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Risk factors and health behaviors associated with loneliness among cancer survivors during the COVID-19 pandemic

Elena S. Aßmann[1,2] · Jennifer Ose[1,3] · Cassandra A. Hathaway[4] · Laura B. Oswald[5] · Sheetal Hardikar[1,3] · Caroline Himbert[1,3] · Vimalkumar Chellam[1] · Tengda Lin[1,3] · Bailee Daniels[1] · Anne C. Kirchhoff[1,6] · Biljana Gigic[7] · Douglas Grossman[1,8] · Jonathan Tward[1,9] · Thomas K. Varghese Jr.[1,10] · David Shibata[11] · Jane C. Figueiredo[12] · Adetunji T. Toriola[13] · Anna Beck[1,14] · Courtney Scaife[1,10] · Christopher A. Barnes[1,15] · Cindy Matsen[1,10] · Debra S. Ma[1] · Howard Colman[1,16] · Jason P. Hunt[1,10] · Kevin B. Jones[1,17] · Catherine J. Lee[1,18] · Mikaela Larson[1] · Tracy Onega[1,3] · Wallace L. Akerley[1,14] · Christopher I. Li[19] · William M. Grady[19] · Martin Schneider[7] · Andreas Dinkel[20] · Jessica Y. Islam[4] · Brian D. Gonzalez[5] · Amy K. Otto[21,22] · Frank J. Penedo[21,23] · Erin M. Siegel[4] · Shelley S. Tworoger[4] · Cornelia M. Ulrich[1,3] · Anita R. Peoples[1,3]

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Abstract

Loneliness may exacerbate poor health outcomes particularly among cancer survivors during the COVID-19 pandemic. Little is known about the risk factors of loneliness among cancer survivors. We evaluated the risk factors of loneliness in the context of COVID-19 pandemic-related prevention behaviors and lifestyle/psychosocial factors among cancer survivors. Cancer survivors (n = 1471) seen at Huntsman Cancer Institute completed a survey between August–September 2020 evaluating health behaviors, medical care, and psychosocial factors including loneliness during COVID-19 pandemic. Participants were classified into two groups: 'lonely' (sometimes, usually, or always felt lonely in past month) and 'non-lonely' (never or rarely felt lonely in past month). 33% of cancer survivors reported feeling lonely in the past month. Multivariable logistic regression showed female sex, not living with a spouse/partner, poor health status, COVID-19 pandemic-associated lifestyle factors including increased alcohol consumption and marijuana/CBD oil use, and psychosocial stressors such as disruptions in daily life, less social interaction, and higher perceived stress and financial stress were associated with feeling lonely as compared to being non-lonely (all $p < 0.05$). A significant proportion of participants reported loneliness, which is a serious health risk among vulnerable populations, particularly cancer survivors. Modifiable risk factors such as unhealthy lifestyle behaviors and psychosocial stress were associated with loneliness. These results highlight the need to screen for unhealthy lifestyle factors and psychosocial stressors to identify cancer survivors at increased risk of loneliness and to develop effective management strategies.

Keywords COVID-19 · Cancer · Loneliness · Lifestyle factors · Psychosocial factors

Introduction

Loneliness is the perceived level of social isolation i.e., *the subjective* experience of a perceived lack of social network or interactions (Miaskowski et al., 2021a; Peplau & Perlman, 1982). Loneliness is increasingly being recognized as a major public health concern due to rising burden in the US, especially among younger individuals (Lim et al., 2020). For instance, recent studies in the general population have indicated prevalence of loneliness as high as 49% among young adults (≤35) (Horigian et al., 2021) versus 27% among older individuals (≥50) (Choi et al., 2021). If left unmanaged, loneliness is a key indicator of poor health outcomes and well-being. There is increasing evidence that loneliness is associated with serious physical and mental health problems, such as cardiovascular disease, diabetes, poor immune function, impaired cognitive performance, sleep disruption, and depression, resulting in substantial negative effects on daily functioning, work, and quality of life (QoL) (Christiansen

Cornelia M. Ulrich and Anita R. Peoples have contributed equally to this work.

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et al., 2021; Hawkley & Cacioppo, 2010; Weele et al., 2012). Loneliness is also associated with poor coping mechanisms, particularly unhealthy lifestyle factors such as alcohol consumption, smoking, and substance use (Stickley et al., 2014), as well as increased suicidal ideation (Killgore et al., 2021) and mortality (Holt-Lunstad et al., 2015). Although the risk factors of loneliness are not well understood, research to date suggests that younger age, female sex, ethnic minority groups, lower socioeconomic status, and living alone have been associated with loneliness in the general population (Bu et al., 2020).

With the onset of the COVID-19 pandemic in March 2020, loneliness and its impact on health have become a focus of public attention (Holt-Lunstad, 2021). Stay-at-home policies, social distancing, and other risk mitigation measures to limit the spread of the SARS-CoV-2 virus have contributed to increased loneliness, especially among vulnerable groups such as individuals with chronic health problems like cancer. For example, in one study of 6,186 US adults, loneliness increased significantly over the first 6 months of COVID-19 community lockdown restrictions (Killgore et al., 2020). Another study showed that more than 50% of cancer patients experienced loneliness during the initial phase of the COVID-19 pandemic (Miaskowski et al., 2021b), which is higher than the 30–35% of moderate-severe levels of loneliness reported in a study conducted prior to the pandemic (Deckx et al., 2015).

Compared to the general population, cancer survivors are at an increased risk of loneliness, which is associated with poor QoL outcomes that are known to impact adherence to recommended cancer survivorship behaviors and treatment (Deckx et al., 2014; Ferrari et al., 2021; McGeough et al., 1980). It is possible that the COVID-19-related stay-at-home policies, reduced social interactions, and potential changes or delays to medical services have further exacerbated loneliness and distress among cancer survivors (Nekhlyudov et al., 2020). Additionally, patients with cancer, especially those undergoing active treatment, are at higher risk of contracting COVID-19 and becoming more severely ill (Dai et al., 2020; Giannakoulis et al., 2020; Liang et al., 2020; Robilotti et al., 2020). They may, therefore, adhere even more strictly to risk mitigation strategies thus being more susceptible to loneliness and social isolation i.e., the lack of social contacts and having few people to interact with on a regular basis (Islam et al., 2020; Nekhlyudov et al., 2020). However, limited research exists on loneliness and its risk factors among cancer survivors, particularly during the COVID-19 pandemic.

