

## IN-DEPTH REVIEWS

**Impact of Depression on Health-Related Quality of Life among Skin Cancer Survivors**

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**ABSTRACT**

**Introduction:** Skin cancers are one of the most common cancers in the United States (US). Studies have reported depression to be a common comorbid condition among individuals with skin cancer. This study aimed to evaluate the relationship of depression with health-related quality of life (HRQOL) among individuals with a skin cancer diagnosis.

**Methods:** A cross-sectional study design using the 2017 Behavioral Risk Factor Surveillance System (BRFSS) data, a nationally representative sample of non-institutionalized US adults, was utilized for the study. Multivariable logistic regression was used to assess the relationship between depression and the HRQOL domains (general health status, physical health, mental health, and activity limitations due to poor physical or mental health) among survivors of skin cancer.

**Results:** Comorbid depression was identified in 20% of skin cancer survivors. After adjusting for covariates, skin cancer survivors with depression had higher odds of having poor general health status (Odds Ratio [OR] = 1.67, 95% Confidence Interval [CI] 1.41-1.98) as compared to skin cancer survivors without depression. Skin cancer survivors with depression also had greater odds of having poor physical HRQOL (OR = 1.82, 95% CI 1.53-2.15), poor mental HRQOL (OR = 6.38, 95% CI 5.26-7.74), and activity limitations (OR = 2.42, 95% CI 2.03-2.89) as compared to those without depression.

**Conclusion:** This study highlights the significant negative impact of comorbid depression on HRQOL in a nationally representative sample of skin cancer survivors and serves as evidence for the need for more active surveillance and management of depression in this population.

## INTRODUCTION

Skin cancer is defined as unnatural growth of skin cells and usually develops on exposure to the sun. There are two major subtypes of skin cancer – melanoma and non-melanoma skin cancer (NMSC). Skin cancer is the most prevalent cancer in the United States (US), and the incidence of both NMSC and melanoma has been rapidly increasing in recent years. It was estimated that over 5 million cases of NMSC are diagnosed every year in the US.<sup>1</sup> According to American Cancer Society, in 2019, about 96,480 people in the US will be diagnosed with melanoma and there will be about 7,230 deaths from melanoma.<sup>2</sup>

Previous studies have found skin cancer to greatly impact HRQOL of patients. A systematic review of HRQOL among melanoma patients reported the disease to impact HRQOL at three specific stages - melanoma diagnosis, treatment, and follow-up.<sup>3</sup> In addition, studies using melanoma specific HRQOL instruments reported a significant decrements in HRQOL between patients with local/regional and advanced melanoma.<sup>4,5</sup> While studies comparing HRQOL between melanoma patients and that of the general population have often found no significant differences,<sup>6</sup> melanoma patients have been found to have similar HRQOL as that of patients with other malignancies, such as renal cell carcinoma.<sup>7</sup> Even though it does not have a significant risk of associated mortality, studies have shown NMSC to have a significant negative impact on the HRQOL of a patient. Previous studies of HRQOL among patients with NMSC reported that previous studies have found that the domains of physical deformity, cosmesis, and psychosocial functioning were impacted by the disease.<sup>8,9</sup> Another study that assessed HRQOL among young adults with NMSC reported concerns about their

skin cancer and possibility of developing further cancers in the future as the domains most impacted by the disease.<sup>10</sup> Diagnosis of NMSC, its treatment, and the consequences of the treatment all contributed to its impact on HRQOL.<sup>11</sup>

Extant literature has identified depression to be a significant comorbidity in patients with skin cancer. A study reported that three out of every ten patients with melanoma had emotional distress (i.e., anxiety, depression, and adjustment disorder), a proportion that is comparable to the prevalence of emotional distress in patients with other cancers.<sup>12</sup> A systematic review of psychological response among malignant melanoma patients also found a 30% prevalence of comorbid psychological distress,<sup>13</sup> which was similar to that found in malignancies like breast and colon cancer.<sup>14</sup> Studies have reported anxiety and depression to be most common psychological disorders in this population.<sup>15</sup>

