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Health-related quality of life among colorectal cancer survivors of diverse sexual orientations

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Abstract

Background: The purpose of this study is to examine sexual minority compared to heterosexual survivors' health-related quality of life.

Methods: Four-hundred-eighty eligible survivors participated in a telephone survey, which measured survivors' outcomes, consisting of physical and mental quality of life, and self-rated fair or poor health. These survivors were diagnosed with stage I, II, or III colorectal cancer an average of three years prior to the survey and were recruited from four cancer registries. We considered four domains-- personal factors, environmental factors, health condition characteristics, and body function and structure-- as correlates for each survivorship outcome using forward selection with generalized linear models or logistic regression models.

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Author Contribution Statement

UB conceived of the study and led the writing. AO guided the statistical analysis. MW and FB performed the analysis. All authors helped with the interpretation of the results and edited and approved the final manuscript.

Conflict of Interests:

None of the authors report a conflict of interest.

Results: We found that unadjusted physical quality of life and self-rated fair/poor health were similar for all survivors. Sexual minority survivors had poorer unadjusted mental quality of life compared to heterosexual survivors. After adjusting for covariates, this difference was no longer statistically significant. Three domains (personal factors, health condition characteristics, body function and structure) explained CRC survivors' fair/poor health and explained 46% of the variance in physical quality of life, while 56% of the variance in mental quality of life was explained by personal factors, body function and structure, and environmental factors.

Conclusion: This study identified modifiable factors that can be utilized to improve cancer survivors' quality of life and are therefore relevant to ongoing efforts to improve the survivorship experience.

Precis

Understanding the factors that contribute to diverse colorectal cancer survivors' poor quality of life is critical for the development of effective patient-centered interventions. This study identified modifiable factors that can be utilized to improve sexual minority and heterosexual cancer survivors' quality of life and are therefore relevant to ongoing efforts to improve the survivorship experience.

Keywords

sexual and gender minorities; quality of life; colorectal neoplasms; cancer survivorship

Colorectal cancer (CRC) is the third leading cancer among women and men in the US.¹ For CRC survivors, post-treatment survivorship often includes long-term physical, psychological, and social consequences that can persist for many years following completion of treatment.² As a result, survivors can experience poor health-related quality of life (hereafter quality of life), which is known for its predictive validity for mortality.^{3, 4} Understanding the factors that contribute to poor quality of life is critical for the development of effective patient-centered interventions, especially among subgroups that experience disparities in CRC incidence or mortality.

Quality of life among sexual minorities with CRC has not been addressed by research studies, despite prior work suggesting sexual minorities have a greater risk of receiving a diagnosis of CRC compared to heterosexual individuals.⁵⁻⁷ Previous studies of sexual minority cancer survivors' quality of life have often been gender-specific, focusing predominantly on breast or prostate cancer and resulting in divergent findings.^{8, 9} Breast cancer studies revealed similar quality of life for sexual minority compared to heterosexual women survivors,^{8, 10-13} with sexual orientation having indirect associations through interaction effects.¹⁰ In contrast, prostate cancer studies showed some differences, with sexual minority men reporting worse quality of life compared to heterosexual men.^{8, 14-16}

In the absence of known and validated conceptual frameworks to understand sexual minority cancer survivors' quality of life, we chose to utilize the biopsychosocial framework of quality of life. More specifically, we were guided by a systematic review of CRC survivors' quality of life, which provided strong evidence that four domains—personal factors, environmental factors, health condition characteristics, and body function and structure--

predict CRC survivors' quality of life.¹⁷ The aims of the current study were to compare sexual minority to heterosexual CRC survivors on the aforementioned domains and to explain the quality of life of sexual minority and heterosexual CRC survivors.

Methods

All aspects of the study were approved by the Institutional Review Boards of Boston University and the respective cancer registries from which we obtained CRC cases for this study.

