COVID-19

Adding COVID to cancer: does cancer status influence COVID-19 infection preventive behaviors?

CARRIE A. MILLER[1], JEANINE P.D. GUIDRY[2], PAUL B. PERRIN[3], KELLIE E. CARLYLE[4], VANESSA B. SHEPPARD[4], BERNARD F. FUEMMELER[1]
[1] Family Medicine and Population Health, Virginia Commonwealth University, USA;
[2] Communication and Cognition, Tilburg University, NLD; [3] Departments of Data Science and Psychology, University of Virginia, USA;
[4] Department of Social and Behavioral Sciences, Virginia Commonwealth University, USA

Keywords

COVID-19 • Preventive behaviors • Cancer survivors • Health belief model

Summary

Introduction. *A better understanding of how to promote disease mitigation and prevention behaviors among vulnerable populations, such as cancer survivors, is needed. This study aimed to determine patterns of and factors associated with COVID-19-related preventive behaviors among cancer survivors and assess whether the COVID-19 preventive behaviors of cancer survivors differ from the general population.*
Methods. *In June 2020, an online survey of adults (N = 897) assessed predictors of COVID-19-related preventive behaviors, including socio-demographics, COVID-19 beliefs and perceptions (Health Belief Model [HBM] variables), and cancer statuses (cancer survivors currently in treatment, cancer survivors not currently in treatment, and individuals with no history of cancer). An average score of respondent engagement in eight preventive behaviors was calculated. Differences in HBM variables and preventive behaviors by cancer status were assessed using ANCOVAs. Hierarchical multiple regression analyzed associations among socio-demographics, HBM constructs, cancer statuses, and engagement in COVID-19 preventive behaviors.*
Results. *Participants reported engaging in 3.5 (SD = 0.6) preventive behaviors. Cancer survivors not in treatment engaged in preventive behaviors significantly less than the comparison group. In the final adjusted model, after adding COVID-19 beliefs and perceptions, cancer status was no longer significant. All HBM constructs except perceived susceptibility were significant predictors of preventive behaviors.*
Conclusions. *COVID-19 beliefs and perceptions were more robust predictors preventive behaviors than cancer status. Nonetheless, public health organizations and practitioners should communicate the risk and severity of infection among cancer survivors and emphasize the need to engage in protective behaviors for COVID-19 and other infectious diseases with this vulnerable population.*

Introduction

Individuals who are immunosuppressed, such as people undergoing certain cancer treatments, are at increased risk of COVID-19-related morbidity and mortality [1, 2]. A better understanding of how to promote mitigation and prevention behaviors among vulnerable populations is needed in general as well as in the case of future infectious disease outbreaks.
An early study from China showed cancer patients, specifically, may have a higher risk of COVID-19 infection than individuals without cancer and that cancer patients had poorer COVID-19 outcomes, such as requiring ventilation and death [3]. Additionally, the pandemic has likely caused a host of negative outcomes for cancer survivors, including disruptions in their treatment and survivorship care. A systematic review of the cancer survivor literature published shortly after data in the present study were collected suggested the pandemic has introduced new challenges related to social isolation, financial hardship, and uncertainty with respect to ongoing care [4]. These consequences of COVID-19 for cancer survivors may disproportionately affect survivors in active treatment [5, 6], including those who are immunosuppressed by the disease itself or treatment. However, research suggests both those receiving chemotherapy and those who have completed treatment may be at increased risk of developing severe symptoms [7]. Since COVID-19 is highly contagious and potentially fatal, measures such as stay-at-home orders and social distancing were implemented worldwide to slow the spread of the virus. In addition, infection preventive behaviors such as washing hands, staying home when sick, and wearing a face mask were recommended to reduce the risk of contracting and spreading the virus, even after being fully vaccinated against COVID-19 [8]. Uptake of preventive behaviors among those at greater risk for adverse outcomes of COVID-19 infection is especially important for personal protection.
Although the body of literature is growing, there is limited research examining the practice of COVID-19 infection preventive behaviors in cancer patients [9-10]. Analyses of a nationally representative sample suggest that cancer survivors and immunocompromised adults are more likely to practice preventive behaviors than those with no history of cancer [10, 11]. However, these studies did not differentiate by cancer survivor treatment status. In addition, prior research suggests differences in

