Tangka FKL, Subramanian S, Jones M, et al. Insurance coverage, employment status, and financial well-being of young women diagnosed with breast cancer. *Cancer Epidemiol Biomarkers Prev*. 2020;29(3):616–24. <https://doi.org/10.1158/1055-9965.Epi-19-0352>.
13. Nathan PC, Henderson TO, Kirchoff AC, Park ER, Yabroff KR. Financial hardship and the economic effect of childhood cancer survivorship. *J Clin Oncol*. 2018;36(21):2198–205. <https://doi.org/10.1200/jco.2017.76.4431>.
14. Altice CK, Banegas MP, Tucker-Seeley RD, Yabroff KR. Financial hardships experienced by cancer survivors: a systematic review. *J Natl Cancer Inst*. 2017;109(2). <https://doi.org/10.1093/jnci/djw205>.
15. Zhao J, Zheng Z, Han X, et al. Cancer history, health insurance coverage, and cost-related medication nonadherence and medication cost-coping strategies in the United States. *Value Health*. 2019;22(7):762–7. <https://doi.org/10.1016/j.jval.2019.01.015>.
16. Ramsey SD, Bansal A, Fedorenko CR, et al. Financial insolvency as a risk factor for early mortality among patients with cancer. *J Clin Oncol*. 2016;34(9):980–6. <https://doi.org/10.1200/JCO.2015.64.6620>.
17. Bestvina CM, Zullig LL, Rushing C, et al. Patient-oncologist cost communication, financial distress, and medication adherence. *J Oncol Pract*. 2014;10(3):162–7. <https://doi.org/10.1200/jop.2014.001406>.
18. Dusetzina SB, Winn AN, Abel GA, Huskamp HA, Keating NL. Cost sharing and adherence to tyrosine kinase inhibitors for patients with chronic myeloid leukemia. *J Clin Oncol*. 2014;32(4):306–11. <https://doi.org/10.1200/jco.2013.52.9123>.
19. Knight TG, Deal AM, Dusetzina SB, et al. Financial toxicity in adults with cancer: adverse outcomes and noncompliance. *J Oncol Pract*. 2018;Jop1800120. <https://doi.org/10.1200/jop.18.00120>.

20. Tran G, Zafar SY. Financial toxicity and implications for cancer care in the era of molecular and immune therapies. *Ann Transl Med.* 2018;6(9):166. <https://doi.org/10.21037/atm.2018.03.28>.
21. Trego ML, Baba ZM, DiSantis KI, Longacre ML. Food insecurity among adult cancer survivors in the United States. *J Cancer Surviv.* 2019;13(4):641–52. <https://doi.org/10.1007/s11764-019-00783-9>.
22. Brenner MH. Will there be an epidemic of corollary illnesses linked to a COVID-19-related recession?. *Am J Public Health.* 2020;e1-e2. <https://doi.org/10.2105/ajph.2020.305724>.
23. Nekhlyudov L, Duijts S, Hudson SV, et al. Addressing the needs of cancer survivors during the COVID-19 pandemic. *J Cancer Surviv.* 2020;1–6. <https://doi.org/10.1007/s11764-020-00884-w>.
24. Blustein DL, Duffy R, Ferreira JA, Cohen-Scali V, Cinamon RG, Allan BA. Unemployment in the time of COVID-19: a research agenda. *J Vocat Behav.* 2020;103436. <https://doi.org/10.1016/j.jvb.2020.103436>.
25. Thom B, Benedict C, Friedman DN, Watson SE, Zeitler MS, Chino F. Economic distress, financial toxicity, and medical cost-coping in young adult cancer survivors during the COVID-19 pandemic: findings from an online sample. *Cancer.* 2021;127(23):4481–91. <https://doi.org/10.1002/cncr.33823>.
26. van Egmond MP, Duijts SFA, Loyen A, Vermeulen SJ, van der Beek AJ, Anema JR. Barriers and facilitators for return to work in cancer survivors with job loss experience: a focus group study. *Eur J Cancer Care (Engl).* 2017;26(5). <https://doi.org/10.1111/ecc.12420>.
27. Kvale MN, Hesselton S, Hoffmann TJ, et al. Genotyping informatics and quality control for 100,000 subjects in the Genetic Epidemiology Research on Adult Health and Aging (GERA) cohort. *Genetics.* 2015;200(4):1051–60. <https://doi.org/10.1534/genetics.115.178905>.
28. Feigelson HSCC, Van Den Eeden SK, et al. The Kaiser Permanente Research Bank Cancer Cohort: a collaborative resource to improve cancer care and survivorship. *BMC Cancer.* 2022;22(1):209. <https://doi.org/10.1186/s12885-022-09252-6>.
29. Cella D, Riley W, Stone A, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005–2008. *J Clin Epidemiol.* 2010;63(11):1179–94. <https://doi.org/10.1016/j.jclinepi.2010.04.011>.
30. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav.* 1983;24(4):385–96.
31. Williams DR, Yan Y, Jackson JS, Anderson NB. Racial differences in physical and mental health: socio-economic status, stress and discrimination. *J Health Psychol.* 1997;2(3):335–51. <https://doi.org/10.1177/135910539700200305>.
32. Behavioral Risk Factor Surveillance System—survey data & documentation. Accessed November 7, 2021. https://www.cdc.gov/brfss/data_documentation/index.htm.
33. Kahn JR, Pearlin LI. Financial strain over the life course and health among older adults. *J Health Soc Behav.* 2006;47(1):17–31. <https://doi.org/10.1177/002214650604700102>.
34. Institute of Medicine. Capturing Social and Behavioral Domains and Measures in Electronic Health Records: Phase 2. The National Academies Press; 2014:374.
35. Hager ER, Quigg AM, Black MM, et al. Development and validity of a 2-item screen to identify families at risk for food insecurity. *Pediatrics.* 2010;126(1):e26–32. <https://doi.org/10.1542/peds.2009-3146>.
36. Hornbrook MC, Hart G, Ellis JL, et al. Building a virtual cancer research organization. *J Natl Cancer Inst.* 2005;35:12–25. <https://doi.org/10.1093/jncimonographs/lgi033>.
37. Ross TR, Ng D, Brown JS, et al. The HMO Research Network Virtual Data Warehouse: A Public Data Model to Support Collaboration. EGEMS (Washington, DC). 2014;2(1):1049. <https://doi.org/10.13063/2327-9214.1049>.
38. Seiffert JE. Development and use of the North American Association of Central Cancer Registries standards for cancer registries. *Top Health Inf Manage.* 1997;17(3):35–44.
39. Klabunde CN, Potosky AL, Legler JM, Warren JL. Development of a comorbidity index using physician claims data. *Validation Studies. J Clin Epidemiol.* 2000;53(12):1258–67.
40. Garg A, Jack B, Zuckerman B. Addressing the social determinants of health within the patient-centered medical home: lessons from pediatrics. *JAMA.* 2013;309(19):2001–2. <https://doi.org/10.1001/jama.2013.1471>.
41. Gottlieb LM, Tirozzi KJ, Manchanda R, Burns AR, Sandel MT. Moving electronic medical records upstream: incorporating social determinants of health. *Am J Prev Med.* 2015;48(2):215–8. <https://doi.org/10.1016/j.amepre.2014.07.009>.
42. Bazemore AW, Cottrell EK, Gold R, et al. “Community vital signs”: incorporating geocoded social determinants into electronic records to promote patient and population health. *JAMA.* 2016;23(2):407–12. <https://doi.org/10.1093/jamia/ocv088>.
43. Page-Reeves J, Kaufman W, Bleecker M, et al. Addressing social determinants of health in a clinic setting: the WellRx Pilot in Albuquerque, New Mexico. *JABFM.* 2016;29(3):414–8. <https://doi.org/10.3122/jabfm.2016.03.150272>.
44. Pinto AD, Glattstein-Young G, Mohamed A, Bloch G, Leung FH, Glazier RH. Building a foundation to reduce health inequities: routine collection of sociodemographic data in primary care. *JABFM.* 2016;29(3):348–55. <https://doi.org/10.3122/jabfm.2016.03.150280>.
45. DeVoe JE, Bazemore AW, Cottrell EK, et al. Perspectives in primary care: a conceptual framework and path for integrating social determinants of health into primary care practice. *Ann Fam Med.* 2016;14(2):104–8. <https://doi.org/10.1370/afm.1903>.
46. Billioux A, Verlander K, Anthony S, Alley D. Standardized screening for health-related social needs in clinical settings: the accountable health communities screening tool. *NAM Perspectives.* Discussion Paper, National Academy of Medicine, Washington, DC. <https://doi.org/10.31478/201705b>.
47. Cottrell EK, Gold R, Likumahuwa S, et al. Using health information technology to bring social determinants of health into primary care: a conceptual framework to guide research. *J Health Care Poor Underserved.* 2018;29(3):949–63. <https://doi.org/10.1353/hpu.2018.0071>.
48. LaForge K, Gold R, Cottrell E, et al. How 6 organizations developed tools and processes for social determinants of health screening in primary care: an overview. *J Ambul Care Manag.* 2018;41(1):2–14. <https://doi.org/10.1097/jac.0000000000000221>.
49. Kreuter MW, Thompson T, McQueen A, Garg R. Addressing social needs in health care settings: evidence, challenges, and opportunities for public health. *Annu Rev Public Health.* 2021;42:329–44.
50. Garg A, Boynton-Jarrett R, Dworkin P. Avoiding the unintended consequences of screening for social determinants of health. *JAMA.* 2016;316(8):813–4.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.