Study setting

We selected the geographic regions based on high proportions of same-sex partner households recorded in the 2010 Census and similarity in cancer registry policies regarding patient contact for research studies. After careful evaluation, cases were obtained from the: California Cancer Registry; Seattle-Puget Sound Registry; Georgia Cancer Registry; and Florida Cancer Data System. For each registry, we further restricted the geographic reach to areas with high numbers of CRC cases and same-sex partnered households. Our definition of high was above the median for both, colorectal cancer cases and same-sex partnered households, after stratifying by gender. Men and women were eligible for the study. Other eligibility criteria included: diagnosis of colon or rectal carcinoma less than 5 years ago; Stage I, II, or III at diagnosis; age 21 or older at diagnosis; and English-speaking. At first contact, we determined each respondent's sexual orientation. All individuals who reported a sexual minority identity, defined as lesbian, gay, or bisexual, or reported a same-sex partner were eligible. Every 10th self-identified heterosexual individual was eligible for the study.

Participant recruitment and data collection

All potential participants were contacted following each respective registries' policies for contact. In short, the first contact consisted of a mailed package that included a study recruitment letter, a consent form without signature requirement, a screening questionnaire, and a self-addressed stamped return envelope for the screening questionnaire. The recruitment letter explained the purpose of the study, provided information about the means to opt-out of the study, and announced that a member of the study team would call individuals who did not opt-out of the study or return the screening questionnaire to conduct the screening by telephone. A few weeks after sending the mailing, we initiated the first of a maximum of ten call attempts, including three voice mail messages, to complete the screening survey. Between October 2015 and June 2019, we mailed study packages to 17,855 individuals across the four registries. Of these 2,553 opted out or refused participation upon contact, 1,286 were ineligible, and we were unable to make contact with 7,646 due to bad addresses, nonworking phone numbers, or having made the maximum number of call attempts. We obtained 6,370 completed screening surveys, which corresponds to a 35.7% response and 62.4% cooperation rate. Of 5,750 eligible survivors, we invited all sexual minority survivors and every 10th heterosexual survivor to participate in a 45-minute telephone survey. Of the 719 invited survivors, 127 could not be located for the survey, 108 refused the survey, and four were deemed ineligible at the time of the survey, which resulted in 480 survivors who participated in the survey an average 3 years post

diagnosis (127 sexual minority and 353 heterosexual survivors). For the telephone survey, sexual minority survivors' response and cooperation rates were 69.8% and 88.8% and for heterosexual survivors 65.7% and 78.6%, respectively.

Measures

Our core set of *personal factors* consisted of sexual orientation (sexual minority vs. heterosexual), race/ethnicity (non-Hispanic White, non-Hispanic Black, and other/unknown), and income (less than \$40,000, \$40,000- < \$80,000, \$80,000- <\$120,000, \$120,000 or more) as well as sex and age at diagnosis, which we obtained from the registry. Other *personal factors* consisted of marital status, employment, education, discrimination experiences, coping styles, and resilience. Discrimination was assessed by inquiring about harassment due to age, race/ethnicity, gender, sexual orientation, appearance, income level, or cancer¹⁸ and then categorized into having any of these experiences vs. none. To measure coping styles, we used six (self-distraction, behavioral disengagement, active coping, denial, venting, and positive reframing) of the 14 distinct coping scales of the Brief Cope. Each coping style was dichotomized as less than 50 vs. a score of 51+ to reflect endorsement of this self-reported coping style, "I've been doing this a medium amount or a lot."¹⁹ We measured resilience with the 14-item Resilience Scale (RS-14), which we dichotomized into low to moderate vs. high resilience.²⁰

Health condition characteristics consisted of clinical information, including cancer site, stage at diagnosis, and date of diagnosis, which we obtained from the cancer registry. Additional self-reported data on survivors' health conditions consisted of cancer recurrence, family history of cancer, currently undergoing cancer treatment, stoma, type of treatment (surgery, chemotherapy, radiation, and/or treatment) and co-morbidity, measured with a 9- item self-reported Charlson Co-morbidity Index with a range from 0–9, which we categorized into 0, 1, 2, or 3+ or more comorbidities.²¹