It has been seen that comorbid depression has a detrimental effect on patient QOL and disease prognosis. A study by Trask et al. examined the psychosocial characteristics of non-stage IV melanoma patients in a melanoma clinic in the US. The study results suggested that ~33% of the patients exhibited high levels of distress, and that the group of distressed patients had inferior QOL compared with the non-distressed patient group. It also revealed that the group of distressed patients was more likely to use maladaptive (negative) coping strategies as compared to the non-distressed group of patients.<sup>16</sup> Several other studies have also found a strong association between comorbid depression and poor HRQOL among adult cancer survivors.<sup>17–20</sup>

However, to our knowledge, there are no studies that have assessed the impact of comorbid depression on HRQOL on

survivors of skin cancer in a nationally representative sample of US adults. A nationally representative estimate of the burden of comorbid depression on HRQOL amongst skin cancer survivors will be instrumental in helping policy-makers make decisions about depression management in this population. It will also help policy-makers better allocate healthcare resources geared towards screening and management of depression.

## METHODS

**Study Design and Data:** In this retrospective cross-sectional study, we analyzed the 2017 Behavioral Risk Factor Surveillance System (BRFSS) dataset for the study. BRFSS data is collected by joint collaboration of the Center for Disease Control and Prevention (CDC) and state health departments of the 50 states and territories on health risk behaviors, preventive health practices, and health care service use and access pertaining to chronic conditions. It is funded by the federal government and data is collected annually by state-based surveillance systems through telephone surveys. Iterative proportional fitting is used to assign weights to BRFSS data in order for the sample to be considered nationally representative. Public accessibility of the BRFSS data obviated the need for the study to be reviewed by the Institutional Review Board at the University of Mississippi. Data regarding skin cancer, depression and HRQOL was obtained from the 2017 BRFSS dataset to examine the study objectives.

**Study Variables:** Identification of individuals with a history of skin cancer was done based on their response to the question in the BRFSS questionnaire, “Has a doctor, nurse, or other health professional ever told you that you had skin cancer?” Individuals who

responded with a yes were identified as skin cancer survivors.

Among skin cancer survivors, depression was identified based on an individual’s response (“yes” or “no”) to the question in the BRFSS questionnaire, “Has a doctor, nurse, or other health professional ever told you that you have a depressive disorder, including depression, major depression, dysthymia, or minor depression?”

Four questions are used to measure HRQOL in BRFSS. The four questions evaluate four aspects of HRQOL, viz. general health status, physical HRQOL, mental HRQOL, and activity limitations attributed to poor physical or mental health. General health status was determined based on response (“excellent”, “very good”, “good”, “fair”, and “poor”) to the question in the questionnaire, “Would you say that in general your health is ?” For the purpose of this study, the responses were dichotomized into good health (including “excellent”, “very good”, and “good”) and poor health (including “fair” and “poor”). Physical HRQOL was evaluated based on the response to the question in the questionnaire, “Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?” Mental HRQOL was assessed based on the response to the question in the questionnaire, “Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?” Activity limitations due to poor physical and mental health was gauged based on the response to the question in the questionnaire, “During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?” We collapsed

responses for physical HRQOL, mental HRQOL, and activity limitations attributed to poor physical or mental health into two categories contingent upon whether the individuals were affected for less than 14 days (good) or greater than or equal to 14 days (poor). Scoring of the four HRQOL variables has been previously validated<sup>21</sup>, and it has been employed by studies that have assessed HRQOL using BRFSS data.<sup>22</sup>

Other covariates that were taken into consideration comprised of age, sex, race, income, geographic region, employment status, health insurance, marital status, education, and a count of chronic diseases. Age was divided into three categories, for individuals between 18 and 44 years, for individuals between 45 and 64 years, and for individuals who are 65 years old and older. Race was stratified into non-Hispanic whites, non-Hispanic blacks, Hispanics, multiracial, and others. Income was categorized as less than \$10,000, between \$10,000 and 19,999, between \$20,000 and \$34,999, between \$35,000 and \$74,999, and greater than or equal to \$75,000. Geographic regions were categorized as Northeast, Midwest, South, and West. Employment status included unable to work, retired, student/homemaker, out of work, and employed. Health insurance status was dichotomized contingent on individuals reporting any kind of healthcare coverage. Marital status included never married, widowed, divorced or separated, and married or part of a couple. Education status was categorized into less than high school, graduated high school, attended college or technical school, and college graduate. A count of chronic disorders was taken by adding the chronic conditions (Myocardial Infarction, Coronary Heart Disease, Stroke, Asthma, Other Cancer, COPD, Arthritis, Kidney Disease, Diabetes) reported to be present by individuals, other than skin cancer and depression. This has

