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Health-related quality of life in Black breast cancer survivors with and without triple-negative breast cancer (TNBC)

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Abstract

Purpose Black women are more likely to develop early-onset (≤ 50 years) breast cancer (BC) and have the lowest five-year, cause-specific survival rate of any United States (U.S.) racial or ethnic group. These disparities can be attributed partially to the higher rate of triple-negative BC (TNBC) in Blacks. Yet, little is known about health-related quality of life (HRQOL) among Black women with TNBC. **Methods** Black women with invasive BC ≤ 50 years were recruited via the Florida Cancer Data System as part of a population-based case-only study of etiology and outcomes of early-onset invasive BC. Of 460 consented participants, a subset of 355 self-reported sociodemographic, clinical, and psychosocial variables. Descriptive analyses included participants with known TNBC ($n = 85$) or non-TNBC ($n = 245$) disease. Univariable and multivariable analyses were conducted to examine differences in factors associated with HRQOL.

Results In unadjusted analyses, TNBC participants had significantly lower FACT-B total scores (90.1 ± 27.9)

compared to non-TNBC (98.5 ± 27.6) participants ($p < 0.05$). For the TNBC group, multivariable analyses indicated five individual-level, and three systemic-level factors explain 80% of the response variation in HRQOL. For the non-TNBC group, seven individual-level factors and three systemic-level factors account for 76% of the variation in HRQOL scores.

Conclusions Compared to Black women with non-TNBC, TNBC women have worse HRQOL. There are key individual and systemic-level factors that are unique to both groups. Findings can inform future HRQOL interventions to support young Black BC survivors.

Keywords Triple-negative breast cancer · Breast cancer · Quality of life · Black women

Introduction

Despite the increase in breast cancer (BC) survival, disparities in morbidity and mortality persist between Black and White women [1, 2]. In 2012, BC mortality was 42% higher in Black than White women [1, 2], attributable partly to higher rates of triple-negative BC (TNBC) in Blacks [3]. Women with TNBC are generally diagnosed at later stages, have a poorer prognosis, fewer treatment options, and a higher recurrence risk compared to those diagnosed with non-TNBC [4]. While there is growing literature regarding prognosis and survival for TNBC among Black women [4, 5], far less is known about the health-related quality of life (HRQOL) of Black women diagnosed with TNBC [6]. Such information is a necessary first step in determining whether there is need for targeted interventions to improve BC survivorship for Black women. In the current study, we examined HRQOL in TNBC and non-TNBC patients participating

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in a larger population-based, case-only study investigating the etiology and outcomes of early-onset BC in Black women [7, 8].

Methods

Sample

Recruitment methods and participation are detailed elsewhere and are briefly described here [9, 10]. Eligible participants were self-identified Black women who were: living in Florida when diagnosed with invasive BC, at or below age 50 between 2009 and 2012, alive at time of recruitment, and English speaking. Recruitment was initiated upon approval from the University of South Florida and the Florida Department of Health Institutional Review Boards. The Florida Cancer Data System (FCDS) released patient contact information and available clinical and sociodemographic information on all eligible participants and de-identified information on deceased Black women diagnosed with BC between 2009 and 2012. The lag time between diagnosis and availability of contact information from FCDS ranged from 6 to 18 months.

Patients were approached using state-mandated recruitment methods of two mailings, 3 weeks apart, including a telephone response card giving women the option to decline or express interest in participation. If no response was received within 3 weeks of the second mailing, a study team member telephoned the participant. In those willing to participate, written informed consent was obtained via mail. Study participation included completion of a medical records release, study questionnaires, genetic consultation, and saliva sample collection for DNA extraction. Of the 1647 Black women with BC in FCDS who qualified for the parent study, 882 were contacted. Among these, 456 consented to participate. In the current study, 355 parent study participants completed additional psychosocial measures.

Measures

The Contextual Model considers the importance of individual-level as well as systemic-level factors on HRQOL [11]. Individual-level factors include demographic characteristics, cancer-related medical factors, health status, and psychological wellbeing. Systemic-level factors include socioecological, health care system, and cultural factors. The Contextual Model has been empirically validated in minority cancer survivors [12, 13], providing an appropriate framework to examine HRQOL in Black women diagnosed with early-onset BC.

Individual-level factors

Demographic characteristics

Participants reported their age, relationship status, education, income, and insurance status.

Cancer-related medical factors

Factors extracted from FCDS include: cancer stage, hormone receptor status, age at diagnosis, time since diagnosis, type of surgery, and adjuvant therapy.