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the endorsement of COVID-19 misinformation beliefs based on cancer status, with survivors currently receiving treatment being more likely to endorse false statements about the pandemic, compared to those without a cancer history [12]. Studies have also found a relationship between misinformation beliefs and lower performance of COVID-19-related preventive behaviors [13-14]. Although it is unclear why individuals with cancer are more vulnerable to misinformation, it may undermine how well cancer patients adhere to the guidelines for behaviors to prevent COVID-19. It is crucial to understand why some individuals follow recommendations strictly and others do not, especially cancer patients who are at increased risk for negative disease sequalae.

The Health Belief Model (HBM) is a well-known health behavior theory that is often associated with engaging in preventive behaviors [15-18]. The HBM proposes that intention to perform the preventive behavior is dependent on (a) the level of perceived threat (consisting of *perceived severity* – how serious someone perceives COVID-19 to be – and *perceived susceptibility* – how likely someone believes they are to contract COVID-19), (b) *perceived benefits* of the preventive behavior (whether someone believes the behavior will protect them from getting COVID-19) (c) *perceived barriers* to the preventive behavior (*e.g.*, is uncomfortable wearing a mask), and (d) *self-efficacy* for performing the preventive behavior. The present study examined whether the HBM constructs are associated with engagement in preventive behaviors during the COVID-19 infection. Understanding how the HBM predicts engagement can inform future efforts to increase engagement in preventive behaviors now and in future infectious disease outbreaks.

In light of the serious potential impact of COVID-19 on cancer patients, further examination of the uptake of preventive behaviors in this population relative to other groups is warranted. The purpose of this study, therefore, was to assess differences in engagement in COVID-19 infection preventive behaviors during the COVID-19 pandemic (Aim 1a) and HBM constructs (Aim 1b) among the three groups of adults (cancer survivors in active treatment, cancer survivors not receiving treatment currently, and a comparison group without a history of cancer). The second aim of this research aim was to determine which individual characteristics and other factors (HBM constructs and history of cancer) are associated with performance of preventive behaviors during the pandemic. Finally, the HBM constructs were assessed as predictors of COVID-19 preventive behaviors within each cancer survivor group separately (Aim 3). We hypothesized that cancer survivors in active treatment would be the most engaged in COVID-19 preventive behaviors due to their increased potential to be immunocompromised.

Methods

Survey administration and sample

United States (U.S.) residents (N = 897) were recruited through a commercial survey administration and sampling company, Qualtrics, in June 2020. Quota sampling was utilized to ensure the sample would consist of approximately one-third of cancer survivors currently in treatment, one-third of cancer survivors not currently in treatment, and one-third of individuals without a history of cancer. Another quota was implemented to assure an approximately equal proportion of female and male respondents. Survey items collected information on socio-demographic characteristics, Health Belief Model components, and COVID-19-related preventive behaviors. These preventive behaviors were among the most important COVID-19 prevention strategies at the time these data were collected as no vaccines were available yet. Moreover, these behaviors (*e.g.*, frequent handwashing and mask wearing) are routinely recommended to vulnerable groups, such as cancer survivors. Data collection was anonymized. The study was approved by the Institutional Review Board of a large mid-Atlantic university.

Measures

Cancer status

Participants were assigned a label according to their self-reported cancer status. The three cancer status groups were delineated as cancer survivors in active treatment, cancer survivors not receiving treatment currently, and respondents with no history of cancer (comparison group).

Socio-demographic characteristics

(age, sex, race/ethnicity, educational attainment, and marital status). Respondent age in years and sex (female or male) were queried. Race/ethnicity was assessed with three mutually exclusive options (White/Caucasian, Black/African American, and Hispanic). Participants were asked to indicate their highest education level attained. This variable was collapsed to indicate college-educated versus other. Finally, marital status was assessed and collapsed to married/living together or other.