been done by previous studies that have utilized BRFSS data.<sup>22</sup>

**Study Analyses:** Study analyses were conducted using SAS version 9.4 (SAS Institute Inc, Cary, NC). PROC SURVEY procedures were used to account for BRFSS's complex study design. PROC SURVEYFREQ and PROC SURVEYMEANS were employed for comparison of frequencies and percentages of categorical and continuous variables. PROC SURVEYLOGISTIC was used to conduct bivariate analyses and multivariable logistic regression to assess the relationship between depression and HRQOL (general health status, physical HRQOL, mental HRQOL, and activity limitations due to physical and mental HRQOL) among skin cancer survivors. Odds ratios (ORs) and confidence intervals (CIs) were reported and results were considered statistically significant at  $p = 0.05$ .

## RESULTS

Of the 450,016 adults who participated in the 2017 BRFSS survey, 42,045 (9.3%) were skin cancer survivors and constituted the final sample of interest. Of the skin cancer survivors, 8,394 (20.0%) had a diagnosis of depression. Patient demographic and clinical characteristics for skin cancer survivors with and without depression are shown in Table 1. Skin cancer survivors with depression were younger, predominantly female and non-white, had lower income, more likely to not be able to work, and less likely to be married than those without depression. They also had higher number of chronic comorbid conditions and were more likely to not have health insurance as compared to those without depression.

The results from the bivariate analyses for the association between depression and the four HRQOL variables (general health status, physical HRQOL, mental HRQOL, and activity limitations) have been presented in Table 2. These were the unadjusted comparisons that did not account for any covariates. From the results of the bivariate analysis we can say that adult skin cancer survivors with depression had significantly greater odds of having poor general health status (OR = 2.78, 95% CI 2.47-3.12), poor physical HRQOL (OR = 2.97, 95% CI 2.61-3.37), poor mental HRQOL (OR = 8.84, 95% CI 7.41-10.56), and activity limitations (OR = 4.17, 95% CI 3.59-4.84) as compared to their non-depressed counterparts.

Table 3 presents results of the multivariable logistic regression analyses examining the impact of depression on the four HRQOL variables (general health status, physical HRQOL, mental HRQOL, and activity limitations). After accounting for baseline demographics and comorbidities, adult skin cancer survivors with depression had greater odds of having poor general health status (OR = 1.67, 95% CI 1.41-1.98) as compared to skin cancer survivors without depression. They also had higher odds of having poor ( $\geq 14$  unhealthy days) physical HRQOL (OR = 1.82, 95% CI 1.53-2.15), poor mental HRQOL (OR = 6.38, 95% CI 5.26-7.74), and activity limitations (OR = 2.42, 95% CI 2.03-2.89) versus those without depression.

**Table 1.** Demographic and Clinical Characteristics of Adult Skin Cancer Survivors. Behavioral Risk Factor Surveillance System (BRFSS), 2017.

Characteristics <sup>a</sup>	Total, <sup>b</sup> n (%)	Skin Cancer with Depression, <sup>c</sup> n (%)	Skin Cancer without Depression, n (%)	p-value
<b>Age</b>				<.001
18-44	1,409 (3.4)	416 (5.0)	993 (3.0)	
45-64	11,448 (27.2)	3,099 (36.9)	8,349 (24.8)	
$\geq 65$	29,188 (69.4)	4,879 (58.1)	24,309 (72.2)	
<b>Gender</b>				<.001
Male	19,489 (46.4)	2,983 (35.6)	16,506 (49.1)	
Female	22,532 (53.6)	5,401 (64.4)	17,131 (50.9)	
<b>Race/ethnicity</b>				<.001
White	39,540 (95.5)	7,729 (93.7)	31,811 (96.0)	
Black	197 (0.5)	59 (0.7)	138 (0.4)	
Hispanic	561 (1.4)	165 (2.0)	396 (1.2)	
Multiracial	504 (1.2)	138 (1.7)	366 (1.1)	
Other <sup>a</sup>	600 (1.4)	160 (1.9)	440 (1.3)	
<b>Income</b>				<.001
<\$10 000	873 (2.5)	419 (5.8)	454 (1.6)	