To measure body functions and structures (hereafter body functions), we used the European Organisation for Research and Treatment of Cancer (EORTC) module for CRC, the QLQ-CR29.²² The QLQ-CR29 has 4 functional scales (body image, weight, health-related anxiety, and sexual interest) and 15 symptom scales (e.g., bloating) which were transformed into scales ranging from 0–100. Consistent with earlier research, we then dichotomized each scale to distinguish frequent symptoms, defined as 'quite a bit' or 'very much', which equaled scores ≥ 51 versus scores ≤ 50 , indicating that a symptom was 'not at all' or 'a little' present.^{23, 24} To capture psychological distress, we used the Hospital Anxiety and Depression scale (HADS), which measures symptoms of anxiety and depression over the past week.²⁵ Consistent with earlier research, we defined presence of anxiety (or depression) as scores ≥ 8 .²⁶ To assess survivors' psychological history, we inquired about mental health counseling before the cancer diagnosis.

We considered different dimensions of *environmental factors* experienced by survivors. We assessed perceived social support (9 items from the MOS social support scale)²⁷, which we combined into an overall scale ranging from 0 to 100, and then dichotomized into 100 vs. less to capture unmet social support needs.²⁸ Dichotomous yes vs. no measures included: living alone, having a caregiver for the cancer experience, having attended a cancer support

group, and reporting mental health counseling to deal with cancer. We considered social isolation, measured by a 3-item loneliness scale,²⁹ ranging from 3 “hardly ever lonely” to 9 “very lonely,” which we then dichotomized into “not lonely” for scores of 3–5 and “lonely” for scores of 6 or greater.

A second set of environmental factors consisted of survivor reports of quality of care. Overall quality of care was measured with a single item, “how would you rate the quality of your care”, with response options from excellent to poor, which were dichotomized into excellent care vs. not. Survivors’ perceptions of interpersonal cancer care experiences consisted of physician communication and coordination of care,³⁰ which had scores from 0 (worst) to 100 (best) care. We then dichotomized physician communication and coordination of care into excellent (score of 100) vs. a score of 99 or less.³¹ Receipt of survivorship care plans (SCP) was assessed using questions from the National Health Interview Survey with yes/no response options:³² (1) receipt of a written summary of received treatments, which we refer to as treatment SCP; (2) receipt of written instructions of who to see for follow-up care after the completion of treatment, which we refer to as follow-up SCP; and (3) receipt of individualized recommendations for a healthy lifestyle, such as exercising and not-smoking, which we refer to as individualized SCP. Individuals who responded not knowing whether they received a SCP were counted as not having received a SCP.

A third set of *environmental factors* captured neighborhood-level descriptors of socioeconomic status from survivors’ census tracts at diagnosis. We considered the percent of the population below the poverty level and two others, which captured spatial social and economic polarization, summarized as an Index of Concentration at the Extremes (ICE) for income and race/ethnicity.^{33, 34} The ICE measures range from –1 to +1, which reflect an entire population concentrated in the most disadvantaged or most advantaged extremes respectively, while a value of 0 indicates an equal number of persons are in the most disadvantaged and most advantaged categories.³⁴

As *outcome measures*, we used the 12-item Veterans Rand (VR)³⁵ to measure physical and mental quality of life and a one item dichotomous measure of self-rated health (fair or poor vs. good or better general health). From the VR-12, one can derive two summary scores, the Physical Component Summary (PCS) for physical quality of life and the Mental Component Summary (MCS) for mental quality of life. Both PCS and MCS scores range from 0 (worst) to 100 (best) health.

