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Impact of the COVID-19 pandemic on rural and urban cancer patients' experiences, health behaviors, and perceptions

Anita R. Peoples PhD[1,2] | Laura B. Oswald PhD[3] | Jennifer Ose PhD[1,2] | Bailee Daniels BS[1] | Caroline Himbert BS[1,2] | Cassandra A. Hathaway MPH[3] | Biljana Gigic PhD[4] | Anne C. Kirchhoff PhD[1,5] | Tengda Lin MPH, MA[1] | Douglas Grossman MD, PhD[1,6] | Jonathan Tward MD, PhD[1,7] | Thomas K. Varghese Jr. MD[1,8] | Jane C. Figueiredo PhD[9] | Adetunji T. Toriola MD, PhD[10] | Anna Beck MD[1,11] | Courtney Scaife MD[1,8] | David Shibata MD[12] | Paul LaStayo PhD[1,13] | Brian Gonzalez PhD[3] | Karen Salas BA[1] | Anjelica Ashworth BS[1] | Cindy Matsen MD[1,8] | Cristina Christenson MPH[1] | Debra S. Ma MBA[1] | Howard Colman MD, PhD[1,14] | Jason P. Hunt MD[1,8] | Kevin B. Jones MD[1,15] | Catherine J. Lee MD[1,11] | Mikaela Larson BS[1] | Tracy Onega PhD[1,2] | Wallace L. Akerley MD[1,11] | Christopher I. Li MD, PhD[16] | Martin Schneider MD[4] | Frank J. Penedo PhD[17,18] | Erin M. Siegel PhD[3,#] | Shelley S. Tworoger PhD[3,#] | Cornelia M. Ulrich PhD[1,2,#]

[1] Huntsman Cancer Institute, Salt Lake City, Utah, USA

[2] Department of Population Health Sciences, University of Utah, Salt Lake City, Utah, USA

[3] Department of Cancer Epidemiology, Division of Population Science, H. Lee Moffitt Cancer Center & Research Institute, Tampa, Florida, USA

[4] Heidelberg University Hospital, Heidelberg, Germany

[5] Department of Pediatrics, Division of Hematology/Oncology, University of Utah School of Medicine, Salt Lake City, Utah, USA

[6] Department of Dermatology, University of Utah, Salt Lake City, Utah, USA

[7] Department of Radiation Oncology, University of Utah, Salt Lake City, Utah, USA

[8] Department of Surgery, University of Utah, Salt Lake City, Utah, USA

[9] Department of Medicine, Samuel Oschin Comprehensive Cancer Institute, Cedars-Sinai Medical Center, Los Angeles, California, USA

[10] Washington University School of Medicine in St. Louis, St. Louis, Missouri, USA

[11] Department of Internal Medicine, University of Utah, Salt Lake City, Utah, USA

[12] University of Tennessee Health Science Center, Memphis, Tennessee, USA

[13] Department of Physical Therapy and Athletic Training, University of Utah, Salt Lake City, Utah, USA

[14] Department of Neurosurgery, University of Utah, Salt Lake City, Utah, USA

[15] Department of Orthopedics, University of Utah, Salt Lake City, Utah, USA

[16] Fred Hutchinson Cancer Research Center, Seattle, Washington, USA

[17] Sylvester Comprehensive Cancer Center, Miami, Florida, USA

[18] Departments of Psychology and Medicine, University of Miami, Coral Gables, Florida, USA

Correspondence
Anita R. Peoples and Cornelia M. Ulrich, Huntsman Cancer Institute, University of Utah, 2000 Circle of Hope Drive, Salt Lake City, UT 84112, USA.
Email: anita.peoples@hci.utah.edu; neli.ulrich@hci.utah.edu

[#]These authors contributed equally.

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Abstract

Purpose: The COVID-19 pandemic has disrupted many facets of life. We evaluated pandemic-related health care experiences, COVID-19 prevention behaviors and measures, health behaviors, and psychosocial outcomes among rural and urban cancer patients.

Methods: Among 1,472 adult cancer patients, who visited Huntsman Cancer Institute in the past 4 years and completed a COVID-19 survey (August-September 2020), we assessed the impact of the pandemic on medical appointments, prevention/health behaviors, and psychosocial factors, stratified by urbanicity.

Findings: Mean age was 61 years, with 52% female, 97% non-Hispanic White, and 27% were residing in rural areas. Rural versus urban patients were more likely to be older, not employed, uninsured, former/current smokers, consume alcohol, and have pandemic-related changes/cancellations in surgery appointments (all $P<.05$). Changes/cancellations in other health care access (eg, doctor's visits) were also common, particularly among urban patients. Urban versus rural patients were more likely to socially distance, use masks and hand sanitizer, and experience changes in exercise habits and in their daily lives (all $P<.05$). Less social interaction and financial stress were common among cancer patients but did not differ by urbanicity.

Conclusions: These findings suggest that the COVID-19 pandemic had a substantial impact on cancer patients, with several challenges specific to rural patients. This comprehensive study provides unique insights into the first 6 months of COVID-19 pandemic-related experiences and continuity of care among rural and urban cancer patients predominantly from Utah. Further research is needed to better characterize the pandemic's short- and long-term effects on rural and urban cancer patients and appropriate interventions.

KEYWORDS
cancer, COVID-19, exercise habits, financial stress, health care delivery

The COVID-19 pandemic is one of the most disruptive global events in our recent history. Virtually, all areas of daily life have been impacted, including access to medical care, health behaviors, and socioeconomic stability.[1–4] Patients with cancer, especially those undergoing active treatment, are at higher risk of contracting COVID-19 and having more severe disease.[5–8] Cancer patients may also be more susceptible to the negative repercussions of the pandemic because of their dependence on the medical system for care, and elevated risk for financial toxicity and distress.[9–14] For example, delays or deferral of cancer-related and other health care may negatively impact health outcomes and increase patient anxiety.[9–12,14] COVID-19 preventive behaviors, including stay-at-home policies, social distancing, and mask-wearing to lower infection risk, may increase social isolation of cancer patients and survivors.[12]

Rurality may also influence cancer patients' experiences during the COVID-19 pandemic. Research has documented disparities between cancer patients residing in rural versus urban areas, such that rural cancer patients have less access to health care, poor health status, unhealthy lifestyle factors, and worse clinical outcomes.[15,16] Rural communities may also be particularly vulnerable to the pandemic's economic and psychosocial impacts, and, thus, require different recovery plans than those for urban areas.[17] It also remains unclear whether recommended health behaviors in cancer patients, such as physical activity,[18–21] may be reduced,[22,23] and whether shifts in such behaviors may disproportionately occur between rural and urban residences.[24] Overall, rural cancer patients and survivors may be at greater risk for adverse outcomes during the COVID-19 pandemic.

In response to the COVID-19 pandemic, our team established the COVID-19 and Oncology Patient Experience Study (COPES) consortium among 3 NCI-designated Cancer Centers: University of Utah Huntsman Cancer Institute (HCI), University of Miami Sylvester Comprehensive Cancer Center, and Moffitt Cancer Center. COPES consortium's goal is to longitudinally assess COVID-19 experiences (eg, perceptions, symptoms, exposures, infection, and risk-mitigation behaviors), health behaviors, health care access and use, psychosocial factors, and quality of life among cancer patients and healthy

participants. In this paper, we leveraged data from the COPES survey at HCI to describe the short-term effects of the COVID-19 pandemic on cancer patients, and we explored differences by patients' urbanicity.