\$10 000-\$19 000	3,503 (10.1)	1,132 (15.7)	2,371 (8.6)	
\$20 000-\$34 999	6,850 (19.7)	1,656 (23.0)	5,194 (18.9)	
\$35 000-\$74 999	11,386 (32.8)	2,234 (31.0)	9,152 (32.2)	
≥\$75 000	12,149 (34.9)	1,767 (24.5)	10,382 (37.7)	
<b>Health Plan</b>				<.001
No	957 (2.3)	285 (3.4)	672 (2.0)	
Yes	41,016 (97.7)	8,092 (96.6)	32,924 (98.0)	
<b>Marital Status</b>				<.001
Never married	2,199 (5.2)	619 (7.4)	1,580 (4.7)	
Widowed	9,066 (21.6)	1,695 (20.3)	7,371 (22.0)	
Divorced	5,900 (14.1)	1,943 (23.2)	3,957 (11.8)	
Married	24,737 (59.1)	4,106 (49.1)	20,631 (61.5)	
<b>Education</b>				<.001
Less than High School	2,047 (4.9)	600 (7.2)	1,447 (4.3)	
High School Graduate	10,064 (24.0)	2,051 (24.5)	8,013 (23.9)	
Attended College / Technical School	11,274 (26.9)	2,444 (29.2)	8,830 (26.3)	
College Graduate	18,571 (44.2)	3,286 (39.1)	15,285 (45.5)	
<b>Employment</b>				<.001
Unable to work	2,539 (6.1)	1,399 (16.7)	1,140 (3.4)	
Retired	24,240 (57.9)	4,101 (49.1)	20,139 (60.1)	
Student/Homemaker	2,016 (4.8)	397 (4.7)	1,619 (4.8)	
Out of work	1,047 (2.5)	351 (4.2)	696 (2.1)	
Employed	12,051 (28.7)	2,111 (25.3)	9,940 (29.6)	
<b>Geographic Region</b>				<.001
Northeast	6,795 (16.2)	1,331 (15.9)	5,464 (16.3)	
Midwest	11,138 (26.6)	2,105 (25.2)	9,033 (26.9)	
South	14,031 (33.4)	2,897 (34.6)	11,134 (33.2)	
West	9,975 (23.8)	2,028 (24.3)	7,947 (23.6)	
<b>General Health Status</b>				<.001
Good	32,308 (77.1)	5,017 (60.0)	27,291 (81.4)	

Poor	9,593 (22.9)	3,349 (40.0)	6,244 (18.6)	
<b>Physical HRQOL</b>				<.001
Good (< 14)	33,647 (82.0)	5,455 (66.7)	28,192 (85.8)	
Poor (≥ 14)	7,386 (18.0)	2,722 (33.3)	4,664 (14.2)	
<b>Mental HRQOL</b>				<.001
Good (< 14)	37,510 (90.6)	5,638 (69.1)	31,872 (95.9)	
Poor (≥ 14)	3,883 (9.4)	2,523 (30.9)	1,360 (4.1)	
<b>Activity Limitations</b>				<.001
No (< 14)	36,947 (89.0)	6,093 (74.3)	30,854 (92.6)	
Yes (≥ 14)	4,575 (11.0)	2,113 (25.7)	2,462 (7.4)	
<b>Number of Chronic Conditions, mean (± SD)</b>	42,045	1.99 (0.02)	1.35 (0.01)	<.001

- a. Other includes Asians, native Hawaiians, other Pacific Islanders, American Indians, or Alaska Natives.
  - b. The study sample included 42,045 adult skin cancer survivors
  - c. 8,394 of the adult skin cancer survivors had depression
- All n indicate unweighted estimates  
 HRQOL, health-related quality of life; SD, standard deviation

**Table 2.** Bivariate association between Depression and General Health Status, Physical HRQOL, Mental HRQOL, and Activity Limitations among Adult Skin Cancer Survivors. Behavioral Risk Factor Surveillance System (BRFSS), 2017.