Statistical Analysis

We examined all sample characteristics using descriptive statistics, including proportions for categorical variables and means, standard deviations, medians, and interquartile ranges for continuous variables. To avoid bias associated with listwise deletion of observations during multivariable regression, we performed multiple imputations using SAS PROC MI. We generated five complete data sets with missing data replaced by imputed values. For each outcome, we first computed a base model, consisting of registry, to account for geographic differences, and selected personal factors: sexual orientation (the main independent variable of interest) and other commonly reported confounders of quality of life: sex, age, race/ethnicity, income. All other variables from the four domains were assessed for significant

bivariate associations with the quality of life outcomes, using generalized linear models (GLM) for PCS and MCS and logistic regression for the dichotomous fair or poor health, across all five imputed data sets. We utilized SAS PROC MIANALYZE to integrate parameter estimates with valid standard errors and significance levels. All variables with a significant bivariate association ($p < 0.05$) with an outcome were considered as candidates for selection into the final model for that outcome, unless more than 95% of the sample was concentrated in a single categorical response (e.g. health insurance). We then used forward selection procedures for each outcome, separately on each of the five completed imputed data sets, forcing entry of the base model variables. The forward selection of additional independent variables into the model was determined using an entry criterion of $p < 0.05$, and the Akaike Information Criterion (AIC) was used to select a model for each imputed data set. We included variables in the final model using a ‘majority rules’ selection process. That is, a variable was included if it was selected into the forward selection models generated with at least three of five imputed data sets. As a final step, we fit the final model specification to all five imputed data sets using SAS PROC MIANALYZE to obtain summarized parameter estimates and standard errors, as we did for the bivariate analyses. For PCS and MCS we calculated the range and mean of the R-squared statistic across all five models. All analyses were performed using SAS version 9.4.

Results

Sexual minority survivors differed from their heterosexual peers on personal characteristics, in that they were significantly younger, less likely to be married, more educated, and more likely employed. Further, sexual minority survivors reported significantly more discrimination experiences and more venting coping compared to heterosexual survivors. Survivors’ descriptors of their health condition was similar, with the exception that sexual minority survivors were significantly less likely to be currently receiving cancer treatment compared to heterosexual survivors.

With respect to body function and structures, few differences were noted between sexual minority and heterosexual survivors. The only exceptions were sexual minority survivors being significantly more likely to report anxiety and greater use of mental health counseling prior to their cancer compared to their heterosexual peers.

Significant differences were noted for environmental factors, including greater use of mental health counseling to cope with cancer among sexual minority survivors and greater likelihood of reporting receipt of excellent care compared to their heterosexual peers. Of the neighborhood level environmental factors, sexual minority survivors were significantly more likely to live in areas with greater concentrations of poverty and experienced more income disadvantage compared to heterosexual survivors.

With respect to the outcomes, sexual minority and heterosexual survivors reported similar physical quality of life (PCS score of 42) and 15–20% of all survivors reported fair or poor health. However, sexual minority survivors reported significantly lower mental quality of life (MCS) compared to heterosexual survivors (MCS 48.9 vs. 52.2, respectively ($p < 0.01$)).

The combination of personal factors, health condition characteristics, and body function explained 46% of the variance in PCS, while environmental factors made no significant contribution towards explaining survivors' PCS (Table 2). Of the personal factors, younger age related to worse PCS, whereas more education and being employed related to better PCS. Of the health condition characteristics, having a stoma and more comorbidities were associated with worse PCS. In addition, body function characteristics, including decreased sexual function, more health-related anxiety, problems with bloating, sore skin, urinary frequency, overweight or obesity, and depression, were associated with worse PCS.

In comparison, 56% of the variance in survivors' MCS was explained by the combination of personal factors, environmental factors, and body function, while health condition characteristics made no significant contribution towards explaining MCS. Of the personal factors, venting coping related to worse MCS, whereas being in the middle income group and reporting high resilience related to better MCS. Of the body function and structures, survivors with weight and health-related anxiety, problems with dry mouth embarrassment, depression, anxiety, and with a past history of mental health counseling had worse MCS. Finally of the environmental factors, survivors with excellent social support and an individualized SCP had better MCS, whereas lonely survivors and those who used mental health counseling to deal with cancer had worse MCS.

We also explored potential explanations for sexual minority survivors' worse MCS compared to heterosexual survivors in unadjusted results, which no longer significantly differed, after other factors were considered. In a series of regression models (results not shown), we observed that the predetermined set of personal factors had little effect on sexual orientation's MCS parameter estimate. However, including mental health counseling before cancer as a covariate reduced the estimated sexual orientation difference in MCS. We also ran the final MCS model with an interaction term for sexual orientation by mental health counseling before cancer, which was not significant.