Since loneliness, a frequently overlooked psychosocial symptom, can have a profound impact on the well-being of cancer survivors as it is associated with adverse health outcomes, it warrants further research. Encouragingly, previous studies on group-based, telephone-based, and web-based psychosocial interventions, such as cognitively-based compassion training, have shown that loneliness is modifiable among adult cancer survivors (McElfresh et al., 2021). Thus, establishing effective tailored interventions to address loneliness in cancer survivors may have a positive impact on the overall health in this population (McElfresh et al., 2021). Consequently, there is a need to better understand risk factors associated with loneliness among cancer survivors, identify high-risk groups to improve screening outcomes, and develop loneliness mitigation strategies to improve survivorship and quality of life.

In the present work, we surveyed a large study population of patients with cancer to identify the determinants of loneliness among cancer survivors during the COVID-19 pandemic in the context of clinicodemographic and health characteristics, COVID-19 prevention measures and perceptions, and lifestyle and psychosocial factors.

Methods

Study design and participant selection

The COVID-19 and Oncology Patient Experience Study (COPES) consortium is a multicenter cohort study conducted at three NCI-designated Cancer Centers (University of Utah Huntsman Cancer Institute (HCI), University of Miami Sylvester Comprehensive Cancer Center, and Moffitt Cancer Center), with the aim to evaluate health behaviors, healthcare delivery, QoL, and psychosocial factors among patients with cancer and healthy participants during COVID-19 pandemic (Hathaway et al., 2021, 2022a, 2022b; Himbert et al., 2022; Peoples et al., 2022). The present work included cancer survivors who had visited HCI between 2016 and 2020, were enrolled in the Total Cancer Care (TCC) study, the ColoCare Study (ClinicalTrials.gov identifier: NCT02328677), or the Precision-Exercise-Prescription (PEP) study (ClinicalTrials.gov identifier: NCT03306992) (Ose et al., 2021; Ulrich et al., 2018, 2019), were ≥ 18 years, and completed a COVID-19 survey between August and September 2020 to investigate pandemic-related changes during the first 6 months, including questions about loneliness. The University of Utah Institutional Review Board approved this protocol, and all participants provided written informed consent.

Briefly, the TCC study is an observational study and eligible participants include individuals with any cancer diagnosis, benign tumors, or healthy controls (Ose et al., 2021). The ColoCare Study is a multicenter, prospective cohort of newly diagnosed colorectal cancer patients (ages 18–89; stages 0–IV) (Ulrich et al., 2019). The PEP study is a randomized controlled trial in adult lung cancer patients (any stage), undergoing surgery (Ulrich et al., 2018).

Survey administration

Eligible participants received an email invitation and up to 3 reminders to participate in the COVID-19 survey between August and September 2020. The questionnaire was completed online using the Research Electronic Data Capture (REDCap) system (Harris et al., 2019). Participants who did not respond or who did not have an email available, were able to complete a paper-based survey or answer survey questions over the phone. The majority of surveys were completed electronically (96%). The COVID-19 survey response rates for TCC, PEP, and ColoCare studies ranged from 14 to 57%.

Measures

Outcome

Loneliness: Loneliness was measured with the following self-reported, validated question "How often have you felt lonely in the last month?" rated on a Likert scale from 1 (never) to 5 (always). This item was taken from the NIH Toolbox Loneliness instrument (Salsman et al., 2013) and is comparable to the single-item loneliness question from the Center for Epidemiological Studies Depression Scale (CES-D). Single-item loneliness measure has been previously shown to be sufficient as a screening tool to classify individuals as being lonely during the COVID-19 pandemic and is strongly correlated with UCLA Loneliness scale (Kotwal et al., 2022). It also has good face and predictive validity, as well as well-suited for large-scale, population-based studies (Salinas et al., 2022). In line with prior literature (Kotwal et al., 2022; Perissinotto et al., 2012), participants were categorized into two groups: non-lonely (never or rarely felt lonely) and lonely (sometimes, usually, or always felt lonely).

Exposures

Demographic and clinical characteristics: Clinicodemographic characteristics (e.g., age, sex, race, ethnicity, tumor site, and tumor stage) were abstracted from electronic medical records. Participants self-reported employment, insurance, and living arrangement. Urbanicity was computed from zip codes and the Rural–Urban Commuting Area Codes classification system (Rural Health Research Center, 2017); zip codes with ≥ 30% of workers going to a Census Bureau-defined Urbanized Area were coded as urban, the remaining zip codes were coded as rural (Peoples et al., 2022). Socioeconomic status was assessed from zip codes using the National Area Deprivation Index (ADI), which measures census block group level of income, education, employment, and housing quality, with higher percentile scores indicating more disadvantaged areas (Kind & Buckingham, 2018; University of Wisconsin School of Medicine and Public Health, 2019).

Health characteristics and experiences: Participants self-reported comorbidities and overall health status (adapted from the 12-item Short-Form Health Survey quality-of-life measure) (Ware et al., 1996). Changes in cancer-related and other healthcare appointments were measured using a single-item adapted from an American Cancer Society survey "Since March 2020, have you had to change or cancel an appointment at Huntsman due to the COVID-19 epidemic?" (American Cancer Society, 2020).

COVID-19 risk-mitigation measures and perceptions: Participants reported how often they engaged in four COVID-19 risk mitigation behaviors including leaving the house for routine errands, social distancing, and use of face masks and hand sanitizer on a 5-point scale from 1 (never) to 5 (very often), which were adapted from prior studies assessing behaviors associated with reducing risk of COVID-19 exposure (Kassas et al., 2021; Mendoza-Jimenez et al., 2021). Responses for each behavior were summed (with leaving the house for routine errands as inversely coded) to calculate a total risk mitigation score (range: 4–20), with a higher score indicating more frequent risk mitigation behaviors, similar to previously published behavior scores (Gao et al., 2020). Participants' perceived likelihood of contracting COVID-19 was measured on a 5-point scale from 1 (very unlikely) to 5 (very likely), and perceived severity of COVID-19 infection was assessed on a 3-point scale from 1 (not at all serious) to 3 (very serious).

Lifestyle factors: Participants reported their height and weight for body-mass-index (BMI) estimation, current/recent smoking status, alcohol consumption, and marijuana and/or CBD oil use. If participants did not report their height, weight, or smoking status, data were abstracted from medical records. Participants also self-reported changes in alcohol consumption, marijuana/CBD oil use, and exercise habits since the onset of the COVID-19 pandemic.

Psychosocial stressors: Participants rated changes in their daily lives, difficulties that could not be overcome (taken from the Perceived Stress Scale) (Cohen et al., 1983; Golden-Kreutz et al., 2004), and financial stress (adapted from the COmprehensive Score for financial Toxicity measure) (de Souza et al., 2017) on a 5-point Likert scale, with higher scores indicating higher levels of the respective constructs. Participants also reported changes in social interactions due to the pandemic on a scale from 1 (much less social interaction) to 5 (a lot more social interaction).