METHODS

Study design and participant selection

The University of Utah Institutional Review Board approved this protocol, and all participants provided written informed consent. Participants included in the present analysis were adult cancer patients 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),[25–27] and completed a COVID-19 survey between August and September 2020 either electronically, in person/via mail (paper-based questionnaire), or over the phone. Briefly, the TCC study is an observational study and eligible participants include men and women, aged 18 years or older, with any cancer diagnosis, benign tumors, or healthy controls.[25] The ColoCare Study is a multicenter, prospective cohort of adult men and women, ages 18-89, with newly diagnosed colorectal cancer (stages I-IV).[26] The PEP study is a randomized controlled trial in lung cancer patients (any stage), over 18 years old, and undergoing surgery.[27]

Survey administration

Eligible participants were invited to complete the COVID-19 survey between August and September 2020 via email. The survey was completed online using the Research Electronic Data Capture (REDCap) system.[28] For nonresponders to email or those participants who did not have an email available, we provided a paper-based survey via mail or at patient's clinic visit or conducted the survey over phone, based on participant preference. The participants were sent up to 3 automated reminders via email or contacted over phone over a period of 1 month to complete the survey. The COVID-19 survey response rates for TCC, PEP, and ColoCare studies ranged from 14% to 57%.

Measures

Demographic, clinical, and behavioral characteristics

Sociodemographic and clinical characteristics, namely, age, sex, race, ethnicity, tumor site, and tumor stage, were abstracted from electronic medical records. Participants reported their body-mass-index (BMI; if self-reported BMI was missing, it was abstracted from medical records), current cancer treatments, and employment, insurance, and living status. A measure of health status was adapted from the 12-item Short-Form Health Survey quality-of-life (QoL) measure.[29] Urbanicity was computed from self-reported zip codes (if self-reported zip code was missing, it was abstracted from medical records) and the Rural-Urban Commuting Area Codes (RUCA) classification system;[30] zip codes with ≥30% of workers going to a Census Bureau-defined Urbanized Area were coded as urban (RUCA codes: 1.0, 1.1, 2.0, 2.1, 3.0, 4.1, 5.1, 7.1, 8.1, and 10.1), while the remaining zip codes as rural (RUCA codes: 4.0, 4.2, 5.0, 5.2, 6.0, 6.1, 7.0, 7.2, 7.3, 7.4, 8.0, 8.2, 8.3, 8.4, 9.0, 9.1, 9.2, 10.0, 10.2, 10.3, 10.4, 10.5, and 10.6).

Health care experiences

Adapted items from an American Cancer Society survey[31] captured self-reported changes in participants' cancer-related health care, other health care, and use of telemedicine.

COVID-19 risk-mitigation measures and perceptions

Participants indicated how often they engaged in COVID-19 risk-mitigation behaviors, such as "leaving house for routine errands," "social distancing (ie, staying ~6 feet away from anyone who is not living in your household)," and "use of face masks and hand sanitizer." Items were assessed on a 5-point scale from 1 (never) to 5 (very often). Patients' perceived likelihood of contracting COVID-19 was assessed on a 5-point scale from 1 (very unlikely) to 5 (very likely).

Health behaviors

Participants reported their current/recent smoking status (if self-reported ever smoking status, ie, at least 100 cigarettes in their lifetime was missing, it was abstracted from medical records), alcohol consumption, and marijuana and/or CBD oil use. They also reported changes in the use of these products, and engaging in exercise since the pandemic started.

Psychosocial factors

Participants reported changes in daily life and financial stress on a Likert scale from 1 (not at all) to 5 (a lot/very much).[32] Participants rated changes in social interaction on a scale from 1 (much less social interaction) to 5 (a lot more social interaction). Difficulties that could not be overcome (taken from the Perceived Stress Scale)[33,34] and feeling lonely were assessed on a scale: 1 (never) to 5 (often/always).

Statistical analyses

Descriptive statistics (means + standard deviations or %) were performed for all variables of interest. *T*-tests for continuous variables and χ-square tests for categorical variables were used to determine statistically significant differences ($P<.05$) between urban

and rural areas. Statistical analyses were performed using SPSS version 27.

RESULTS

Patient characteristics

A total of 1,472 cancer patients completed the survey, with 96% completed the online version, while only 4% completed the paper-based questionnaire and <1% over the phone. Briefly, the mean age was 61 years (range 20-92) and 52% were females. Participants were predominantly non-Hispanic/Latino White. Most were diagnosed with cancer stage I-III (81%) and fell within the overweight-obese range, with the average BMI being 28.1 kg/m^2. Most participants were from Utah (71%), and 27% from rural areas (Table 1).

Patients from rural versus urban areas were more likely to be older (63 vs 60 years; $P = .002$), American Indian/Alaska Native (3% vs 0.1%; $P<.001$), not employed (65% vs 56%; $P = .01$), without health insurance (3% vs 1.4%; $P = .02$), and on Medicare (57% vs 44%; $P<.001$). Among those who were not currently employed, 3% of urban and rural patients lost their occupation due to the pandemic, while 77% of rural and 70% of urban patients were retired ($P = .08$). Rural patients were also less likely to complete electronic surveys as compared to urban patients (93% vs 97%; $P<.001$). Only 12% of rural and 10% of urban patients were living alone, while a higher proportion of urban versus rural patients were living with family members (27% vs 19%; $P = .004$). Across groups, the majority (>80%) reported "good" to "excellent" health.

Health care experiences

Nearly 1 in 3 patients reported currently receiving treatment at HCI (Table 2). Due to the pandemic, almost one-third of both urban and rural patients had a medical appointment changed or cancelled, and the most commonly affected appointments were doctors' visits (80%) followed by imaging (19%), bloodwork (17%), and cancer screenings or biopsies (14%), while appointments for chemotherapy (3%) and radiation therapy (1%) were minimally affected; with no differences between the 2 groups (Figure 1). Although surgery appointments were also minimally affected for all patients (4%), rural versus urban patients were more likely to report a change or cancellation (7% vs 3%; $P = .03$). Further, 25% of rural while 17% of urban patients had their imaging appointments affected ($P = .05$). Overall, nearly two-thirds of patients changed an in-person visit to a telemedicine visit.

COVID-19 risk-mitigation measures and perceptions

Since the pandemic started, 27% of urban and 33% of rural patients reported leaving their house to run routine errands "fairly often" or "very often" ($P = .32$; Table 3). Although the majority (>80%) practiced COVID-19 risk-mitigation behaviors "fairly/very often," urban versus rural patients were more likely to practice social distancing (93% vs 85%; $P<.001$), wear face masks (94% vs 83%; $P<.001$), and use hand sanitizer (85% vs 81%; $P = .01$; Figure 1). Twenty-two percent of urban patients while 16% of rural patients also felt they were "somewhat" to "very" likely to contract COVID-19 ($P = .14$).

Health behaviors

While the majority of patients (72%) were never smokers, rural versus urban patients were more likely to be current (4% vs 2%) or former smokers (34% vs 22%; $P<.001$; Table 4). Rural patients were more likely to consume alcohol regularly in the past year than urban patients (25% vs 15%; $P<.001$), with relatively small increases (6%) or decreases (5%) in alcohol consumption due to the pandemic in both groups. About 14% of all patients reported using marijuana and/or CBD oil in the past month, of which urban versus rural patients were more likely to report an increased marijuana/CBD oil use since the pandemic started (22% vs 10%; $P = .049$), while rural versus urban patients more likely to decrease the use (14% vs 5%; $P = .049$).

Changes in exercise habits due to the pandemic were more commonly reported by urban versus rural patients (52% vs 36%; $P<.001$; Table 4). Of those who reported a change, 46% of both urban and rural patients exercised less, 21% exercised more, and 21% did not exercise regularly, with no differences by urbanicity.

Psychosocial factors

Most patients experienced "somewhat" to "a lot" of change in their daily lives due to the pandemic, with urban versus rural patients being more likely to report "a lot" of change in daily life (35% vs 23%; $P<.001$; Table 5; Figure 1). No significant differences were observed between urban and rural patients regarding social interaction, feelings of loneliness, difficulties piling up, or financial stress (all $P>.70$).