Health belief model constructs

Participants rated their agreement with statements related to their perceived susceptibility, severity, benefits, and barriers on a seven-point Likert scale ranging from "strongly disagree" to "strongly agree". ***Perceived severity*** of COVID-19 was determined using three items from a study focused on a pandemic flu vaccine by [15] (*e.g.*, "Complications of COVID-19 are serious"). Cronbach's alpha was.834. The mean of the three items was calculated as an overall measure of perceived severity. ***Perceived susceptibility*** to COVID-19 was measured using three items (*e.g.*, "I am worried about the likelihood of getting COVID-19 in the near future") [15]. Cronbach's alpha was.801. The mean of the three items was calculated as an overall measure of perceived susceptibility. ***Perceived benefits*** of COVID-19 preventive behaviors were measured using eight items focused on the benefits of COVID-19

Tab. I. Sample Characteristics (N = 897).

	Cancer Survivors		Comparison
	In active treatment. *(n = 287)*	Not in active treatment. *(n = 301)*	No history of cancer. *(n = 309)*
Characteristic	% (n)	% (n)	% (n)
Education			
College degree or higher	55.7% (*n* = 160)	48.8% (n = 147)	42.7% (n = 132)
Other	44.3% (*n* = 127)	51.2% (n = 154)	57.3% (n = 177)
Gender			
Male. Female	47.0% (*n* = 135). 53.0% (*n* = 152)	48.2% (n = 145) 51.8% (n = 156)	49.8% (n = 154) 50.2% (n = 155)
Race			
White/Caucasian	80.1% (*n* = 230)	87.4% (n = 263)	34.0% (n = 105)
Black/African American	9.8% (n = 28)	7.6% (n = 23)	32.4% (n = 100)
Hispanic	10.1% (n = 29)	5.0% (n = 15)	33.7% (n = 104)
Marital Status			
Married or living together	70.4% (*n* = 202)	62.8% (n = 189)	53.1% (n = 164)
Other	29.6% (*n* = 85)	37.2% (n = 112)	46.9% (n = 145)
	M, SD	*M, SD*	
Age (years)	48.2, 17.1	56.4, 16.2	44.3, 16.3
Preventive Behaviors	3.5, 0.6	3.4, 0.6	3.6, 0.5

preventive behaviors (*e.g.*, "Wearing a mask in public can help prevent contracting and spreading COVID-19") [15, 18]. Cronbach's alpha was. 920, and the mean of the four items was calculated as an overall measure of perceived benefits. ***Perceived barriers*** to COVID-19 preventive behaviors were measured using eight items asking respondents to rate how difficult it would be for them to perform specific preventive behaviors [15, 18]. Cronbach's alpha was.846, and the mean of the ten items was calculated as an overall measure of perceived barriers. ***Self-efficacy*** was measured by three items (*e.g.*, "How certain are you that you can perform COVID-19 preventive behaviors?" [15] and assessed using a six-point Likert scale ranging from "very difficult" to "very easy." Cronbach's alpha was .878. The mean of the three items was calculated as an overall measure of self-efficacy.

COVID-19-related preventive behaviors

Behaviors including handwashing, avoiding contact with sick people, staying home when feeling sick, respiratory hygiene, avoiding touching face, social distancing, avoiding large gatherings, and wearing a mask were assessed. Engagement in these eight behaviors during the past week was reported on a 4-point Likert scale ranging from never to frequently. The Cronbach's alpha for these behaviors was high (.908) and thus, an average score of all behaviors was computed for each participant, with higher scores indicating higher overall engagement in COVID-19 preventive behaviors.