Statistical analyses

Means and standard deviations for continuous variables and percentages for categorical variables were calculated. *T*-tests

for continuous variables and χ-square tests for categorical variables were used to examine the associations between exposures/factors and loneliness (yes/no). To identify the strongest determinants of loneliness, a multivariable forward selection logistic regression analysis was performed including the factors that were individually associated with loneliness. In regression models, for factors with missing values, the missing values were included as a separate category. Any variables with a p-value threshold of <0.05 remained in the model. Robustness of the model was tested using Hosmer and Lemeshow Goodness-of-Fit test. A two-sided p-value of <0.05 was considered statistically significant, and all statistical analyses were performed using SPSS version 27 (IBM Corp., Armonk, NY).

Results

Study population characteristics

A total of N = 1471 cancer survivors were included in the analysis, and 33% were categorized as lonely in the past month (i.e., sometimes, usually, or always felt lonely; Table 1). The mean age was 61 years (20% < 50 years, 46% ≥ 65 years), 52% were female, and most were from Utah (70%). The average time since cancer diagnosis was 3.2 years. Most participants were non-Hispanic/Latino, White, from urban areas, and had overall good to excellent self-reported health status.

Clinicodemographic and health characteristics

Lonely versus non-lonely cancer survivors were more likely to be younger (< 50 years; 28% versus 17%; $p<0.001$), female (66% versus 46%; $p<0.001$), Hispanic/Latino (6% versus 3%; $p=0.01$), socioeconomically disadvantaged ($p=0.04$), living alone (17% versus 7%; $p<0.001$), to have lost their job due to COVID-19 (3% versus 1%; $p<0.001$), and to have experienced a change/cancellation of their medical appointments (35% versus 27%; $p=0.003$), while they were less likely to be employed full-time (31% versus 35%; $p<0.001$), retired (36% versus 44%; $p<0.001$), or live with a spouse/partner (63% versus 85%; $p<0.001$; Table 2). Lonely individuals were also more likely to report a fair/poor health status (24% versus 11%), have higher number of comorbidities, and have been diagnosed with breast cancer as well as stage IV tumors relative to non-lonely individuals (all $p<0.05$).

COVID-19 risk-mitigation measures and perceptions

The majority of participants practiced social distancing, wore masks, and used hand sanitizer fairly/very often. However, there were significant differences by loneliness (Table 3). Lonely cancer survivors were more likely to practice social distancing (94% versus 89%; $p=0.001$), not leave the house for routine errands (29% versus 19%; $p<0.001$), wear a mask (94% versus 90%; $p=0.03$), use hand sanitizer (89% versus 81%; $p=0.001$), and overall practice more risk mitigation behaviors (higher total risk mitigation score; $p<0.001$) relative to non-lonely cancer survivors. Further, lonely cancer survivors felt they were more likely to experience more severe COVID-19 infection compared to non-lonely cancer survivors (55% versus 43%; $p<0.001$).

Lifestyle factors

While most participants were never smokers and categorized as overweight/obese, there were no differences in smoking status and BMI by loneliness (Table 3). However, lonely cancer survivors were not only more likely to consume alcohol in the past year ($p=0.03$), they also increased their alcohol consumption during the pandemic relative to non-lonely individuals (11% versus 3%; $p<0.001$). Similarly, a greater proportion of lonely cancer survivors reported marijuana/CBD oil use in the past month relative to non-lonely individuals (21% versus 10%; $p<0.001$), as well as increased the use during the pandemic (25% versus 11%; $p=0.04$). Almost half of all participants reported a change in exercise habits due to the pandemic, with lonely individuals being more likely to experience a change (57% versus 42%; $p<0.001$). Particularly, lonely cancer survivors were more likely to not exercise regularly during the pandemic relative to non-lonely cancer survivors (26% versus 18%; $p=0.01$).

Psychosocial stressors

The majority of participants experienced significant disruptions in their daily lives and had fewer social interactions during the COVID-19 pandemic. However, lonely cancer survivors were more likely to experience changes in their daily lives (73% versus 55%; $p<0.001$) and have less social interaction relative to non-lonely cancer survivors (81% versus 63%; $p<0.001$; Table 3). Although only a small proportion of cancer survivors reported perceived stress (7%) and financial stress (11%) frequently in the past month, lonely cancer survivors had a higher likelihood to experience perceived stress (18% versus 2%; $p<0.001$) and financial stress (23% versus 5%; $p<0.001$) relative to non-lonely cancer survivors.

Key determinants of loneliness

In the fully adjusted multivariable logistic regression model (Fig. 1), sex, living with a spouse or partner, health status, alcohol consumption, marijuana/CBD oil use, disruptions in

Table 1 Characteristics of the study population

Characteristics	Cancer survivors N = 1471
Age, n (%)	
< 50 years	300 (20.4%)
50–59 years	289 (19.6%)
60–69 years	460 (31.3%)
≥ 70 years	422 (28.7%)
Sex, n (%)	
Male	700 (47.6%)
Female	771 (52.4%)
Race, n (%)[a]	
White	1403 (97.3%)
Non-White	39 (2.7%)
Ethnicity, n (%)[a]	
Hispanic/Latino	53 (3.9%)
Non-Hispanic/Latino	1322 (96.1%)
BMI (kg/m^2), mean ± SD[a]	28.1 ± 6.2
Time since diagnosis (years), mean ± SD[a]	3.2 ± 3.9
Tumor stage, n (%)[a]	
In situ	32 (2.9%)
I	421 (37.6%)
II	261 (23.3%)
III	236 (21.1%)
IV	170 (15.2%)
Tumor site, n (%)[a]	
Breast	199 (14.3%)
GI tract	190 (13.7%)
Lung	105 (7.6%)
Hematologic neoplasms	244 (17.6%)
Melanoma	84 (6.1%)
Prostate	181 (13.0%)
Other	385 (27.7%)
Survey modality, n (%)	
Electronic survey	1,407 (95.6%)
Paper-based survey	60 (4.1%)
Phone survey	4 (0.3%)
Residential area, n (%)[a]	
Rural	393 (26.7%)
Urban	1077 (73.3%)
National ADI, mean ± SD[a]	32.0 ± 17.7
Employment status, n (%)[a]	
Employed full-time	499 (34.0%)
Employed part-time	120 (8.2%)
Not currently employed (retired)	611 (41.6%)
Not currently employed (lost job due to COVID-19)	21 (1.4%)
Not currently employed (other reasons)	218 (14.8%)
Heath insurance status, n (%)[a]	
Yes, any health insurance	1439 (98.1%)
No	28 (1.9%)
Health status, n (%)[a]	
Excellent or very good	742 (50.6%)
Good	505 (34.4%)