Outcome Variable	Odds Ratio (95% confidence interval)		p-value
	Depressed	Non-Depressed	
General Health Status	2.78 (2.47-3.12)	Reference	<.001
Physical HRQOL	2.97 (2.61-3.37)	Reference	<.001
Mental HRQOL	8.84 (7.41-10.56)	Reference	<.001
Activity Limitations	4.17 (3.59-4.84)	Reference	<.001

HRQOL, health-related quality of life

**Table 3.** Multivariable Logistic Regression Assessing Relationship between Depression and General Health Status, Physical HRQOL, Mental HRQOL, and Activity Limitations among Adult Skin Cancer Survivors. Behavioral Risk Factor Surveillance System (BRFSS), 2017.

Study Variable	Odds Ratio (95% confidence interval)			
	General Health Status	Physical HRQOL	Mental HRQOL	Activity Limitations
<b>Depression</b>				
No	Reference	Reference	Reference	Reference
Yes	1.67 (1.41-1.98) *	1.82 (1.53-2.15)*	6.38 (5.26-7.74)*	2.42 (2.03-2.89)*

Study Variable	Odds Ratio (95% confidence interval)			
	General Health Status	Physical HRQOL	Mental HRQOL	Activity Limitations
<b>Age</b>				
18 – 44	Reference	Reference	Reference	Reference
45 – 64	1.10 (0.77-1.59)	0.95 (0.67-1.34)	0.61 (0.45-0.81)*	0.67 (0.45-0.99)*
≥65	0.77 (0.52-1.16)	0.69 (0.47-1)	0.44 (0.31-0.61)*	0.51 (0.33-0.78)*
<b>Gender</b>				
Female	Reference	Reference	Reference	Reference
Male	1.27 (1.10-1.47)*	1.03 (0.88-1.2)	1.09 (0.89-1.32)	1.06 (0.9-1.26)
<b>Race</b>				
White	Reference	Reference	Reference	Reference
Black	1.47 (0.66-3.26)	1.06 (0.45-2.49)	1.34 (0.6-2.98)	1.41 (0.62-3.21)
Hispanic	0.99 (0.5-1.99)	0.68 (0.36-1.3)	1.16 (0.56-2.42)	0.53 (0.25-1.15)
Multiracial	1.07 (0.69-1.64)	1.32 (0.78-2.24)	1.28 (0.82-1.99)	0.98 (0.56-1.7)
Other <sup>a</sup>	0.89 (0.42-1.89)	1.45 (0.79-2.65)	1.46 (0.86-2.49)	1.55 (0.82-2.92)
<b>Income</b>				
<\$10 000	Reference	Reference	Reference	Reference
\$10,000-\$19,000	0.88 (0.58-1.34)	0.78 (0.52-1.15)	0.79 (0.5-1.25)	0.9 (0.58-1.4)
\$20,000-\$34,999	0.59 (0.39-0.89)*	0.49 (0.33-0.73)*	0.64 (0.39-1.03)	0.69 (0.44-1.09)
\$35,000-\$74,999	0.46 (0.3-0.7)*	0.37 (0.25-0.55)*	0.58 (0.35-0.96)*	0.57 (0.36-0.9)*
≥ \$75,000	0.28 (0.18-0.44)*	0.27 (0.18-0.42)*	0.50 (0.29-0.85)*	0.43 (0.25-0.73)*
<b>Health plan</b>				
No	Reference	Reference	Reference	Reference
Yes	0.94 (0.64-1.4)	1.01 (0.67-1.52)	0.85 (0.61-1.18)	1.05 (0.72-1.53)
<b>Marital status</b>				
Never married	Reference	Reference	Reference	Reference
Widowed	0.98 (0.69-1.38)	1.32 (0.92-1.89)	1.03 (0.69-1.53)	0.88 (0.59-1.3)
Divorced	1.11 (0.79-1.55)	1.25 (0.9-1.73)	0.95 (0.67-1.33)	1.04 (0.72-1.53)