The three domains that made a significant contribution to PCS—(personal factors health condition characteristics, and body function)-- also explained survivors' reports of fair/poor health. Female gender, being married or employed and having high resilience were the personal factors associated with significantly lower odds of reporting poor health. Having more comorbidities and currently undergoing treatment were the health characteristics with greater odds of poor health, while family history of CRC was linked to lower odds of poor health. Finally, low sexual interest, problems with urinary frequency, bloating, depression, and a history of mental health counseling were the body function characteristics with greater odds of poor health.

DISCUSSION

This study considered four domains, personal factors, health condition characteristics, body function, and environmental factors for which there has been strong evidence linking them to CRC survivors' quality of life¹⁷. Using a representative survivor sample of different sexual orientations, we found that unadjusted PCS and poor health were similar for all survivors. Sexual minority survivors had worse unadjusted MCS compared to heterosexual survivors.

However; after adjusting for covariates, this difference was no longer statistically significant. Many of the sexual orientation differences in each of the four domains are consistent with earlier sexual minority cancer survivor studies. Sexual minority survivors used more mental health care before and after the colorectal cancer diagnosis compared to heterosexual survivors. This finding is consistent with previous general population and cancer survivor studies, which showed higher mental health care use among sexual minorities.^{36–39} This finding should be interpreted in the context of prior studies suggesting that sexual minorities' elevated mental health care use can be explained as a means of coping with their disadvantaged status in society, which exposes them to stigma and discrimination, consistent with the minority stress model.^{40, 41} Thus, sexual minority survivors' lower MCS might be explained by their mental health history, as evidenced by their past mental health care utilization.

Further, compared to heterosexual survivors, sexual minority survivors reported more venting coping, which is considered to be a maladaptive coping strategy.¹⁹ Sexual minority survivors also reported both greater health-related anxiety and general anxiety compared to heterosexual survivors, while both groups had similar levels of depression. These findings expand on a review of sexual minority cancer survivors' mental health. The review found divergent findings of no significant sexual orientation differences in anxiety in a sample of men and women with diverse cancers and among breast cancer survivors, while significant sexual orientation differences in anxiety among prostate cancer survivors were noted.⁸ In comparison, findings in the general (non-cancer) population are consistent with our findings, in that sexual minorities report greater anxiety compared to the heterosexual population.^{36, 42} The combination of these sexual minority-specific findings, all of which are linked to better MCS, could be leveraged by developing culturally-tailored psychological interventions to improve the well-being of sexual minority survivors. To date, sexual minority-specific interventions to address well-being among adult sexual minorities and sexual minority cancer survivors are lacking.⁴³ However, culturally-tailoring interventions to sexual minority individuals is a known practice and can complement ongoing efforts to train healthcare professionals to deliver culturally competent care to sexual minority patients.^{44–46}

Findings for all survivors show that three domains (personal factors, health condition characteristics, and body function), explained CRC survivors' poor health and explained 46% of the variance in PCS, while 56% of the variance in MCS was explained by personal factors, body function and environmental factors. Focusing on the modifiable factors identified in each model, these findings suggest that survivors' PCS might be improved by guiding survivors to a healthy body weight. Survivors' PCS and poor health might also be improved by alleviating the symptomatic sequelae of their CRC and its treatments.

Consistent with prior studies,^{47, 48} loneliness, social isolation, and depression were correlates of CRC survivors' MCS. Various guidelines recommend assessing and then addressing the psychosocial needs of cancer survivors.⁴⁹ A review showed limited evidence that survivorship care plans (SCPs) improve well-being.⁵⁰ In this study, the various SCPs had significant bivariate associations with each outcome, but only the individualized SCP related to MCS in the fully adjusted model, suggesting that SCPs associations with quality of life are not strong.