Statistical analyses

Differences among cancer status groups in HBM constructs and COVID-19-related preventive behaviors, controlling for socio-demographic characteristics, were assessed using analysis of covariance (ANCOVA) tests. Hierarchical multiple regression analysis was used to determine how socio-demographic characteristics, HBM constructs, and cancer status were associated with engagement in preventive COVID-19 behaviors. Socio-demographic covariates included age, gender, race, education, and marital status. Since the comparison group has no history of cancer, it was not possible to include cancer type as a covariate in the analyses. The effects of the independent variables were expressed in terms of standardized regression coefficients (betas). The amount of variance explained in the models was reported in terms of R^2. The threshold for statistical significance used in this study was p-value <.05. SPSS 27.0 was used for all analyses.

Results

Sample characteristics

Respondents were 49.61 years (SD = 17.27) on average, 51.6% female, and 48.9% had a Bachelor's degree or higher educational attainment. Most respondents were White (66.7%), followed by 16.8% Black and 16.5% Hispanic. More than one-half of respondents were married or living with a partner (61.9%). The average score for preventive behaviors was 3.49 (SD = 0.56). Among the cancer survivors, diagnoses included solid tissue (81.3%), blood (9.9%), and skin (8.8%) cancers. Sample characteristics by cancer status group are shown in Table I.

COVID-19 preventive behaviors by cancer status

There was a significant effect of cancer status on COVID-19 infection preventive behaviors for the three groups [$F(2,889) = 4.695$, $p = .009$, partial $eta^2 = .010$]. Bonferroni-corrected post-hoc comparisons indicated

the mean score for preventive behaviors among cancer survivors not in treatment (M = 3.414, SE = .603) was significantly lower than the comparison group of respondents with no history of cancer (M = 3.558, SE = .516), p = .008. There was no significant difference between cancer survivors in treatment (M = 3.500, SE = .565) and either survivors not in treatment or the comparison group.

HBM constructs by cancer status

There was a significant effect of cancer status on ***perceived susceptibility*** across the three groups [F(2,889) = 7.300, p = .001, partial eta^2 = .016]. Bonferroni-corrected post-hoc comparisons indicated that the mean of the comparison group (M = 2.46, SE = .073) was significantly lower than both cancer survivors in active treatment (M = 2.85, SE = .070), p = .001 and those not in treatment (M = 2.75, SE = .071), p = .02. There was also a significant effect of cancer status on ***perceived severity*** across the three groups [F(2,889) = 4.959, p = .007, partial eta^2 = .011]. Bonferroni- corrected post-hoc comparisons indicated that the mean of the comparison group (M = 4.70, SE = .047) was significantly higher than both cancer survivors in active treatment (M = 4.52, SE = .045), p = .026, and those not in treatment (M = 4.49, SE = .046), p = .011. There was a significant effect of cancer status on ***perceived benefits*** for the three groups [F(2,889) = 8.482, p <.001, partial eta^2 = .019]. Bonferroni-corrected post-hoc comparisons indicated the comparison group (M = 4.74, SE = .038) was significantly higher than both cancer survivors in active treatment (M = 4.53, SE = .036), p <.001, and those not in treatment (M = 4.56, SE = .037), p = .004. Lastly, the effects of cancer status on ***perceived barriers*** F(2,889) = 0.343, p = .710, partial eta^2 = .001] and ***self-efficacy*** [F(2,889) = 2.780, p = .063, partial eta^2 = .006] for the three groups were not significant.

Overall Predictors of COVID-19 Preventive Behaviors.

Almost all socio-demographic characteristics (age, race/ethnicity, gender, and marital status [all p-values <.05]) were significant in the first model examining socio-demographics as predictors of preventive behavior. The R^2 of this model was. 038, with demographics explaining 3.8% of the variance, F(6,890) = 6.948, p <.001. When cancer status was added in model 2, most of the socio-demographic characteristics remained significant and cancer survivors not in treatment currently reported significantly lower preventive behaviors compared to the comparison group with no history of cancer (p = .003). In model 2, the R^2 was.046, meaning with the addition of cancer status, the model explained 4.6% of the variance in the model, F(8,888) = 6.426, p < .001. In model 3, when HBM constructs were added along with the other covariates, cancer status was no longer significant but all HBM constructs except perceived susceptibility were significant. Specifically, those with greater perceived severity, benefits, and self-efficacy reported significantly higher engagement in COVID-19 preventive behaviors (all p-values < .01). Those with greater perceived barriers reported significantly lower preventive behaviors (p = .002). When the HBM variables were added to the model, the R^2 increased to.480, F(13,883) = 64.563, p < .001. This indicates that the HBM constructs accounted for an additional 43.4% of the variance. Complete results for each model predicting preventive behaviors are shown in Table II.