Study Variable	Odds Ratio (95% confidence interval)			
	General Health Status	Physical HRQOL	Mental HRQOL	Activity Limitations
Married	1.05 (0.76-1.44)	1.37 (1-1.89)*	0.74 (0.54-1.03)	0.9 (0.62-1.31)
<b>Education</b>				
Less than high school	Reference	Reference	Reference	Reference
High school Graduate	0.67 (0.51-0.88)*	1.06 (0.81-1.4)	0.93 (0.67-1.29)	0.72 (0.54-0.98)*
Attended college/ technical school	0.48 (0.36-0.64)*	0.97 (0.72-1.3)	0.71 (0.51-0.99)*	0.76 (0.55-1.03)
College graduate	0.41 (0.31-0.55)*	0.91 (0.68-1.23)	0.57 (0.40-0.8)*	0.69 (0.5-0.96)*
<b>Employment</b>				
Unable to work	Reference	Reference	Reference	Reference
Retired	0.31 (0.23-0.43)*	0.25 (0.19-0.33)*	0.47 (0.34-0.65)*	0.25 (0.19-0.33)*
Student/ Homemaker	0.25 (0.16-0.4)*	0.22 (0.15-0.34)*	0.42 (0.26-0.66)*	0.18 (0.12-0.29)*
Out of work	0.31 (0.21-0.45)*	0.43 (0.29-0.63)*	0.81 (0.55-1.2)	0.45 (0.31-0.65)*
Employed	0.20 (0.15-0.28)*	0.15 (0.11-0.21)*	0.44 (0.32-0.61)*	0.13 (0.09-0.18)*
<b>Geographic Region</b>				
Northeast	Reference	Reference	Reference	Reference
Midwest	0.91 (0.75-1.11)	0.99 (0.81-1.22)	0.81 (0.63-1.03)	0.92 (0.71-1.2)
South	1.04 (0.85-1.27)	0.86 (0.7-1.06)	0.96 (0.75-1.23)	0.91 (0.7-1.18)
West	0.88 (0.69-1.1)	0.95 (0.75-1.21)	0.89 (0.67-1.18)	0.91 (0.69-1.2)
<b>Number of Chronic Conditions</b>	1.80 (1.7-1.91)*	1.50 (1.42-1.58)*	1.15 1.13 (1.06-1.2)*	1.45 (1.37-1.53)*

a. Other includes Asians, native Hawaiians, other Pacific Islanders, American Indians, or Alaska Natives.

\*signifies p value less than .05

HRQOL, health-related quality of life.

## DISCUSSION

Even though previous studies have assessed the relationship between depression and

HRQOL among skin cancer, none of them have been investigated in a sample representative of the US population. To the best of our knowledge, this is the first study

to have assessed the burden of depression among skin cancer survivors in a nationally representative sample of US adults. Specifically, the study compared HRQOL among skin cancer patients with and without depression.

This study estimated the prevalence rate of comorbid depression to be 20 % among skin cancer survivors. This is similar to findings in other studies. An assessment of current depression among melanoma survivors using the 2010 BRFSS data reported a prevalence of 17%.<sup>23</sup> However, the data for this study was collected in only six states, limiting its generalizability at a national level. Another study that collected data from a melanoma clinic in the US found that almost 30% of the melanoma patients were also suffering from high psychological distress.<sup>16</sup> Additionally, several other studies that have assessed depression among skin cancer patients, both in US and non-US samples, have reported a 15%-23.5% prevalence rate of comorbid depression.<sup>24-26</sup>

The study results bring to attention the incremental impact of depression on HRQOL among skin cancer survivors. In comparison with those without depression, skin cancer survivors with depression were worse off on all aspects of HRQOL - general health status, physical HRQOL, mental HRQOL, and activity limitations. In this study, we found that depression had the greatest impact on mental HRQOL of skin cancer survivors. For adult skin cancer survivors with depression, the odds of poor mental HRQOL, were ~6 times that for those without depression. This finding was endorsed by previous studies. A study by Trask et al., in a midwestern, multi-center melanoma clinic reported around 33% of the patients to be afflicted with moderate or high psychological distress and increased distress was seen to be correlated with inferior QOL and impaired functioning. Trask

et al. hypothesized that the inversely proportional relationship of distress and QOL is due to the coping technique employed by individuals.<sup>16</sup> Although limited evidence is available regarding the impact of depression on mental HRQOL among skin cancer patients, this relationship has been explored among patients with other cancer types. A cross-sectional study of baseline data, from a randomized control trial of adult cancer patients, assessing the relationship between depression and HRQOL found that depression impacted all domains of HRQOL, including mental health, vitality, perceived disability, overall quality of life, and general health perceptions.<sup>18</sup> Another study, that examined the association of comorbid depression with HRQOL among German cancer patients, found comorbid depression to be a predictor of mental HRQOL, controlling for the patient's physician-assessed performance status.<sup>27</sup> Given the severe impact of depression on mental HRQOL of skin cancer survivors, psychological health profile evaluation can be considered during routine clinic visits to enable better management for such patients.