Table 1 (continued)

Characteristics	Cancer survivors N = 1471
Fair or poor	220 (15.0%)
No. of Comorbidities, n (%)[a]	
0	857 (61.3%)
1	376 (26.9%)
2 or more	164 (11.7%)
Felt lonely in past month, n (%)	
Never	494 (33.6%)
Rarely	489 (33.2%)
Sometimes	396 (26.9%)
Usually	77 (5.2%)
Always	15 (1.0%)

Note Data might not add to 100% because of rounding

ADI area deprivation index; *SD* standard deviation; *BMI* Body Mass Index

[a]Missing values due to non-response not shown [race: n = 29 (2.0%); ethnicity: n = 96 (6.5%); BMI: n = 35 (2.4%); time since diagnosis: n = 83 (5.6%); tumor stage: n = 351 (23.9%); tumor site: n = 83 (5.6%); residential area: n = 1 (0.1%); national ADI: n = 115 (7.8%); employment status: n = 2 (0.1%); health insurance status: n = 4 (0.3%); health status: n = 4 (0.3%); no. of comorbidities: n = 74 (5.0%)]

daily life, social interactions, perceived stress, and financial stress emerged as the strongest determinants of loneliness. Specifically, female sex, poor health status, increased alcohol consumption during the pandemic, marijuana/CBD oil use in past month, frequent disruptions in daily life, less social interactions, and higher perceived stress and financial stress were significantly associated with higher odds of loneliness, while living with a spouse or partner had a protective effect among cancer survivors.

Discussion

To our knowledge, this is the first study using a large, well-characterized cohort to examine the determinants of loneliness during the COVID-19 pandemic among cancer survivors. Overall, our findings showed that 33% of survivors experienced loneliness during the pandemic and that female sex, poor health, increased alcohol consumption, marijuana or CBD oil use, disruptions in daily life, less social interactions, and higher perceived stress and financial stress were associated with being lonely, while living with a spouse or partner had a protective effect.

Although the occurrence of loneliness in cancer survivors in our study was lower than that reported in a recent study in oncology patients (53%) by Miakowski and colleagues (Miaskowski et al., 2021b), it was still higher than that observed in the US general population during the pandemic (14%) (McGinty et al., 2020). This could be due to differences in demographic characteristics, survey time period, and/or state-wide COVID-19 restrictions, particularly since the study by Miakowski and colleagues included mostly female patients with breast cancer (83%), while our study had only 52% female cancer survivors. Nonetheless, loneliness was prevalent among one-third of our cancer survivors, making it clinically significant.

Age is a well-known risk factor of loneliness (Barreto et al., 2021; Rumas et al., 2021), with studies just prior to the pandemic showing that loneliness has been on the rise among younger individuals (Barreto et al., 2021). Older adults usually have a more effective emotional regulation, lower reactivity to stress, and more experience with being alone, and thus are less vulnerable (Vahia et al., 2020). Younger individuals, in contrast, are known to have more social connections than older adults (Bruine de Bruin et al., 2020), which would be affected during the pandemic. Although our findings did show that a higher proportion of survivors younger than 50 years of age reported loneliness, it wasn't a key determinant of loneliness. Further, female cancer survivors reported more loneliness than male participants, consistent with previous findings (Bu et al., 2020; Islam et al., 2021). Women are more likely than men to report disruptions in daily life, increased mental load, and loss of work income during the pandemic (Raile et al., 2020). Since women are also more likely than men to seek social support in stressful situations (Zhou et al., 2017), they may be particularly vulnerable to feelings of loneliness because of limited access to sources of support due to the pandemic.

In line with previous research (Bu et al., 2020; Czaja et al., 2021; Pagan, 2020), we observed that participants lacking spousal support, with poorer health status, and having reduced social interactions were more likely to report loneliness, which in part may be due to social isolation.

Table 2 Clinicodemographic and health characteristics by loneliness

	Lonely cancer survivors N = 488 (33.2%)	Non-lonely cancer survivors N = 983 (66.8%)	*P*-value
Clinicodemographic characteristics			
Age, n (%)			
< 50 years	135 (27.7%)	165 (16.8%)	< 0.001
50–59 years	102 (20.9%)	187 (19.0%)	
60–69 years	144 (29.5%)	316 (32.1%)	
≥ 70 years	107 (21.9%)	315 (32.0%)	
Sex, n (%)			
Female	323 (66.2%)	448 (45.6%)	< 0.001
Male	165 (33.8%)	535 (54.4%)	
Race, n (%)[a]			
White	456 (96.2%)	947 (97.8%)	0.07
Non-White	18 (3.8%)	21 (2.2%)	
Ethnicity, n (%)[a]			
Hispanic/Latino	27 (5.9%)	26 (2.8%)	0.01
Non-Hispanic/Latino	430 (94.1%)	892 (97.2%)	
Time since diagnosis (years), mean ± SD[a]	3.0 ± 3.5	3.3 ± 4.1	0.21
Tumor stage, n (%)[a]			
In situ	9 (2.5%)	23 (3.0%)	0.04
I	153 (42.3%)	268 (35.4%)	
II	71 (19.6%)	190 (25.1%)	
III	66 (18.2%)	170 (22.4%)	
IV	63 (17.4%)	107 (14.1%)	
Tumor site, n (%)[a]			
Breast	83 (18.3%)	116 (12.4%)	0.01
GI tract	55 (12.1%)	135 (14.5%)	
Lung	37 (8.1%)	68 (7.3%)	
Hematologic neoplasms	80 (17.6%)	164 (17.6%)	
Melanoma	21 (4.6%)	63 (6.7%)	
Prostate	44 (9.7%)	137 (14.7%)	
Other	134 (29.5%)	251 (26.9%)	
State, n (%)			
Utah	357 (73.2%)	679 (69.1%)	0.50
Idaho	51 (10.5%)	115 (11.7%)	
Wyoming	32 (6.6%)	72 (7.3%)	
Nevada	20 (4.1%)	57 (5.8%)	
Other	28 (5.7%)	60 (6.1%)	
Residential area, n (%)[a]			
Rural	119 (24.4%)	274 (27.9%)	0.15
Urban	369 (75.6%)	708 (72.1%)	
National ADI, mean ± SD[a]	33.4 ± 17.4	31.3 ± 17.8	0.04
Employment status, n (%)[a]			
Employed full-time	151 (31.0%)	348 (35.4%)	< 0.001
Employed part-time	39 (8.0%)	81 (8.2%)	
Not currently employed (retired)	176 (36.1%)	435 (44.3%)	
Not currently employed (lost job due to COVID-19)	12 (2.5%)	9 (0.9%)	
Not currently employed (other reasons)	109 (22.4%)	109 (11.1%)	
Current living arrangement, n (%)[b]			
Alone	85 (17.4%)	64 (6.5%)	< 0.001
With spouse/partner	305 (62.5%)	832 (84.6%)	< 0.001