To determine whether the effects of the HBM constructs on preventive behaviors differed as a function of survivor group, we ran post hoc pairwise comparisons where interaction terms were created between each survivor group and HBM constructs. No significant interactions were found (all ps >.05) and there were no cases in which the two groups had an absolute value magnitude difference of.10 or larger in their beta weight for a specific HBM construct.

Tab. II. Results of Hierarchical Multiple Regression Predicting Preventive Behaviors.

Variable	Beta	p-value	Beta	p-value	Beta	p-value
Socio-demographics						
Age	**.083**	**.016***	**.109**	**.002***	**-.081**	**.003***
Black (Ref: White)	**.126**	**<.001***	**.089**	**.017***	.046	.098
Hispanic (Ref: White)	**.076**	**.031***	.039	.301	.029	.296
Female (Ref: Male)	**.157**	**<.001***	**.159**	**<.001***	**.056**	**.029***
College degree (Ref: Other)	.059	.093	.061	.083	.012	.629
Married[1] (Ref: Other)	**.116**	**<.001***	**.116**	**<.001***	.049	.054
Cancer status						
Cancer status: In treatment (Ref: Comparison)			-.053	.198	.028	.362
Cancer status: Not in treatment (Ref: Comparison)			**-.131**	**.003***	-.058	.077
HBM constructs						
Perceived Susceptibility					.017	.485
Perceived Severity					**.086**	**.005***
Perceived Benefits					**.369**	**<.001***
Perceived Barriers					**-.116**	**.002***
Perceived Self-efficacy					**.227**	**<.001***

[1] Includes married respondents as well as those living with a significant other.

Discussion

The purpose of this study was to assess differences in engagement in COVID-19 infection preventive behaviors during the pandemic between two cancer survivor groups (survivors in active treatment and those not currently receiving treatment) and a comparison group (adults with no history of cancer). Our hypothesis was not supported; there was no significant difference in engagement in preventive behaviors between cancer survivors in treatment and either survivors not in treatment or the comparison group while controlling for socio-demographics. However, cancer survivors not in treatment engaged in fewer preventive behaviors compared to the comparison group. We also analyzed results through the lens of the HBM, a health behavior theory often used in studies of preventive behaviors. In adjusted models controlling for socio-demographic, all HBM variables except perceived susceptibility were significant predictors of preventive behaviors, while the influence of cancer status was no longer significant.

Our comparison of COVID-19 beliefs and perceptions (HBM variables) by cancer status yielded interesting results. Both cancer survivor groups reported higher susceptibility to COVID-19 than the comparison group, which may accurately reflect their elevated level of infection risk [19]. However, cancer survivors also reported lower perceived severity of COVID-19 as compared to those without a history of cancer. One potential explanation for this finding may be that survivors have a diminished perception of the severity of COVID-19 because they have experienced much greater health challenges relative to others with no history of cancer, including their cancer symptoms and treatment side effects. Nonetheless, people with a cancer history remain at an increased risk of serious complications from COVID-19 [19-21]; so this perception is concerning. Future research should attempt to understand the cognitive mechanisms underlying these differences. Another potentially troublesome finding is how perceived benefits of preventive behaviors were lower among cancer survivors, as many of the behaviors assessed are the same as those routinely recommended for infection prevention for immunosuppressed cancer survivors. Those with lowered immune systems, a potential side effect of cancer treatment, should be engaging in preventive behaviors the most. While a mild case of COVID-19 may be not be as serious as cancer, severe cases of COVID-19 – especially among those with a history of cancer – can have equally grave consequences. To address this in messages targeting cancer survivors, public health and communication professionals should emphasize the benefits of COVID-19 infection preventive behaviors and the severity of COVID-19.