DISCUSSION

To our knowledge, this is the first report using a large cohort to describe the effects of the COVID-19 pandemic on rural and urban cancer patients. We observed that rural versus urban patients were more likely to be older, not employed, uninsured, and have unhealthy behaviors (eg, smoking), consistent with prior research.[35] Rural versus urban patients were also more likely to report a change or cancellation for surgery and imaging services due to the pandemic. Conversely, urban versus rural patients were more likely to follow COVID-19 risk-mitigation behaviors and experience changes in exercise habits and their daily lives. Most other factors, including a change or cancellation of doctor's visits, changes in health behaviors, as well as psychosocial changes (eg, loneliness) due to the pandemic were similar across the 2 populations.

TABLE 1 Characteristics of the study population

Characteristics	Total (N = 1,472)	Urban (N = 1,078)	Rural (N = 394)	*P*-value
Age				
Mean (SD)	61.1 (13.4)	60.4 (13.6)	62.9 (12.8)	.002
Range	20-92	20-92	22-86	
Sex, n (%)				
Male	701 (47.6%)	513 (47.6%)	188 (47.7%)	.97
Female	771 (52.4%)	565 (52.4%)	206 (52.3%)	
Race, n (%)[a]				
White	1,404 (97.3%)	1,030 (97.5%)	374 (96.6%)	<.001
Asian	13 (0.9%)	13 (1.2%)	0 (0%)	
American Indian or Alaska Native	12 (0.8%)	1 (0.1%)	11 (2.8%)	
Other	14 (1.0%)	12 (1.1%)	2 (0.5%)	
Ethnicity, n (%)[a]				
Hispanic/Latino	53 (3.9%)	39 (3.9%)	14 (3.8%)	.94
Non-Hispanic/Latino	1,323 (96.1%)	967 (96.1%)	356 (96.2%)	
BMI (kg/m^2)[a]				
Mean (SD)	28.1 (6.2)	28.1 (6.4)	27.9 (5.7)	.50
Tumor stage, n (%)[a]				
In situ	31 (2.8%)	23 (3.0%)	8 (2.5%)	.08
I	393 (36.0%)	288 (37.2%)	105 (33.0%)	
II	267 (24.4%)	190 (24.5%)	77 (24.2%)	
III	230 (21.0%)	146 (18.8%)	84 (26.4%)	
IV	172 (15.7%)	128 (16.5%)	44 (13.8%)	
Tumor site, n (%)[a]				
Breast	202 (14.5%)	149 (14.7%)	53 (14.0%)	<.001
GI tract	194 (14.0%)	118 (11.7%)	76 (20.1%)	
Lung	110 (7.9%)	69 (6.8%)	41 (10.8%)	
Hematologic neoplasms	245 (17.6%)	193 (19.1%)	52 (13.8%)	
Melanoma	82 (5.9%)	60 (5.9%)	22 (5.8%)	
Prostate	184 (13.2%)	127 (12.5%)	57 (15.1%)	
Other	373 (26.8%)	296 (29.2%)	77 (20.4%)	
Survey modality, n (%)				
Electronic survey	1,408 (95.7%)	1,043 (96.8%)	365 (92.6%)	<.001
Paper-based survey	60 (4.1%)	31 (2.9%)	29 (7.4%)	
Phone survey	4 (0.3%)	4 (0.4%)	0 (0%)	
Employment status, n (%)[a]				
Employed full time	498 (33.9%)	385 (35.8%)	113 (28.7%)	.01
Employed part time	120 (8.2%)	93 (8.6%)	27 (6.9%)	
Not currently employed	852 (58.0%)	598 (55.6%)	254 (64.5%)	
Not currently employed, n (%)[a,b]				
Retired	613 (71.9%)	418 (69.9%)	195 (76.8%)	.08
Lost job due to COVID-19	21 (2.5%)	14 (2.3%)	7 (2.8%)	
Other reasons	218 (25.6%)	166 (27.8%)	52 (20.5%)	
Heath insurance status, n (%)[a]				
Yes, any health insurance	1,440 (98.1%)	1,059 (98.6%)	381 (96.7%)	.02

(Continues)

TABLE 1 (Continued)

Characteristics	Total (N = 1,472)	Urban (N = 1,078)	Rural (N = 394)	*P*-value
No	28 (1.9%)	15 (1.4%)	13 (3.3%)	
Health insurance type, n (%)[a,c,d]				
Employer-provided	704 (48.9%)	552 (52.1%)	152 (39.9%)	<.001
Medicare	682 (47.4%)	464 (43.8%)	218 (57.2%)	<.001
Medicaid	75 (5.2%)	49 (4.6%)	26 (6.8%)	.10
Self-provided	211 (14.7%)	149 (14.1%)	62 (16.3%)	.30
Other	183 (12.7%)	132 (12.5%)	51 (13.4%)	.64
Current living arrangement, n (%)[d]				
Living alone	149 (10.1%)	102 (9.5%)	47 (11.9%)	.17
Living with spouse/partner	1,138 (77.3%)	833 (77.3%)	305 (77.4%)	.96
Living with other family members	362 (24.6%)	286 (26.5%)	76 (19.3%)	.004
Living with other people	27 (1.8%)	24 (2.2%)	3 (0.8%)	.06
Living with pet/s	255 (17.3%)	181 (16.8%)	74 (18.8%)	.37
Health status, n (%)[a]				
Excellent	174 (11.9%)	131 (12.2%)	43 (10.9%)	.40
Very good	568 (38.7%)	432 (39.4%)	145 (36.8%)	
Good	506 (34.5%)	363 (33.8%)	143 (36.3%)	
Fair	187 (12.7%)	137 (12.8%)	50 (12.7%)	
Poor	33 (2.2%)	20 (1.9%)	13 (3.3%)	

Note: Data might not add to 100% because of rounding.
Abbreviations: BMI, body mass index; SD, standard deviation.
[a]Missing values due to skip patterns or nonresponse not shown.
[b]Among responders who were not currently employed.
[c]Among responders who had health insurance coverage.
[d]Participants could select multiple answers, so data might not add up to 100%.

Regardless of urbanicity, we observed that approximately one-third of cancer patients had a health care appointment changed or cancelled, and doctor's visits were the most frequently affected appointments. Only a small proportion of our patients reported changes or cancellations for imaging, bloodwork, cancer screenings/biopsies, and active cancer treatments, with limited changes to essential cancer care from March to September 2020. However, rural patients were more likely to report a change or cancellation in surgery and imaging appointments. This is consistent with prior research showing that elective surgeries[36] and imaging services[37–39] were delayed or cancelled during the initial phase of the COVID-9 pandemic. Nearly all states, including Utah, issued emergency executive orders postponing elective surgeries and medical procedures between March and April 2020.[40] Nonurgent imaging services that were considered general elective screening appointments, particularly lung and breast screenings, were also impacted,[41] with cancer surveillance and diagnostic services dropping by more than 50%.[39] The observed changes in surgery and imaging utilization between our rural and urban patients likely reflect the impact of facility closures, reduced lung and breast imaging capacity at facilities, travel barriers, combined with patients' willingness to go to medical clinics as well as access to medical care (eg, loss of health insurance). For instance, rural patients in our study were significantly older than urban patients, which may have led to rural patients avoiding hospitals for fear of contracting COVID-19 as elderly individuals are more susceptible to having severe disease. Also, a significantly higher proportion of rural versus urban patients had a lung cancer diagnosis, potentially requiring lung imaging, which was impacted during the pandemic. Having to travel long-distances to specialized equipment, with less time-sensitivity compared to other cancer treatments (eg, radiation oncology) may have also resulted in the disparity.