This study also found depression to be strongly associated with poor physical HRQOL and activity limitations. Adult skin cancer survivors with depression had around 2 times the odds of poor physical HRQOL, and 2.5 times the odds of activity limitations as compared to those without depression. Trask et al., in a study of melanoma patients, found depression to be significantly associated with worse physical functioning.<sup>16</sup> However, this study only assessed people who were currently undergoing treatment for melanoma. Our study, on the other hand, assessed the impact of depression on all skin cancer survivors, not just those who are currently undergoing treatment. Moreover, the Trask et al. study comprised of only melanoma patients. Our study sample

included any skin cancer (melanoma or NMSC). The impact of depression on physical health and activity limitations has been previously seen in studies of survivors of other cancers as well. A cross-sectional study of fatigue (also, defined as activity limitation) in survivors of Hodgkin's disease found fatigue to have moderate correlation with depression, and that depression was a significant risk factor for fatigue.<sup>28</sup> Another study that assessed the relationship between fatigue and psychological distress in a sample of uterine cancer patients found depression to not only be significantly correlated with activity limitations, but also that depression explained almost 50% of the variance in levels of activity limitation.<sup>29</sup> A prospective study of head and neck cancer patients, conducted in the US, reported depression to be significantly associated with poor physical QOL.<sup>30</sup> A registry-based study, conducted in Germany, that assessed anxiety and depression in working age cancer survivors found depression to have an inverse relationship with physical health.<sup>31</sup> Faller et al., in a study of a representative sample of German cancer patients, found depression to be significantly associated with physical HRQOL.<sup>27</sup> Given the significant burden of depression on physical health and activity limitations of skin cancer survivors, assessment of physical health profiles should also be integrated into routine clinical care, in addition to psychological health profile assessment.

Overall, this study has implications from both clinical and policy maker perspectives. From a clinical point of view, the study adds to the evidence base for considering assessment of physical and psychological health profiles of skin cancer survivors during routine care. From a policy maker perspective, this study puts forth evidence for greater emphasis on integration of depression screening and management in care for skin cancer

survivors. Even though the latest American Society of Clinical Oncology (ASCO) guidelines, in 2014, call for periodic depression screening for any adult cancer survivor,<sup>32</sup> there is paucity of studies that have looked at its implementation in practice. Policy makers should consider greater adoption for integrated models for healthcare, especially for skin cancer survivors, in order to initiate depression management as early as possible, minimizing its impact on the skin cancer survivor's HRQOL. Even though there are some intervention programs for people with depression and cancer like "Depression Care for People with Cancer,"<sup>33</sup> there is a need for more active surveillance and management of depression targeted towards skin cancer survivors. A study on effectiveness of cognitive behavioral intervention for distress among melanoma patients found a significant improvement in several domains of HRQOL, including general health, vitality, and mental health.<sup>12</sup> Future research should also assess the effectiveness of various treatments for depression on improvement in HRQOL among skin cancer survivors.

This study had certain limitations. First, due to the cross-sectional nature of the study design, causality cannot be inferred. Future research could study temporality by using a longitudinal design. Second, BRFSS data is self-report, which is susceptible to recall bias. Also, since there is no clinical validation of disease status, under-reporting or over-reporting of depression is a possibility. Moreover, there was no indicator of depression severity and treatment in the data. Accounting for these variables may help further understand the relationship between HRQOL and comorbid depression. In spite of the limitations discussed above, we believe that assessment of the relationship between depression and HRQOL using a nationally representative

data set is an important addition to the pool of scientific literature on depression and skin cancer.

## CONCLUSION

To the best of our knowledge, there are no prior studies that have assessed the relationship between depression and HRQOL in a nationally representative sample of skin cancer survivors. The results highlight the strong association between presence of depression and poor HRQOL. The study accentuates the even sharper impact of depression on mental HRQOL among skin cancer survivors. It serves as an evidence for the need for more active surveillance and management of depression among skin cancer survivors, which in turn has the potential to vastly improve their HRQOL.

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