Table 2 (continued)

	Lonely cancer survivors N = 488 (33.2%)	Non-lonely cancer survivors N = 983 (66.8%)	*P*-value
With other family members	134 (27.5%)	228 (23.2%)	0.07
With other people	13 (2.7%)	14 (1.4%)	0.10
With pet/s	87 (17.8%)	168 (17.1%)	0.73
Health insurance status, n (%)[a]			
Yes, any health insurance	474 (97.1%)	965 (98.6%)	0.06
No	14 (2.9%)	14 (1.4%)	
Health characteristics and experiences			
Health status, n (%)[a]			
Very good or excellent	189 (38.9%)	553 (56.4%)	< 0.001
Good	182 (37.4%)	323 (32.9%)	
Fair or poor	115 (23.7%)	105 (10.7%)	
No. of Comorbidities, n (%)[a]			
0	262 (56.8%)	595 (63.6%)	0.01
1	130 (28.2%)	246 (26.3%)	
2 or more	69 (15.0%)	95 (10.1%)	
Change/cancellation in medical appointments due to pandemic, n (%)[a]			
No	276 (56.6%)	640 (65.2%)	0.003
Yes	171 (35.0%)	263 (26.8%)	
Did not have an appointment	41 (8.4%)	79 (8.0%)	

Note Data might not add to 100% because of rounding

ADI area deprivation index; *SD* standard deviation

[a]Missing values due to non-response not shown [race: n = 29 (2.0%); ethnicity: n = 96 (6.5%); time since diagnosis: n = 83 (5.6%); tumor stage: n = 351 (23.9%); tumor site: n = 83 (5.6%); residential area: n = 1 (0.1%); national ADI: n = 115 (7.8%); employment status: n = 2 (0.1%); health insurance status: n = 4 (0.3%); health status: n = 4 (0.3%); no. of comorbidities: n = 74 (5.0%); change/cancellation in medical appointments due to pandemic: n = 1 (0.1%)]

[b]Participants could select multiple answers, so data might not add up to 100%

Having spousal and/or social support is known to weaken the negative impact of stressful events and alleviate anxiety (Borstelmann et al., 2015) and depression (Gariepy et al., 2016) as well as decrease feelings of loneliness (Czaja et al., 2021). Further, poor health or debilitating health problems requiring individuals to limit activities or stay at home often require practical social support, which may be compromised during the pandemic due to mitigation measures such as social distancing and stay-at-home policies (Pagan, 2020). These mitigation measures may also result in loss of social network and lower engagement in social activities and interactions (Islam et al., 2021), thus, further contributing to social isolation—an independent predictor of loneliness (Miaskowski et al., 2021b; Smith & Lim, 2020).

During March–September 2020, the Utah state advised all residents to follow COVID-19 risk-mitigation measures (e.g., wearing mask, staying at home as much as possible except for necessary travel), which have been strongly recommended for those with chronic conditions including cancer survivors. Consistent with other studies (Islam et al., 2020; Miaskowski et al., 2021a), the vast majority of our participants reported following these recommendations. This could be due to cancer survivors' perception that they had a higher likelihood of having more severe COVID-19 infection, as suggested by our findings, or that most individuals lived in urban areas, which are associated with higher adoption of COVID-19-related risk mitigation behaviors (Callaghan et al., 2021). Greater adherence to risk mitigation behaviors was also associated with loneliness among our cancer survivors, similar to previous research (Tull et al., 2020), suggesting that mitigation measures such as stay-at-home policies and social distancing may have led to increased social isolation as noted earlier; however, it wasn't a key determinant of loneliness (Leigh-Hunt et al., 2017; Miaskowski et al., 2021b; Smith & Lim, 2020).

Pandemic-related stress and social isolation have also been associated with unhealthy lifestyle factors (McGinty et al., 2020; Stanton et al., 2020). These unhealthy lifestyle behaviors may lead to increased loneliness (Eastman et al., 2021; Malcolm et al., 2019), although there could be bi-directional relationships. For instance, a recent study showed that mental health symptomatology such as loneliness, anxiety, and depression were associated with increased alcohol consumption since the onset of the pandemic (Eastman et al.,

Table 3 COVID-19 risk mitigation measures and perceptions, lifestyle factors, and psychosocial stressors by loneliness

	Lonely cancer survivors N = 488 (33.2%)	Non-lonely cancer survivors N = 983 (66.8%)	*P*-value
COVID-19 risk mitigation measures and perceptions			
Leaving house for routine errands, n (%)			
Never or almost never	141 (28.9%)	191 (19.4%)	< 0.001
Sometimes	251 (51.4%)	472 (48.0%)	
Fairly often or very often	96 (19.7%)	320 (32.6%)	
Practicing social distancing, n (%)[a]			
Never or almost never	12 (2.6%)	24 (2.6%)	0.001
Sometimes	14 (3.0%)	79 (8.4%)	
Fairly often or very often	435 (94.4%)	833 (89.0%)	
Regular face mask use, n (%)[a]			
Never or almost never	8 (1.8%)	19 (2.2%)	0.03
Sometimes	19 (4.3%)	71 (8.1%)	
Fairly often or very often	418 (93.9%)	782 (89.7%)	
Regular hand sanitizer use, n (%)[a]			
Never or almost never	12 (2.7%)	53 (6.1%)	0.001
Sometimes	36 (8.1%)	112 (12.8%)	
Fairly often or very often	396 (89.2%)	708 (81.1%)	
Total risk mitigation score, mean ± SD[a]	17.2 ± 2.0	16.3 ± 2.5	< 0.001
Perceived likelihood of contracting COVID-19, n (%)[a]			
Somewhat or very unlikely	228 (48.8%)	511 (54.1%)	0.09
Neither unlikely or likely	131 (28.1%)	258 (27.3%)	
Somewhat or very likely	108 (23.1%)	176 (18.6%)	
Perceived severity of COVID-19 infection, n (%)[a]			
Not at all serious	42 (8.8%)	125 (12.9%)	< 0.001
Somewhat serious	175 (36.5%)	431 (44.6%)	
Very serious	263 (54.8%)	411 (42.5%)	
Lifestyle factors			
BMI (kg/m^2), mean ± SD[a]	28.3 ± 6.9	27.9 ± 5.8	0.38
Current smoking status, n (%)[a]			
Never	341 (70.5%)	712 (73.3%)	0.17
Former	127 (26.2%)	241 (24.8%)	
Current	16 (3.3%)	18 (1.9%)	
Alcohol consumption in past year, n (%)[a]			
Never	223 (50.2%)	462 (52.9%)	0.03
Less than once a month	66 (14.9%)	84 (9.6%)	
Once a month to twice a week	86 (19.4%)	165 (18.9%)	
3–4 times a week to every day	69 (15.5%)	162 (18.6%)	
Change in alcohol consumption habits since COVID-19 pandemic, n (%)[a]			
No	351 (84.2%)	758 (91.9%)	< 0.001
Yes, increased drinking	45 (10.8%)	23 (2.8%)	
Yes, decreased drinking	21 (5.0%)	44 (5.3%)	
Marijuana/CBD oil use in past month, n (%)[a]			
No or not sure	387 (79.5%)	879 (89.7%)	< 0.001
Yes	100 (20.5%)	101 (10.3%)	
Change in marijuana/CBD oil use since COVID-19 pandemic, n (%)[ab]			
No, using the same amount compared to before	58 (65.9%)	67 (82.7%)	0.04
Yes, used more compared to before	22 (25.0%)	9 (11.1%)	
Yes, used less compared to before	8 (9.1%)	5 (6.2%)	