Overall, our data are consistent with emerging trends showing that delivery of cancer care during the pandemic has been challenging because of the risk of infection or potential complications from contracting COVID-19, especially among immunocompromised patients.[10,11,42,43] A recent survey (n = 1,219) estimated that half of the individuals with cancer experienced a COVID-19-related health care delay,[31] although in our study we did not observe a delay or cancellation of critical cancer treatments. Additionally, stay-at-home policies and travel restrictions, loss of employment and employment-based health insurance, and financial loss may further contribute to the inability to obtain cancer care, affecting rural patients disproportionately.[44,45]

A significant proportion of all patients (62%), independent of ubanicity, rescheduled an appointment to a telehealth visit. Previous studies

TABLE 2 Health care experiences of cancer patients by rural and urban areas

Health care experiences	Total (N = 1,472)	Urban (N = 1,078)	Rural (N = 394)	*P*-value
Current patient status at HCI, n (%)[a]				
Have cancer and currently receiving treatment	417 (30.8%)	320 (32.1%)	97 (27.3%)	.18
Have cancer and completed cancer treatment	877 (64.9%)	632 (63.4%)	245 (69.0%)	
Have cancer and came for second opinion	23 (1.7%)	16 (1.6%)	7 (2.0%)	
Other	35 (2.6%)	29 (2.9%)	6 (1.7%)	
Any current treatments, n (%)[a,b,c]				
Surgery	58 (13.9%)	43 (13.4%)	15 (15.5%)	.61
Chemotherapy	155 (37.2%)	113 (35.3%)	42 (43.3%)	.15
Radiation therapy	26 (6.2%)	17 (5.3%)	9 (9.3%)	.16
Immunotherapy	60 (14.4%)	48 (15.0%)	12 (12.4%)	.52
Hormonal therapy	54 (12.9%)	43 (13.4%)	11 (11.3%)	.59
Other	53 (12.7%)	46 (14.4%)	7 (7.2%)	.06
None of the above treatments	32 (7.7%)	22 (6.9%)	10 (10.3%)	.27
Not receiving any treatment	53 (12.7%)	46 (14.4%)	7 (7.2%)	.06
Change/cancellation in medical appointments due to pandemic, n (%)[a]				
No	917 (62.3%)	680 (63.1%)	237 (60.2%)	.52
Yes	434 (29.5)	313 (29.1%)	121 (30.7%)	
Did not have an appointment	120 (8.2%)	84 (7.8%)	36 (9.1%)	
Type of medical appointments changed/cancelled due to pandemic, n (%)[a,c,d]				
Doctor's visit	348 (80.2%)	254 (81.2%)	94 (77.7%)	.42
Bloodwork	73 (16.8%)	55 (17.6%)	18 (14.9%)	.50
Cancer screening	54 (12.4%)	36 (11.5%)	18 (14.9%)	.34
Biopsy	7 (1.6%)	4 (1.3%)	3 (2.5%)	.40
Imaging	82 (18.9%)	52 (16.6%)	30 (24.8%)	.05
Surgery	18 (4.1%)	9 (2.9%)	9 (7.4%)	.03
Chemotherapy	11 (2.5%)	9 (2.9%)	2 (1.7%)	.74
Radiation therapy	3 (0.7%)	2 (0.6%)	1 (0.8%)	1.00
Other	30 (6.9%)	25 (8.0%)	5 (4.1%)	.16
Doctor's visit rescheduled as virtual visit due to pandemic, n (%)[a,d]				
No	165 (38.3%)	116 (37.4%)	49 (40.5%)	.56
Yes	266 (61.7%)	194 (62.6%)	72 (59.5%)	

Note: Data might not add to 100% because of rounding.
[a]Missing values due to skip patterns or nonresponse not shown.
[b]Among responders who have cancer and were currently receiving treatment.
[c]Participants could select multiple answers, so data might not add up to 100%.
[d]Among responders who had a change/cancellation in medical appointment due to pandemic.

have indicated that less than 5% of cancer patients used telemedicine before COVID-19.[46–49] However, the pandemic has accelerated the rapid adoption of telemedicine, and this could have positive effects on cancer care, particularly for rural cancer patients,[50–52] although this population may have barriers to accessing telemedicine due to limited technology access and/or lower digital literacy.[53–55] Nonetheless, telemedicine could potentially improve cancer care delivery for patients living in rural areas by providing easier access to care. For example, 30% of patients seen at HCI travel >150 miles to receive care, making telemedicine a central opportunity.

COVID-19 risk-mitigation measures have been strongly recommended for those who are elderly or have chronic conditions, such

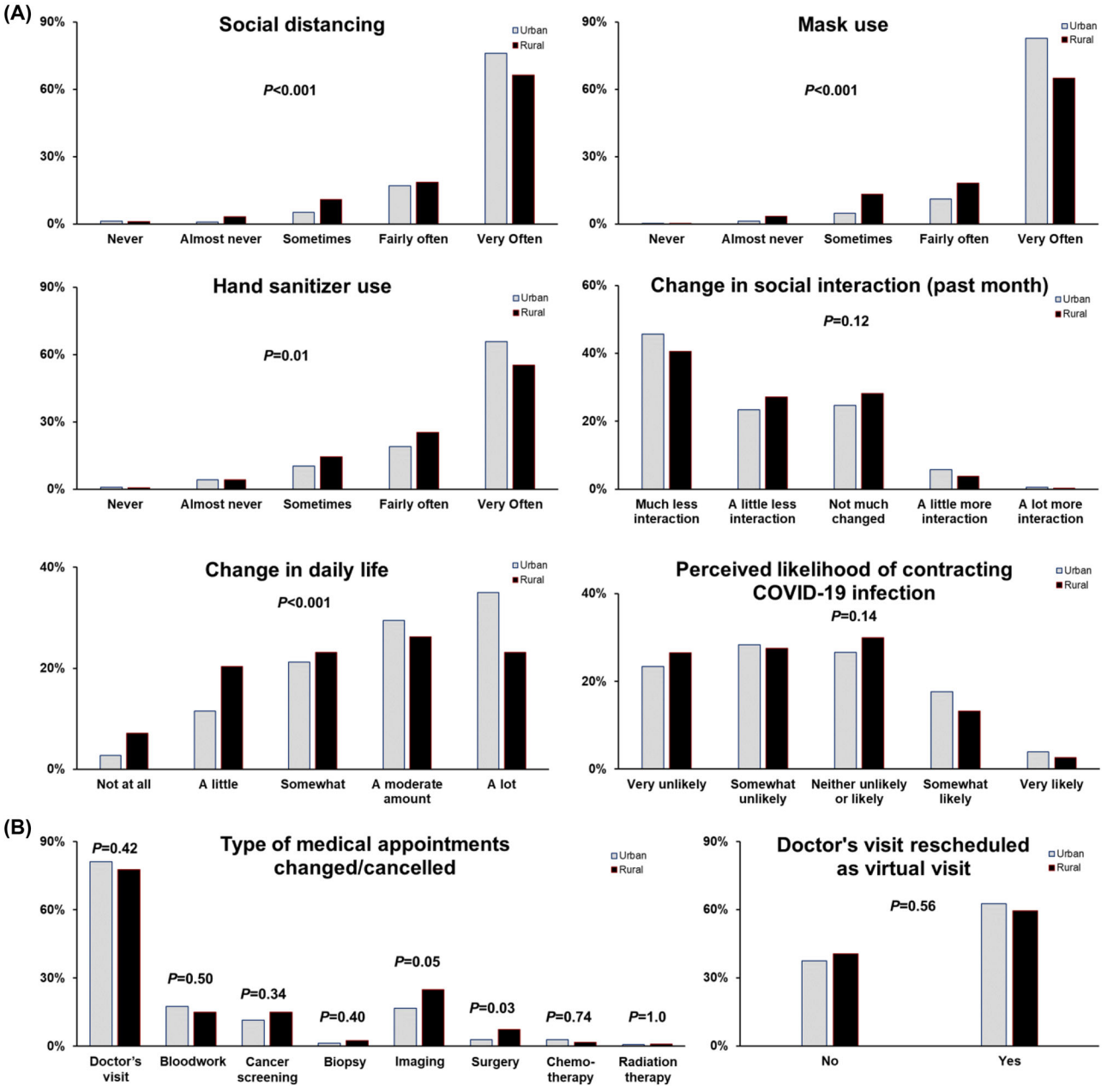

FIGURE 1 (A) Compliance with COVID-19 risk-mitigation efforts; (B) impact on cancer care