Despite this study's strength in recruiting CRC survivors of diverse sexual orientations who were representative of various geographic regions, one possible limitation is that the study sample may still include geographic biases. Further, while we used validated measures of quality of life, we recognize that these measures have likely been derived from exclusively heterosexual samples, and validation studies of these measures in sexual minority populations are absent. Other limitations are that eligibility was limited to English speakers; thus, findings are not inclusive of linguistic minorities. Moreover, the survivor sample included a small percentage of racial and ethnic minorities, which means that the findings may not adequately reflect the experience of racial and ethnic minorities. Finally, the cross-sectional study design prohibits drawing causal inferences.

Methodological changes in future studies should be considered to address current goals to advance the field of sexual minority health research⁴³ and overcome some of the limitations acknowledged in this study. One goal is to address intersecting identities of sexual minorities. As such, increasing the diversity of samples might be achieved by conducting studies in multiple languages. Another goal to be implemented in cancer survivorship, consistent with recent consensus statements,⁴³ is to conduct longitudinal studies that address sexual minorities' well-being over time. Finally, consideration should be given to determining whether the current validated measures of quality of life adequately measure the lived experiences of sexual minority cancer survivors. Despite these limitations, this study makes several important contributions to the literature. First, our findings are relevant to ongoing efforts to improve the survivorship experience for all cancer survivors. Second, the use of a representative sample of sexual minority and heterosexual survivors is an important improvement over nonprobability samples with diverse cancers. Third, this study fills an important gap in cancer research, in that CRC affects both men and women, while previous studies of sexual minority cancer survivors mostly draw on breast cancer for women and prostate cancer for men.⁸ Fourth, our findings suggest modifiable factors that differ between sexual minority and heterosexual cancer survivors, which can be utilized in the development of interventions to enhance quality of life for diverse populations of cancer survivors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Characteristics of sexual minority and heterosexual cancer survivors (N=480)

	All Survivors N=480	Sexual minority N=127	Heterosexual N=353	p-value
Registry				
California	223 (46.5%)	83 (65.4%)	140 (39.7%)	<0.0001
Florida	127 (26.5%)	25 (19.7%)	102 (28.9%)	
Georgia	55 (11.5%)	6 (4.7%)	49 (13.9%)	
Washington	75 (15.6%)	13 (10.2%)	62 (17.6%)	
Age at diagnosis				
21–49 years old	71 (14.8%)	20 (15.7%)	51 (14.4%)	0.08
50–64 years old	199 (41.5%)	62 (48.8%)	137 (38.8%)	
65 years and older	210 (43.8%)	45 (35.4%)	165 (46.7%)	
Sex: Male (vs. Female)	243 (50.6%)	74 (58.3%)	169 (47.9%)	0.04
Race				
Non Hispanic White	385 (80.2%)	108 (85.0%)	277 (78.5%)	0.28
Non Hispanic Black	41 (8.5%)	8 (6.3%)	33 (9.3%)	
Other/Unknown	54 (11.3%)	11 (8.7%)	43 (12.2%)	
Household income				
< \$40k	122 (26.9%)	27 (23.1%)	95 (28.3%)	0.57
\$40k to < \$80k	130 (28.7%)	35 (29.9%)	95 (28.3%)	
\$80k to < \$120k	98 (21.6%)	24 (20.5%)	74 (22.0%)	
\$120k or more	103 (22.7%)	31 (26.5%)	72 (21.4%)	
Other personal Factors				
Marital status: Married (vs. Not married)	232 (48.4%)	28 (22.0%)	204 (58.0%)	<0.0001
Education: College grad or higher(vs. less)	251 (53.3%)	79 (64.8%)	172 (49.3%)	0.003
Employment: Employed (vs. Not)	196 (41.3%)	64 (50.4%)	132 (37.9%)	0.01
Health Insurance: Yes (vs. No)	468 (98.3%)	122 (97.6%)	346 (98.6%)	0.47
Discrimination experiences: Any (vs. None)	207 (44.0%)	79 (65.3%)	128 (36.7%)	<0.0001
Brief COPE: self-distraction	192 (42.1%)	54 (45.0%)	138 (41.1%)	0.4543
Brief COPE: active coping	254 (55.1%)	73 (61.3%)	181 (52.9%)	0.1117
Brief COPE: denial	31 (6.7%)	6 (5.0%)	25 (7.2%)	0.3992
Brief COPE: behavioral disengagement	19 (4.1%)	3 (2.5%)	16 (4.7%)	0.2900
Brief COPE: venting	66 (14.5%)	31 (25.6%)	35 (10.5%)	<.0001
Brief COPE: positive reframing	262 (56.6%)	64 (52.9%)	198 (57.9%)	0.3400