Results of the adjusted models predicting COVID-19 preventive behaviors suggest that COVID-19 beliefs and perceptions (HBM variables) have a greater impact on performance of preventive behaviors during a pandemic than cancer status [22]. Therefore, public health communication efforts should focus on HBM constructs when promoting COVID-19 preventive behaviors.

Finally, it should be noted that when the HBM constructs were added to the final regression model, they explained an additional 43.4% of the variance in COVID-19 preventive behaviors. This provides strong evidence for using the HBM and its constructs as a guiding framework when designing messages to promote infection prevention adherence. This finding is consistent with other studies [22-24]. Therefore, the HBM is relevant for public health and health communication practitioners and will likely remain relevant beyond the COVID-19 pandemic, into future flu seasons and other infectious disease outbreaks.

Strengths, limitations, and future directions

Utilizing a panel sample for this research made it possible to access this unique sample in the time-sensitive period before vaccines were available, when preventive behaviors were the first line of defense against COVID-19 infection. Although use of a panel sample may limit the generalizability of the results, it should not impact the associations examined. Future studies should replicate this research using a random, more representative sample and consider including COVID-19 vaccination as a preventive behavior since a vaccine was not available at the time these data were collected. Detailed medical and treatment information (*e.g.*, stage of cancer diagnosis, time since diagnosis and treatment) was not collected from cancer survivors and could have enhanced our results better in the survivorship context. In addition, interactions with healthcare providers, such as receipt of provider recommendations for COVID-19 infection preventive behaviors, were not collected in this study. Future studies examining preventive behaviors should aim to collect this information when possible as provider recommendations are frequently and highly associated preventive behaviors attitudes and uptake [20, 25]. The impact of this potential confound in the present study is unknown. The study is also limited by it's use of a cross-section survey. A longitudinal survey would have allowed for the assessment of changes in preventive behaviors at different times throughout the course of the pandemic. Finally, data collection was limited to U.S. residents – future studies should include other nationalities and geographic areas, since preventive approaches to COVID-19 as well as cultural factors likely affect both perceptions and behaviors. However, the limitations of this study are balanced by important strengths. One of the primary strengths of this study is its inclusion of cancer survivors with two cancer treatment statuses – survivors currently undergoing treatment and those no longer in treatment. This unique distinction adds to the limited cancer research examining differences between cancer survivor subtypes. In addition, a well-known and commonly accepted health behavior theory, the HBM, was used as a framework for understanding adherence to recommendations for COVID-19 preventive behaviors. Our findings related to the HBM afford insights related to the reasons underlying uptake of COVID-19

preventive behaviors. Future qualitative research would help provide a further nuanced understanding of why individuals do or not do engage in the recommended behaviors.

Conclusions

This study focused on identifying differences in COVID-19 infection preventive behaviors and HBM constructs among three unique groups (cancer survivors in active treatment, cancer survivors not receiving treatment currently, and a comparison group without a history of cancer). In addition, we assessed which factors predicted COVID-19 predictive behaviors during the pandemic. Collectively, our findings suggest that COVID-19-related beliefs and perceptions (HBM constructs) matter more than cancer status in predicting adherence to recommended preventive behaviors. Although vaccines against COVID-19 are now widely available, preventive behaviors continue to be recommended to protect vulnerable groups, including cancer survivors. Therefore, public health organizations and practitioners should focus on emphasizing elements of the HBM such as the benefits of preventive behaviors and the potential seriousness of COVID-19 and other infectious diseases.

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Conflict of interest statement

The authors declare that they have no conflicts of interest.

Authors' contributions

CAM, JPDG, BFF: researched literature and conceived the study. CAM, JPDG: designed the survey and gained ethical approval. CAM, JPDG, PBP: conducted data analysis. CAM: wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

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Correspondence: Carrie Miller, Address: 830 East Main Street, Box 980101, Richmond, Virginia, USA 23298-0101. E-mail: carrie.a.miller@vcuhealth.org

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