as cancer patients and survivors. During March-September 2020, the Utah state directed all people to voluntarily stay at home as much as possible except for essential travel, as well as advising people to maintain 6 feet distance from others when outside the home with mask requirement when social distancing was not possible. The "Lockdown" period in Utah was only from March 27 to April 30, 2020. Nonetheless, urban populations in Utah were more likely to adhere to the recommendations for a longer time period. Consistent with other studies,[42,56] most urban and rural cancer patients (>80%) in our study adhered to accepted risk-mitigation measures as recommended by the state, although adherence was slightly lower among rural patients. This could be due to social attitudes or urban patients' perceptions that they had a higher likelihood of contracting the COVID-19 infection. Indeed, rates of COVID-19 infection were initially higher in urban versus rural areas, although this trend has changed.[57,58]

Rural patients were also more likely to be current or former smokers and report higher alcohol consumption. This is consistent with previous research showing that some high-risk behaviors may disproportionately occur in those living in rural areas.[24] More than one-fourth of urban and rural patients reported increased tobacco usage due to the pandemic, similar to that reported by other studies,[59] perhaps in response to pandemic-related stress. Nonetheless, similar proportions of urban and rural patients reduced their use of tobacco products. We also noted that few urban and rural patients decreased their alcohol consumption due to the pandemic. Social smokers and

TABLE 3 COVID-19 risk-mitigation measures and perceptions of cancer patients by rural and urban areas

COVID-19 risk-mitigation measures during the pandemic and perceptions	Total (N = 1,472)	Urban (N = 1,078)	Rural (N = 394)	*P*-value
Regularly leaving house for routine errands, n (%)				
Never	35 (2.4%)	27 (2.5%)	8 (2.0%)	.32
Almost never	297 (20.2%)	222 (20.6%)	75 (19.0%)	
Sometimes	723 (49.1%)	540 (50.1%)	183 (46.4%)	
Fairly often	332 (22.6%)	230 (21.3%)	102 (25.9%)	
Very often	85 (5.8%)	59 (5.5%)	26 (6.6%)	
Practicing social distancing, n (%)[a]				
Never	16 (1.1%)	12 (1.2%)	4 (1.1%)	<.001
Almost never	20 (1.4%)	8 (0.8%)	12 (3.3%)	
Sometimes	93 (6.7%)	53 (5.1%)	40 (10.9%)	
Fairly often	242 (17.3%)	174 (16.9%)	68 (18.5%)	
Very often	1,027 (73.5%)	783 (76.0%)	244 (66.3%)	
Regular face mask use, n (%)[a]				
Never	4 (0.3%)	3 (0.3%)	1 (0.3%)	<.001
Almost never	23 (1.7%)	12 (1.2%)	11 (3.3%)	
Sometimes	90 (6.8%)	46 (4.7%)	44 (13.3%)	
Fairly often	169 (12.8%)	109 (11.0%)	60 (18.1%)	
Very often	1,032 (78.3%)	817 (82.8%)	215 (65.0%)	
Regular hand sanitizer use, n (%)[a]				
Never	10 (0.8%)	8 (0.8%)	2 (0.6%)	.01
Almost never	55 (4.2%)	41 (4.2%)	14 (4.2%)	
Sometimes	149 (11.3%)	101 (10.2%)	48 (14.5%)	
Fairly often	272 (20.6%)	188 (19.0%)	84 (25.4%)	
Very often	832 (63.1%)	649 (65.8%)	183 (55.3%)	
Perceived likelihood of contracting COVID-19, n (%)[a]				
Very unlikely	342 (24.2%)	242 (23.4%)	100 (26.5%)	.14
Somewhat unlikely	398 (28.2%)	294 (28.4%)	104 (27.6%)	
Neither unlikely or likely	389 (27.5%)	276 (26.6%)	113 (30.0%)	
Somewhat likely	233 (16.5%)	183 (17.7%)	50 (13.3%)	
Very likely	51 (3.6%)	41 (4.0%)	10 (2.7%)	

Note: Data might not add to 100% because of rounding.
[a]Missing values due to skip patterns or nonresponse not shown.

drinkers had less opportunity to engage in these high-risk behaviors with stay-at-home policies.[59] Marijuana became legal for medical use in Utah in 2018, and a significant proportion (14%) of patients reported use, with modest increases as a result of the pandemic, particularly among urban patients. Reduced use among rural residents with the pandemic may be related to access or financial reasons. Increased substance use among the patients may be part of coping mechanisms for pandemic-related stress and social isolation.[60]

Physical activity is known to have beneficial effects on immune function, sleep, and mental health,[61–66] and has been associated with improved QoL and lower mortality among individuals with cancer.[18–21] Although urban versus rural patients experienced more changes in their exercise habits due to the pandemic, almost half of both patient groups reported exercising less. This is consistent with recent studies reporting decreased physical activity levels during the pandemic,[67,68] potentially due to stay-at-home policies, self-isolation, and closure of gyms.[22,23]

Our findings showed that most patients experienced some change in their daily lives due to the pandemic, particularly for urban residents, and almost half of all patients reported some financial stress and reduced social interaction. Despite this, fewer than 10% experienced loneliness and challenges to manage difficulties, with no differences by rural-urban residences. A recent survey among older adults found that about 27% were lonely at least some of the time during the pandemic.[67]