	All Survivors N=480	Sexual minority N=127	Heterosexual N=353	p-value
High resilience (82+) vs. Low to Moderate	375 (79.3%)	96 (78.0%)	279 (79.7%)	0.6950
Health Condition				
Primary Site : Colon (vs. Rectum)	320 (66.7%)	79 (62.2%)	241 (68.3%)	0.21
Stage at diagnosis				
Stage I	148 (30.8%)	37 (29.1%)	111 (31.4%)	0.66
Stage II	162 (33.8%)	47 (37.0%)	115 (32.6%)	
Stage III	170 (35.4%)	43 (33.9%)	127 (36.0%)	
Surgery: Yes (vs. No)	454 (95.4%)	123 (96.9%)	331 (94.8%)	0.36
Radiation therapy: Yes (vs. No)	111 (23.1%)	33 (26.0%)	78 (22.1%)	0.37
Chemotherapy: Yes (vs. No)	250 (52.1%)	70 (55.1%)	180 (51.0%)	0.42
Any other treatments: Yes (vs. No)	39 (8.2%)	10 (8.0%)	29 (8.2%)	0.94
Currently in treatment: Yes (vs. No)	30 (6.3%)	3 (2.4%)	27 (7.6%)	0.03
Stoma: Yes (vs. No)	42 (8.8%)	16 (12.6%)	26 (7.4%)	0.07
Recurrence: Yes (vs. No)	43 (9.2%)	9 (7.2%)	34 (9.9%)	0.37
Family History of CRC: Yes (vs. No)	86 (18.9%)	19 (16.1%)	67 (19.9%)	0.37
Comorbidities				
0	201 (41.9%)	48 (37.8%)	153 (43.3%)	0.58
1	158 (32.9%)	48 (37.8%)	110 (31.2%)	
2	75 (15.6%)	19 (15.0%)	56 (15.9%)	
3+	46 (9.6%)	12 (9.4%)	34 (9.6%)	

Table 2.

Explanatory multivariable models of survivors' quality of life

	Physical Quality of Life (PCS) b (95% CI)	Mental Quality of Life (MCS) b (95% CI)
Sexual minority vs. Heterosexual	-0.46 (-2.29, 1.38)	-1.10 (-2.72, 0.53)
Age		
21-49 years vs. 65	-3.60 (-6.42, -0.77)**	-1.11 (-3.30, 1.08)
50-64 years vs. 65	-1.03 (-3.01, 0.96)	-0.02 (-1.51, 1.48)
Sex		
Female vs. Male	1.63 (-0.02, 3.28)	-0.65 (-2.02, 0.71)
Race/Ethnicity		
NH Black vs. NH White	1.07 (-1.86, 3.99)	1.47 (-1.01, 3.96)
Other vs. NH White	1.74 (-0.76, 4.25)	0.12 (-2.04, 2.29)
Income		
40k-80k vs. <40k	-0.51 (-2.63, 1.61)	1.03 (-0.83, 2.89)
80-120k vs. <40k	0.75 (-1.65, 3.15)	2.11 (0.01, 4.22)**
120 k or more vs. <40k	2.19 (-0.26, 4.64)	0.89 (-1.16, 2.94)
Other personal factors		
Education		
College or higher(vs. less,)	1.69 (-0.02, 3.41)	
Employed (vs. Not)	3.93 (2.02, 5.85)***	
Venting Coping		-2.59 (-4.73, -0.44)**
High Resilience		3.88 (5.77, 1.98)***
Health condition		
Stoma	-3.26 (-6.07, -0.44)**	
Comorbidities		
1 vs. None	-2.90 (-4.75, -1.05)***	
2 vs. None	-7.03 (-9.49, -4.57)***	
3+ vs. None	-12.37 (-15.34, -9.39)***	
Body function and structures		