Table 3 (continued)

	Lonely cancer survivors N = 488 (33.2%)	Non-lonely cancer survivors N = 983 (66.8%)	*P*-value
Change in exercise habits since pandemic, n (%)[a]			
No	208 (42.6%)	566 (57.7%)	< 0.001
Yes	280 (57.4%)	415 (42.3%)	
Do not exercise regularly, n (%)[ac]			
No	193 (73.9%)	323 (82.4%)	0.01
Yes	68 (26.1%)	69 (17.6%)	
Exercise less, ***n (%)***[ac]			
No	152 (54.3%)	220 (53.0%)	0.74
Yes	128 (45.7%)	195 (47.0%)	
Exercise more, ***n (%)***[ac]			
No	223 (79.6%)	324 (78.1%)	0.62
Yes	57 (20.4%)	91 (21.9%)	
Exercising in a different location than normal, n (%)[ac]			
No	224 (80.0%)	306 (73.7%)	0.06
Yes	56 (20.0%)	109 (26.3%)	
Psychosocial stressors			
Change in daily life due to pandemic, n (%)[a]			
Not at all or a little bit	48 (9.8%)	213 (21.7%)	< 0.001
Somewhat	86 (17.6%)	234 (23.8%)	
A moderate amount or a lot	354 (72.5%)	535 (54.5%)	
Change in social interaction in past month, n (%)[a]			
I have little or much less social interaction	394 (80.9%)	615 (62.6%)	< 0.001
My social interaction has not changed much	68 (14.0%)	308 (31.4%)	
I have little or much more social interaction	25 (5.1%)	59 (6.0%)	
Difficulties piling up that could not be overcome (perceived stress) in past month, n (%)[a]			
Never or almost never	236 (48.4%)	845 (86.2%)	< 0.001
Sometimes	165 (33.8%)	115 (11.7%)	
Fairly often or often	87 (17.8%)	20 (2.0%)	
Financially stressed in past month, n (%)[a]			
Not at all or a little bit	310 (63.5%)	869 (88.5%)	< 0.001
Somewhat	68 (13.9%)	69 (7.0%)	
Quite a bit or very much	110 (22.5%)	44 (4.5%)	

Note Data might not add to 100% because of rounding

SD standard deviation; *BMI* Body Mass Index

[a]Missing values due to non-response or skip patterns not shown [practicing social distancing: n = 74 (5.0%); regular face mask use: n = 154 (10.5%); regular hand sanitizer use: n = 154 (10.5%); total risk mitigation score: n = 229 (15.6%); perceived likelihood of contracting COVID-19: n = 3 (0.2%); perceived severity of COVID-19 infection: n = 3 (0.2%); BMI: n = 35 (2.4%); current smoking status: n = 16 (1.1%); alcohol consumption in past year: n = 154 (10.5%); change in alcohol consumption habits since COVID-19 pandemic: n = 229 (15.6%); marijuana/CBD oil use in past month: n = 4 (0.3%); change in marijuana/CBD oil use since COVID-19 pandemic: n = 32 (15.9%); change in exercise habits since pandemic: n = 2 (0.1%); do not exercise regularly: n = 42 (6.0%); change in daily life due to pandemic: n = 1 (0.1%); change in social interaction in past month: n = 2 (0.1%); difficulties piling up that could not be overcome (perceived stress) in past month: n = 3 (0.2%); financially stressed in past month: n = 1 (0.1%)]

[b]Among responders who reported Marijuana/CBD oil use in past month

[c]Among responders who reported change in exercise habits since pandemic

2021). We also observed that increased alcohol consumption during the pandemic and marijuana/CBD oil use were associated with loneliness among cancer survivors. Marijuana became legal for medical use in Utah in 2018. With the legalization of marijuana use in recent years there has been a dramatic increase in its consumption, both recreationally and medically (Martins et al., 2016, 2021), although there is limited understanding of its potential benefits or risks especially among cancer survivors. In our study, we observed that a significant proportion (14%) of all patients