TABLE 4 Health behaviors of cancer patients by rural and urban areas

Health behaviors	Total (N = 1,472)	Urban (N = 1,078)	Rural (N = 394)	*P*-value
Current smoking status, n (%)[a]				
Never	1,054 (72.4%)	813 (76.2%)	241 (62.0%)	<.001
Former	368 (25.3%)	236 (22.1%)	132 (33.9%)	
Current	34 (2.3%)	18 (1.7%)	16 (4.1%)	
Change in frequency of tobacco use since COVID-19 pandemic, n (%)[a,b]				
No, using the same amount compared to before	11 (50.0%)	8 (57.1%)	3 (37.5%)	.44
Yes, used more compared to before	6 (27.3%)	4 (28.6%)	2 (25.0%)	
Yes, used less compared to before	5 (22.7%)	2 (14.3%)	3 (37.5%)	
Alcohol consumption in past year, n (%)[a]				
Never	686 (52.0%)	558 (56.5%)	128 (38.8%)	<.001
Less than once a month	150 (11.4%)	100 (10.1%)	50 (15.2%)	
Once a month to twice a week	251 (19.0%)	182 (18.4%)	69 (20.9%)	
3-4 times a week to every day	231 (17.5%)	148 (15.0%)	83 (25.2%)	
Change in alcohol consumption habits since COVID-19 pandemic, n (%)[a]				
No	1,110 (89.3%)	839 (89.4%)	271 (88.9%)	.60
Yes, increased drinking	68 (5.5%)	53 (5.7%)	15 (4.9%)	
Yes, decreased drinking	65 (5.2%)	46 (4.9%)	19 (6.2%)	
Marijuana/CBD oil use in the past month, n (%)[a]				
No	1,260 (85.8%)	928 (86.2%)	332 (84.7%)	.73
Yes, marijuana only	64 (4.4%)	45 (4.2%)	19 (4.8%)	
Yes, CBD oil only	88 (6.0%)	60 (5.6%)	28 (7.1%)	
Yes, both marijuana and CBD oil	49 (3.3%)	37 (3.4%)	12 (3.1%)	
Not sure if used these products	7 (0.5%)	6 (0.6%)	1 (0.3%)	
Change in marijuana/CBD oil use since COVID-19 pandemic, n (%)[a,c]				
No, using the same amount compared to before	125 (74.0%)	88 (73.3%)	37 (75.5%)	.049
Yes, used more compared to before	31 (18.3%)	26 (21.7%)	5 (10.2%)	
Yes, used less compared to before	13 (7.7%)	6 (5.0%)	7 (14.3%)	
Change in exercise habits since pandemic, n (%)[a]				
No	774 (52.7%)	522 (48.5%)	252 (64.0%)	<.001
Yes	696 (47.3%)	554 (51.5%)	142 (36.0%)	
Type of change in exercise habits since pandemic, n (%)[a,d,e]				
Don't exercise regularly	137 (20.9%)	108 (20.7%)	29 (22.1%)	.71
Exercising less	323 (46.4%)	260 (46.9%)	63 (44.4%)	.58
Exercising more	148 (21.3%)	120 (21.7%)	28 (19.7%)	.61
Exercising in different location	166 (23.9%)	134 (24.2%)	32 (22.5%)	.68
Other	21 (3.0%)	15 (2.7%)	6 (4.2%)	.41

Note: Data might not add to 100% because of rounding.
[a]Missing values due to skip patterns or nonresponse not shown.
[b]Among responders who were current smokers.
[c]Among responders who used marijuana and/or CBD oil in the past month.
[d]Among responders whose exercised habits changed.
[e]Participants could select multiple answers, so data might not add up to 100%.

TABLE 5 Psychosocial factors of cancer patients by rural and urban areas

Psychosocial factors	Total (N = 1,472)	Urban (N = 1,078)	Rural (N = 394)	*P*-value
Change in daily life due to pandemic, n (%)[a]				
Not at all	58 (3.9%)	30 (2.8%)	28 (7.1%)	<.001
A little	204 (13.9%)	124 (11.5%)	80 (20.4%)	
Somewhat	320 (21.8%)	229 (21.2%)	91 (23.2%)	
A moderate amount	421 (28.6%)	318 (29.5%)	103 (26.2%)	
A lot	468 (31.8%)	377 (35.0%)	91 (23.2%)	
Change in social interaction in the past month, n (%)[a]				
I have much less social interaction	651 (44.3%)	491 (45.6%)	160 (40.6%)	.12
I have a little less social interaction	358 (24.4%)	251 (23.3%)	107 (27.2%)	
My social interaction has not changed much	377 (25.6%)	266 (24.7%)	111 (28.2%)	
I have a little more social interaction	77 (5.2%)	62 (5.8%)	15 (3.8%)	
I have a lot more social interaction	7 (0.5%)	6 (0.6%)	1 (0.3%)	
Felt lonely in the past month, n (%)[a]				
Never	494 (33.6%)	358 (33.2%)	136 (34.6%)	.71
Rarely	488 (33.2%)	350 (32.5%)	138 (35.1%)	
Sometimes	396 (26.9%)	299 (27.8%)	97 (24.7%)	
Usually	77 (5.2%)	58 (5.4%)	19 (4.8%)	
Always	15 (1.0%)	12 (1.1%)	3 (0.8%)	
Difficulties piling up that could not be overcome in the past month, n (%)[a]				
Never	643 (43.8%)	466 (43.3%)	177 (45.0%)	.46
Almost never	439 (29.9%)	320 (29.7%)	119 (30.3%)	
Sometimes	280 (19.1%)	206 (19.1%)	74 (18.8%)	
Fairly often	78 (5.3%)	64 (5.9%)	14 (3.6%)	
Often	29 (2.0%)	20 (1.9%)	9 (2.3%)	
Financially stressed in the past month, n (%)[a]				
Not at all	763 (51.9%)	564 (52.4%)	199 (50.5%)	.50
A little bit	417 (28.3%)	293 (27.2%)	124 (31.5%)	
Somewhat	137 (9.3%)	105 (9.7%)	32 (8.1%)	
Quite a bit	97 (6.6%)	74 (6.9%)	23 (5.8%)	
Very much	57 (3.9%)	41 (3.8%)	16 (4.1%)	

Note: Data might not add to 100% because of rounding.
[a]Missing values due to skip patterns or nonresponse not shown.

COVID-19 risk-mitigation strategies have resulted in social isolation, which may present challenges for patients already at risk for distress and loneliness and for whom such contact may be critical.[12] COVID-19 risk-mitigation strategies have also led to financial hardship due to loss of employment, income, or health insurance.[12,69] Consequently, rural and urban cancer patients are a vulnerable population due to the combined physical, social, and emotional demands of cancer and COVID-19 and the costs of cancer care and financial strain imposed by the pandemic.[9]

This study's primary limitation is that most patients were White, non-Hispanic/Latino, had health insurance, mostly from Utah, and from an NCI-designated Comprehensive Cancer Center. Thus, our results may not be generalizable to those with different racial and ethnic backgrounds, lower socioeconomic status, or those from other states who may have had different COVID-19 state-wide policies, as well as patients seen at community oncology clinics. Additionally, information on income and level of education was not available for most of the patients in this study. Since socioeconomic disparities may be

associated with COVID-19 pandemic, future studies need to evaluate these social determinants of health among rural and urban cancer patients in the context of the pandemic. In alignment with prior research,[70,71] we used a dichotomous RUCA classification of patients into rural or urban areas. Future research should also include more detailed urban-rural local classifications, as well as identify useful spatial patterns and neighborhood characteristics to provide more insights into how neighborhood contexts may affect cancer patients' pandemic-related experiences. Lastly, since this analysis was cross-sectional, we plan to evaluate longitudinal changes in rural and urban cancer patients' experiences with COVID-19 in the context of the evolving pandemic.

CONCLUSIONS

This large and comprehensive study provides unique insights into the first 6 months of COVID-19 pandemic-related experiences and continuity of care among rural and urban cancer patients predominantly from Utah and its societal impacts. Our findings showed that rural cancer patients compared to urban patients were more likely to be not employed, uninsured, and have cancer-risk behaviors (eg, smoking) necessitating the need to identify predictors of risk and appropriate interventions. Urban patients were more likely to practice COVID-19 risk-mitigation behaviors, increase their marijuana/CBD oil use during the pandemic, and experience changes in exercise habits and their daily lives compared to rural patients. While changes in health care delivery were common among both rural and urban patients, essential cancer care coordinated by an NCI-designated Comprehensive Cancer Center continued with minimal disruptions. Given the substantial adoption and utilization of telemedicine we observed, we recommend the formal adoption of this practice after the pandemic to address the needs of both urban and rural populations who have challenges in accessing health care. Further research is needed to better characterize the pandemic's short- and long-term effects on cancer patients in rural and urban settings, identify at-risk groups, and guide psychosocial programs that address the unique needs and challenges faced by rural and urban cancer patients during this, and future, pandemics.

DISCLOSURES

Dr. Ulrich has as HCI 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. Other authors declare that they have no conflict of interest.