	Physical Quality of Life (PCS) b (95% CI)	Mental Quality of Life (MCS) b (95% CI)
Low Sexual Interest	-3.14 (-5.04, -1.24) ***	
Weight Concerns		-2.17 (-3.89, -0.46) **
Health-related Anxiety	-2.99 (-5.17, -0.82) ***	-3.67 (-5.70, -1.64) ***
Frequent Bloating	-3.35 (-6.07, -0.63) **	
Sore Skin	-4.73 (-8.03, -1.43) ***	
Urinary Frequency	-3.21 (-5.78, -0.65) ***	
Frequent Dry Mouth		-3.04 (-5.29, -0.79) ***
Frequent Embarrassment		-3.07 (-5.48, -0.67) **
BMI		
Overweight vs. Healthy	-2.49 (-4.34, -0.64) ***	
Obese vs. Healthy	-3.63 (-5.70, -1.57) ***	
Depression	-3.39 (-6.00, -0.77) **	-5.85 (-8.30, -3.40) ***
Anxiety		-2.76 (-4.93, -0.59) **
Mental health counseling BEFORE cancer		-2.44 (-4.12, -0.77) ***
Environmental factors		
Excellent Social Support		2.02 (0.60, 3.43) ***
Individualized Care Plan		1.38 (0.02, 2.73) **
Mental health counseling to deal with cancer		-2.88 (-5.14, -0.62) **
Loneliness Scale Lonely vs. not		-3.27 (-5.36, -1.18) ***
<i>R square Average</i>	0.46	0.56
<i>Range</i>	0.456-0.461	0.560-0.568

p<0.01

**
p<0.05

Models are also adjusted for registry

NH= Non Hispanic

Table 3.

Explanatory model of survivors' poor or fair health

	Poor or Fair Health AOR (95% CI)
Sexual minority vs. Heterosexual	1.08 (0.45, 2.63)
Age	
21–49 years vs. 65	1.27 (0.32, 4.99)
50–64 years vs. 65	2.27 (0.91, 5.66)
Sex	
Female vs. Male	0.40 (0.18, 0.87)**
Race/Ethnicity	
NH Black vs. NH White	1.17 (0.36, 3.76)
Other vs. NH White	1.46 (0.44, 4.85)
Income	
40k–80k vs. <40k	1.22 (0.52, 2.85)
80–120k vs. <40k	0.39 (0.10, 1.46)
120 k or more vs. <40k	0.56 (0.15, 2.08)
Other personal factors	
Marital status: Married (vs. Not married)	0.35 (0.15, 0.86)**
Employment	
Yes vs. not employed	0.27 (0.11, 0.68)***
High Resilience	0.36 (0.16, 0.83)**
Health condition	
Currently in treatment: Yes (vs. No)	6.36 (1.97, 20.47)***
Family History of CRC: Yes (vs. No)	0.20 (0.07, 0.62)***
Comorbidities	
1 vs. None	1.88 (0.72, 4.94)
2 vs. None	6.03 (2.06, 17.64)***
3+ vs. None	11.70 (3.38, 40.57)***
Body function and structures	

	Poor or Fair Health AOR (95% CI)
Low Sexual Interest	3.18 (1.15, 8.81)**
Urinary Frequency	5.96 (2.53, 14.05)***
Frequent Bloating	6.40 (2.43, 16.88)***
Depression	2.11 (0.86, 5.20)
Mental health counseling BEFORE cancer	2.50 (1.10, 5.67)**

p<0.01

**
p<0.05

The model is also adjusted for registry

AOR= Adjusted Odds ratio

CI= Confidence Interval

NH= Non Hispanic

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