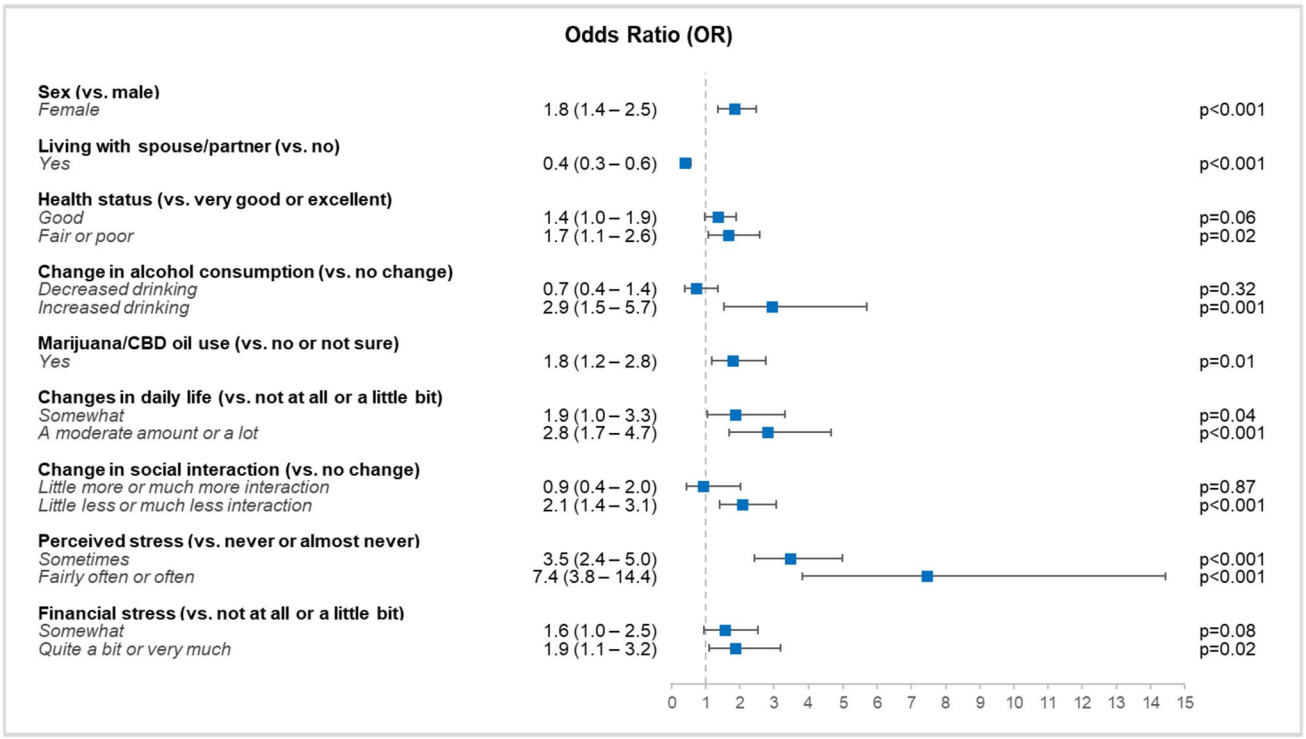

Fig. 1 Associations of loneliness with clinicodemographic, health characteristics, COVID-19 risk mitigation measures, lifestyle factors, and psychosocial stressors among cancer survivors. Blue boxes indicate odds ratio (OR) point estimates and black horizontal lines represent 95% confidence intervals (CI)

reported marijuana/CBD oil use, with modest increases as a result of the pandemic, particularly among lonely cancer survivors. This is in line with recent research showing that loneliness is associated with stress-related harmful coping behaviors such as problematic substance use (Gutkind et al., 2022; Ingram et al., 2020). Among cancer survivors, a higher proportion were reported to have used cannabis for medical reason during the pandemic, possibly as an attempt to manage their symptom burden independently, since the pandemic caused major disruptions in medical care (Sarkar et al., 2023). Although increased substance use may be part of coping mechanisms for pandemic-related stress and negative feelings of being lonely (Galea et al., 2020), it may result in poor health outcomes particularly among cancer survivors (Rodriguez et al., 2020), warranting the promotion of healthy behaviors and alternative coping strategies.

We also observed that a higher proportion of lonely cancer survivors did not exercise regularly, consistent with previous findings (Schrempft et al., 2019), although it wasn't a key determinant of loneliness. Since there is strong evidence that physical activity is related to improved QoL and lower mortality among cancer survivors (Brown & Gilmore, 2020; Cormie et al., 2017; Friedenreich et al., 2017), a reduction in physical activity potentially due to pandemic-related stay-at-home policies, self-isolation, or closure of gyms (Martinez-Ferran et al., 2020; Narici et al., 2020) would be especially concerning. Additionally, a recent study suggested that individuals who remained active or increased their activity levels during the pandemic were better equipped to cope with pandemic-related stress and maintain their mental well-being (Marashi et al., 2021).

In the context of psychosocial stressors, more disruptions in daily life and increased perceived stress and financial stress were associated with being lonely in cancer survivors in our study. The pandemic has resulted in increased levels of stress, anxiety, and financial hardship due to loss of employment, income, or health insurance (Baddour et al., 2020; Nekhlyudov et al., 2020). Moreover, COVID-19 risk mitigation strategies have reduced the ability to cope with underlying mental health conditions. A recent study showed that anxiety and depression were associated with loneliness in the general population, although in multidirectional relationship (McDowell et al., 2021). Our findings also have implications for cancer care as loneliness and depression can be barriers to successful cancer treatment compliance and may result in lower survival (Brower, 2014).

Overall, our findings helped to identify cancer survivors at an increased risk for loneliness during the COVID-19 pandemic, which may enable targeted interventions. Since cancer survivors face multiple isolating experiences with cancer

diagnosis and its treatment (Boland et al., 2018) and the number of survivors is projected to increase, due to improvements in early detection and treatment (American Cancer Society, 2022), the impact of loneliness on health outcomes and well-being among cancer survivors is likely to be substantial. Thus, our findings further highlight the importance of accounting for loneliness in the routine screening of cancer survivors beyond the pandemic. For example, clinicians could screen their patients, focusing on key factors for loneliness, such as poor health, unhealthy lifestyle, and increased psychosocial stressors, and make referrals for appropriate social support resources for high-risk groups. Therapeutic interventions, such as telehealth-based support programs and cognitive-behavioral therapy, which can be delivered via video conferencing, have shown effectiveness in reducing social isolation (Andrews et al., 2018; Smith & Lim, 2020; van der Krieke et al., 2014) and have gained prominence post-COVID-19 pandemic (Smith & Lim, 2020) and thus, could be valuable resource for those at high risk of loneliness. Targeted interventions may not only reduce the impact of loneliness on negative health consequences such as morbidity and mortality, but also improve quality of life for patients with cancer (National Academies of Sciences & Medicine, 2020; Poscia et al., 2018) even outside the context of the COVID-19 pandemic.

This study has many strengths, including a large, well-characterized sample from a comprehensive cancer center, broad assessments of health behaviors, and data from medical records. However, our findings may not be generalizable to those with different racial and ethnic backgrounds or those from other states who may have had different COVID-19 state-wide policies, since the majority of our participants were non-Hispanic/Latino White, had health insurance, and were from Utah. Additionally, survey non-response may have further resulted in decreased racial/ethnic diversity. Nonetheless, our study population included a significant proportion of rural residents making the results more applicable for other states with similar urban–rural proportions especially in the context of rural cancer disparities. Since racial/ethnic disparities may be associated with COVID-19 pandemic, future longitudinal studies need to evaluate these social determinants of health particularly among lonely cancer survivors. To reduce participant burden, loneliness was assessed with a single-item measure, which may result in underreporting due to the stigma associated with being identified as lonely (Kotwal et al., 2022). However, a single-item brief loneliness screen has been extensively used in large-scale, population-based studies and is considered valid and may add value to the clinical encounter (Salinas et al., 2022). This research was conducted under the challenging conditions of a highly disruptive worldwide pandemic, limiting the ability to perform extensive assessments. Nevertheless, we succeeded in obtaining information from N = 1471 cancer survivors during a critical time frame. Future work should also include a multidimensional instrument to provide deeper insight into the multifaceted aspects of loneliness, such as emotional and social loneliness, and include longitudinal assessments to better understand the changes in loneliness over the cancer survivorship continuum especially in the context of the evolving pandemic or other stressful life events such as natural disasters. Additionally, information on other mental health indices, such as emotional state, anxiety, and depression, weren't assessed in order to reduce participant burden. Future studies should also include these additional determinants of mental health, besides loneliness, to have a better understanding of overall mental health status among cancer survivors. Given the cross-sectional study design and that some associations may have bidirectional relationships, no causal inferences can be reached.