ORCID

Anita R. Peoples PhD https://orcid.org/0000-0003-3645-3960
Tracy Onega PhD https://orcid.org/0000-0002-1633-3040

REFERENCES

1. Blumenthal D, Fowler EJ, Abrams M, Collins SR. Covid-19 — implications for the health care system. *N Engl J Med*. 2020;383(15):1483-1488.
2. Meyer J, McDowell C, Lansing J, et al. Changes in physical activity and sedentary behavior in response to COVID-19 and their associations with mental health in 3052 US adults. *Int J Environ Res Public Health*. 2020;17(18):6469. https://pubmed.ncbi.nlm.nih.gov/32899495/
3. McPhee MD, Keough MT, Rundle S, Heath LM, Wardell JD, Hendershot CS. Depression, environmental reward, coping motives and alcohol consumption during the COVID-19 pandemic. *Front Psychiatry*. 2020;11:574676.
4. Tull MT, Edmonds KA, Scamaldo KM, Richmond JR, Rose JP, Gratz KL. Psychological outcomes associated with stay-at-home orders and the perceived impact of COVID-19 on daily life. *Psychiatry Res*. 2020;289:113098.
5. Liang W, Guan W, Chen R, et al. Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China. *Lancet Oncol*. 2020;21(3):335-337.
6. Dai M, Liu D, Liu M, et al. Patients with cancer appear more vulnerable to SARS-CoV-2: a multicenter study during the COVID-19 outbreak. *Cancer Discov*. 2020;10(6):783-791.
7. Robilotti EV, Babady NE, Mead PA, et al. Determinants of COVID-19 disease severity in patients with cancer. *Nat Med*. 2020;26(8):1218-1223.
8. Giannakoulis VG, Papoutsi E, Siempos II. Effect of cancer on clinical outcomes of patients with COVID-19: a meta-analysis of patient data. *JCO Glob Oncol*. 2020;6:799-808.
9. Kutikov A, Weinberg DS, Edelman MJ, Horwitz EM, Uzzo RG, Fisher RI. A war on two fronts: cancer care in the time of COVID-19. *Ann Intern Med*. 2020;172(11):756-758.
10. Patt D, Gordan L, Diaz M, et al. Impact of COVID-19 on cancer care: how the pandemic is delaying cancer diagnosis and treatment for American seniors. *JCO Clin Cancer Inform*. 2020;4:1059-1071.
11. Hartman HE, Sun Y, Devasia TP, et al. Integrated survival estimates for cancer treatment delay among adults with cancer during the COVID-19 pandemic. *JAMA Oncol*. 2020;6(12):1881-1889.
12. Nekhlyudov L, Duijts S, Hudson SV, et al. Addressing the needs of cancer survivors during the COVID-19 pandemic. *J Cancer Surviv*. 2020;14(5):601-606.
13. Jammu AS, Chasen MR, Lofters AK, Bhargava R. Systematic rapid living review of the impact of the COVID-19 pandemic on cancer survivors: update to August 27, 2020. *Support Care Cancer*. 2021;29(6):2841-2850. https://pubmed.ncbi.nlm.nih.gov/33242162/
14. Jones JM, Saeed H, Katz MS, Lustberg MB, Forster VJ, Nekhlyudov L. Re-addressing the needs of cancer survivors during COVID-19: a path forward. *J Natl Cancer Inst*. 2021;113(8):955-961. https://pubmed.ncbi.nlm.nih.gov/33367655/
15. Segel JE, Lengerich EJ. Rural-urban differences in the association between individual, facility, and clinical characteristics and travel time for cancer treatment. *BMC Public Health*. 2020;20(1):196.
16. Afshar N, English DR, Milne RL. Rural-urban residence and cancer survival in high-income countries: a systematic review. *Cancer*. 2019;125(13):2172-2184.
17. Mueller JT, McConnell K, Burow PB, Pofahl K, Merdjanoff AA, Farrell J. Impacts of the COVID-19 pandemic on rural America. *Proc Natl Acad Sci U S A*. 2021;118(1):2019378118. https://pubmed.ncbi.nlm.nih.gov/33328335/
18. Cormie P, Zopf EM, Zhang X, Schmitz KH. The impact of exercise on cancer mortality, recurrence, and treatment-related adverse effects. *Epidemiol Rev*. 2017;39(1):71-92.
19. Friedenreich CM, Shaw E, Neilson HK, Brenner DR. Epidemiology and biology of physical activity and cancer recurrence. *J Mol Med (Berl)*. 2017;95(10):1029-1041.

20. Brown JC, Gilmore LA. Physical activity reduces the risk of recurrence and mortality in cancer patients. *Exerc Sport Sci Rev*. 2020;48(2):67-73.
21. Li T, Wei S, Shi Y, et al. The dose–response effect of physical activity on cancer mortality: findings from 71 prospective cohort studies. *Br J Sports Med*. 2016;50(6):339-345.
22. Martinez-Ferran M, de la Guia-Galipienso F, Sanchis-Gomar F, Pareja-Galeano H. Metabolic impacts of confinement during the COVID-19 pandemic due to modified diet and physical activity habits. *Nutrients*. 2020;12(6):1549. https://pubmed.ncbi.nlm.nih.gov/32466598/
23. Narici M, De Vito G, Franchi M, et al. Impact of sedentarism due to the COVID-19 home confinement on neuromuscular, cardiovascular and metabolic health: physiological and pathophysiological implications and recommendations for physical and nutritional countermeasures. *Eur J Sport Sci*. 2021;21(4):614-635. https://pubmed.ncbi.nlm.nih.gov/32394816/
24. Cudjoe J, Delva S, Cajita M, Han HR. Empirically tested health literacy frameworks. *Health Lit Res Pract*. 2020;4(1):e22-e44.
25. Ose D, Viskochil R, Holowatyj AN. Understanding the Prevalence of Prediabetes and Diabetes in Patients With Cancer in Clinical Practice: A Real-World Cohort Study. *J Natl Compr Canc Netw*. 2021;19(6):709-718. https://pubmed.ncbi.nlm.nih.gov/34129522/
26. Ulrich CM, Gigic B, Böhm J, et al. The ColoCare study: a paradigm of transdisciplinary science in colorectal cancer outcomes. *Cancer Epidemiol Biomarkers Prev*. 2019;28(3):591-601.
27. Ulrich CM, Himbert C, Boucher K, et al. Precision-Exercise-Prescription in patients with lung cancer undergoing surgery: rationale and design of the PEP study trial. *BMJ Open*. 2018;8(12):e024672.
28. Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: building an international community of software platform partners. *J Biomed Inform*. 2019;95:103208.
29. Ware J Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care*. 1996;34(3):220-233.
30. Rural Health Research Center. *Rural Urban Commuting Area Codes Data 2017*. Department of Family Medicine, University of Washington; 2005.
31. American Cancer Society. COVID-19 Pandemic Impact on Cancer Patients and Survivors Survey Findings Summary. 2020.
32. de Souza JA, Yap BJ, Wroblewski K, et al. Measuring financial toxicity as a clinically relevant patient-reported outcome: the validation of the Comprehensive Score for financial Toxicity (COST). *Cancer*. 2017;123(3):476-484.
33. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. 1983;24(4):385-396.
34. Golden-Kreutz DM, Browne MW, Frierson GM, Andersen BL. Assessing stress in cancer patients: a second-order factor analysis model for the perceived stress scale. *Assessment*. 2004;11(3):216-223.
35. Henley SJ, Jemal A. Rural cancer control: bridging the chasm in geographic health inequity. *Cancer Epidemiol Biomarkers Prev*. 2018;27(11):1248-1251.
36. Bakouny Z, Hawley JE, Choueiri TK, et al. COVID-19 and cancer: current challenges and perspectives. *Cancer Cell*. 2020;38(5):629-646.
37. Whaley CM, Pera MF, Cantor J, et al. Changes in health services use among commercially insured US populations during the COVID-19 pandemic. *JAMA Netw Open*. 2020;3(11):e2024984.
38. Sprague BL, O'Meara ES, Lee CI, et al. Prioritizing breast imaging services during the COVID pandemic: a survey of breast imaging facilities within the breast cancer surveillance consortium. *Prev Med*. 2021;151:106540.
39. Zattra O, Fraga A, Lu N, et al. Trends in cancer imaging by indication, care setting, and hospital type during the COVID-19 pandemic and recovery at four hospitals in Massachusetts. *Cancer Med*. 2021;10(18):6327-6335.
40. Strategies T. States with Elective Medical Procedures Guidance in Effect. 2020. https://www.acr.org/-/media/ACR/Files/COVID19/May-18_States-With-Elective-Medical-Procedures-Guidance-in-Effect.pdf. Accessed October 27, 2021.
41. Luker GD, Boettcher AN. Transitioning to a new normal after COVID-19: preparing to get back on track for cancer imaging. *Radiol Imaging Cancer*. 2020;2(3):e204011.
42. Islam JY, Camacho-Rivera M, Vidot DC. Examining COVID-19 preventive behaviors among cancer survivors in the United States: an analysis of the COVID-19 impact survey. *Cancer Epidemiol Biomarkers Prev*. 2020;29(12):2583-2590.
43. Rosenbaum L. The untold toll — the pandemic's effects on patients without Covid-19. *N Engl J Med*. 2020;382(24):2368-2371.
44. Al-Shamsi HO, Alhazzani W, Alhuraiji A, et al. A practical approach to the management of cancer patients during the novel coronavirus disease 2019 (COVID-19) pandemic: an international collaborative group. *Oncologist*. 2020;25(6):e936.
45. Carethers JM, Sengupta R, Blakey R, Ribas A, D'Souza G. Disparities in cancer prevention in the COVID-19 era. *Cancer Prev Res (Phila)*. 2020;13(11):893-896.
46. Barnett ML, Ray KN, Souza J, Mehrotra A. Trends in telemedicine use in a large commercially insured population, 2005–2017. *JAMA*. 2018;320(20):2147-2149.
47. Mehrotra A, Jena AB, Busch AB, Souza J, Uscher-Pines L, Landon BE. Utilization of telemedicine among rural medicare beneficiaries. *JAMA*. 2016;315(18):2015-2016.
48. Douglas MD, Xu J, Heggs A, Wrenn G, Mack DH, Rust G. Assessing telemedicine utilization by using Medicaid claims data. *Psychiatr Serv*. 2017;68(2):173-178.
49. GAO. Telehealth and Remote Patient Monitoring Use in Medicare and Selected Federal Programs. 2017.
50. Hollander JE, Carr BG. Virtually perfect? Telemedicine for Covid-19. *N Engl J Med*. 2020;382(18):1679-1681.
51. Agboola SO, Ju W, Elfiky A, Kvedar JC, Jethwani K. The effect of technology-based interventions on pain, depression, and quality of life in patients with cancer: a systematic review of randomized controlled trials. *J Med Internet Res*. 2015;17(3):e65.
52. Harris J, Cheevers K, Armes J. The emerging role of digital health in monitoring and supporting people living with cancer and the consequences of its treatments. *Curr Opin Support Palliat Care*. 2018;12(3):268-275.
53. Halpern MT, Brawley OW. Insurance status, health equity, and the cancer care continuum. *Cancer*. 2016;122(20):3106-3109.
54. Charlton M, Schlichting J, Chioreso C, Ward M, Vikas P. Challenges of rural cancer care in the United States. *Oncology (Williston Park)*. 2015;29(9):633-640.
55. Wiegel GRA, Sobel L, Salganicoff A, Cubanski J, Freed M. *Opportunities and Barriers for Telemedicine in the US during the COVID-19 Emergency and Beyond*. 2020.
56. Miaskowski C, Paul SM, Snowberg K, et al. Oncology patients' perceptions of and experiences with COVID-19. *Support Care Cancer*. 2021;29(4):1941-1950. https://pubmed.ncbi.nlm.nih.gov/32809060/
57. Zhang CH, Schwartz GG. Spatial disparities in coronavirus incidence and mortality in the United States: an ecological analysis as of May 2020. *J Rural Health*. 2020;36(3):433-445.
58. Paul R, Arif AA, Adeyemi O, Ghosh S, Han D. Progression of COVID-19 from urban to rural areas in the United States: a spatiotemporal analysis of prevalence rates. *J Rural Health*. 2020;36(4):591-601.
59. Jackson SE, Garnett C, Shahab L, Oldham M, Brown J. Association of the COVID-19 lockdown with smoking, drinking and attempts to quit in England: an analysis of 2019–20 data. *Addiction*. 2021;116(5):1233-1244. https://pubmed.ncbi.nlm.nih.gov/33089562/
60. Galea S, Merchant RM, Lurie N. The mental health consequences of COVID-19 and physical distancing: the need for prevention and early

intervention. *JAMA Intern Med*. 2020;180(6):817-818. https://pubmed.ncbi.nlm.nih.gov/32275292/
61. Kruijsen-Jaarsma M, Revesz D, Bierings MB, Buffart LM, Takken T. Effects of exercise on immune function in patients with cancer: a systematic review. *Exerc Immunol Rev*. 2013;19:120-143.
62. Sitlinger A, Brander DM, Bartlett DB. Impact of exercise on the immune system and outcomes in hematologic malignancies. *Blood Adv*. 2020;4(8):1801-1811.
63. Craft LL, Vaniterson EH, Helenowski IB, Rademaker AW, Courneya KS. Exercise effects on depressive symptoms in cancer survivors: a systematic review and meta-analysis. *Cancer Epidemiol Biomarkers Prev*. 2012;21(1):3-19.
64. Brown JC, Huedo-Medina TB, Pescatello LS, et al. The efficacy of exercise in reducing depressive symptoms among cancer survivors: a meta-analysis. *PLoS One*. 2012;7(1):e30955.
65. Kredlow MA, Capozzoli MC, Hearon BA, Calkins AW, Otto MW. The effects of physical activity on sleep: a meta-analytic review. *J Behav Med*. 2015;38(3):427-449.
66. Takemura N, Cheung DST, Smith R, et al. Effectiveness of aerobic exercise and mind-body exercise in cancer patients with poor sleep quality: a systematic review and meta-analysis of randomized controlled trials. *Sleep Med Rev*. 2020;53:101334.
67. Brown L, Mossabir R, Harrison N, Brundle C, Smith J, Clegg A. Life in lockdown: a telephone survey to investigate the impact of COVID-19 lockdown measures on the lives of older people (>/= 75 years). *Age Ageing*. 2021;50(2):341-346. https://pubmed.ncbi.nlm.nih.gov/33173949/
68. Violant-Holz V, Gallego-Jimenez MG, Gonzalez-Gonzalez CS, et al. Psychological health and physical activity levels during the COVID-19 pandemic: a systematic review. *Int J Environ Res Public Health*. 2020;17(24):9419. https://pubmed.ncbi.nlm.nih.gov/33334073/
69. Baddour K, Kudrick LD, Neopaney A, et al. Potential impact of the COVID-19 pandemic on financial toxicity in cancer survivors. *Head Neck*. 2020;42(6):1332-1338.
70. Rogers CR, Blackburn BE, Huntington M, et al. Rural-urban disparities in colorectal cancer survival and risk among men in Utah: a statewide population-based study. *Cancer Causes Control*. 2020;31(3):241-253.
71. Anderson AE, Henry KA, Samadder NJ, Merrill RM, Kinney AY. Rural vs urban residence affects risk-appropriate colorectal cancer screening. *Clin Gastroenterol Hepatol*. 2013;11(5):526-533.

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