Conclusion

Our findings showed that loneliness is a significant problem among cancer survivors, a vulnerable population that are susceptible to the negative consequences of the COVID-19 pandemic. Factors including female sex, lacking a spouse/partner, poor health, unhealthy lifestyle factors, reduced social interactions, and increased psychosocial stressors (e.g., financial stress) were key determinants of loneliness. Given the negative and long-term impact of loneliness on health outcomes, particularly mental health problems, the COVID-19 pandemic has further underscored the significance of loneliness among cancer survivors. These results highlight the need to screen for cancer survivors at elevated risk of loneliness especially in the context of stressful life events such as pandemics or natural disasters, as well as to develop appropriate multilevel psychosocial programs that target loneliness through modifiable risk factors and address simultaneously occurring concerns to improve overall well-being and enhance long-term prognosis.

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Data Availability The data presented in this study are available in this article. Restrictions apply to the availability of supporting data to protect the privacy of participants.

Declarations

Conflicts of Interest Dr. Ulrich has as HCI Cancer Center Director oversight over research funded by several pharmaceutical companies but has not received funding directly herself. Dr. Tward has served on an advisory board and consulted for Myriad Genetics, Inc., Decipher Biosciences, and Boston Scientific; he has received research funding from Bayer for work outside of the present manuscript. Dr. Colman has served on advisory boards and consulted for Best Doctors/Teladoc, Orbus Therapeutics, Adastra Pharmaceuticals, and Bristol Myers Squibbs. Dr. Lee has served on advisory boards and/or consulted for Jazz Pharmaceuticals, Kite Pharma, Kadmon Corporation. Fresenius Kabi, and CareDx; she has received research funding from Incyte for work outside of the present manuscript. Dr. Islam has received consulting fees from Flatiron Health as a member of the COVID-19 and Cancer Advisory Board. Dr. Gonzalez has served on an advisory board for Elly Health, Inc. and previously consulted for SureMed Compliance, neither of which is relevant to this manuscript. Other authors declare that they have no conflict of interest.

Ethical Approval Ethics approval was provided by the institutional review board of the University of Utah.

Consent to Participate All participants provided written informed consent.

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Authors and Affiliations

Elena S. Aßmann[1,2] · Jennifer Ose[1,3] · Cassandra A. Hathaway[4] · Laura B. Oswald[5] · Sheetal Hardikar[1,3] · Caroline Himbert[1,3] · Vimalkumar Chellam[1] · Tengda Lin[1,3] · Bailee Daniels[1] · Anne C. Kirchhoff[1,6] · Biljana Gigic[7] · Douglas Grossman[1,8] · Jonathan Tward[1,9] · Thomas K. Varghese Jr.[1,10] · David Shibata[11] · Jane C. Figueiredo[12] · Adetunji T. Toriola[13] · Anna Beck[1,14] · Courtney Scaife[1,10] · Christopher A. Barnes[1,15] · Cindy Matsen[1,10] · Debra S. Ma[1] · Howard Colman[1,16] · Jason P. Hunt[1,10] · Kevin B. Jones[1,17] · Catherine J. Lee[1,18] · Mikaela Larson[1] · Tracy Onega[1,3] · Wallace L. Akerley[1,14] · Christopher I. Li[19] · William M. Grady[19] · Martin Schneider[7] · Andreas Dinkel[20] · Jessica Y. Islam[4] · Brian D. Gonzalez[5] · Amy K. Otto[21,22] · Frank J. Penedo[21,23] · Erin M. Siegel[4] · Shelley S. Tworoger[4] · Cornelia M. Ulrich[1,3] · Anita R. Peoples[1,3]

✉ Cornelia M. Ulrich
neli.ulrich@hci.utah.edu

✉ Anita R. Peoples
anita.peoples@hci.utah.edu

1 Huntsman Cancer Institute, Salt Lake City, UT, USA

2 School of Medicine, Technical University of Munich, Munich, Germany

3 Department of Population Health Sciences, University of Utah, Salt Lake City, UT, USA

4 Department of Cancer Epidemiology, Division of Population Science, H. Lee Moffitt Cancer Center and Research Institute, Tampa, FL, USA

5 Department of Health Outcomes and Behavior, Division of Population Science, H. Lee Moffitt Cancer Center and Research Institute, Tampa, FL, USA

6 Department of Pediatrics, Division of Hematology/Oncology, University of Utah School of Medicine, Salt Lake City, UT, USA

7 Heidelberg University Hospital, Heidelberg, Germany

8 Department of Dermatology, University of Utah, Salt Lake City, UT, USA

9 Department of Radiation Oncology, University of Utah, Salt Lake City, UT, USA

10 Department of Surgery, University of Utah, Salt Lake City, UT, USA

11 Department of Surgery, University of Tennessee Health Science Center, Memphis, TN, USA

12 Department of Medicine, Cedars-Sinai Medical Center, Samuel Oschin Comprehensive Cancer Institute, Los Angeles, CA, USA

13 Washington University School of Medicine in St. Louis, St. Louis, MO, USA

14 Department of Internal Medicine, University of Utah, Salt Lake City, UT, USA

15 Department of Physical Therapy and Athletic Training, University of Utah, Salt Lake City, UT, USA

16 Department of Neurosurgery, University of Utah, Salt Lake City, UT, USA

17 Department of Orthopedics, University of Utah, Salt Lake City, UT, USA

18 Transplant and Cellular Therapy Program, Huntsman Cancer Institute, University of Utah, Salt Lake City, UT, USA

19 Fred Hutchinson Cancer Center, Seattle, WA, USA

20 Department of Psychosomatic Medicine and Psychotherapy, Klinikum rechts der Isar, Technical University of Munich, Munich, Germany

21 Sylvester Comprehensive Cancer Center, Miami, FL, USA

22 Department of Public Health Sciences, University of Miami, Coral Gables, FL, USA

23 Departments of Psychology and Medicine, University of Miami, Coral Gables, FL, USA