Health status

Participants were asked to rate their current general health and report comorbidities, role limitations, height and weight (used to calculate current body mass index [BMI]), and current tobacco use.

Psychological wellbeing

The 14-item Hospital Anxiety and Depression Scale (HADS) [14] evaluated participant anxiety (seven-items) and depression (seven-items) on an ordinal scale of 0–3, with three indicating higher symptom frequencies. The 15-item Revised-Impact of Event Scale (R-IES) [15], assessed current, subjective distress (range: 0–75) with subscales assessing the frequency of intrusive thoughts (range: 0–35) or avoidance (range: 0–40) over the last 7 days related to BC diagnosis. The Lerman Breast Cancer Worry Scale [16] measured BC worry using a four-point Likert-type scale (1 = not at all/rarely, 4 = a lot), where higher scores indicate more cancer worry. To assess absolute perceived risk of cancer recurrence, participants were asked to estimate the chances that they would get BC again (range: 0–100) and relative risk was assessed by asking their chance of getting BC again compared to a woman diagnosed above the age of 50.

Systemic-level factors

Socioecological characteristics

The 21-item Urban Life Stressors Scale [17] assesses the socioecologic stress associated with various aspects of life (e.g., finances, employment) on a five-point Likert-type scale (1 = no stress, 5 = extreme stress). Social support was ascertained using the Medical Outcomes Study (MOS) Social Support Survey [18]. Using a five-point Likert-type scale (1 = none of the time, 5 = all the time), the MOS assesses perceived availability of social support using four subscales, including emotional/informational support

(eight-items), tangible support (four-items), affectionate support (three-items), and positive social interaction (three-items). Higher total and subscale scores on the MOS indicate greater perceived support.

Health care system factors

Perceived medical discrimination was examined with the nine-item Detroit Area Survey Discrimination Scale (DAS) [19] which measures experiences of mistreatment that are relatively minor but common on a six-point Likert-type scale (0 = never, 5 = almost every day). Four items from the Interpersonal Processes of Care Survey Short Form (IPC) [20] measured on a five-point Likert-type scale (0 = never, 4 = always) assessed participant perceptions of, and confidence with, patient-provider communications [21]. A modified nine-item version of the Perceived Efficacy in Patient–Physician Interactions Questionnaire (PEPPI) [22] assessed self-efficacy in obtaining medical information and attention from physicians to address medical concerns. Items are measured on a five-point Likert-type scale (0 = not at all confident, 4 = very confident). Higher scores indicate greater perceived self-efficacy.

Cultural factors

We assessed birth country and amount of time living in the U.S. We used four scales to measure the role of culture in shaping health beliefs and behaviors on a four-point Likert-type scale (1 = strongly agree, 4 = strongly disagree) by assessing: Religiosity (nine-items), Present (five-items) and Future (five-items) Time Orientation [23], and Collectivism (six-items). The 20-item Fatalism Scale [24] (1 = strongly disagree, 5 = strongly agree) was used to determine participant perceptions of pre-determinism, luck, and pessimism. Higher scores indicate higher levels of fatalism.

HRQOL

The functional assessment of cancer treatment-breast (FACT-B) is a 37-item measure assessing multidimensional HRQOL in BC patients [25]. The FACT-B includes subscales to assess: physical, social/family, emotional, and functional wellbeing as well as the BC scale. Respondents indicate how true each statement has been for them in the previous 7 days on a five-point scale (0 = not at all, 4 = very much). The total score is calculated by summing all five subscale scores.

Data collection and analysis

Baseline survey data were collected by self-report. Descriptive statistics included frequencies and proportions

for categorical variables and means and standard deviations for continuous variables. Fisher's exact tests for categorical variables and Kruskal–Wallis tests for continuous variables were used to examine differences in HRQOL between women with TNBC and non-TNBC. Given the differences in trajectories of BC prognosis, treatment, and outcomes [4], we examined predictors of HRQOL separately for the TNBC and non-TNBC groups. We used generalized linear model (GLM) with identity link function to examine the relationships between theoretically relevant variables and the total score on the FACT-B for the TNBC and non-TNBC groups. Multiple linear regressions using backward elimination were conducted to build a final multivariable model for each group. HRQOL variables with p -values < 0.05 obtained from the univariable model were included in the initial model. The backward elimination step was terminated if all p -values in the model were < 0.05 . For categorical variables with three or more levels, the Tukey–Cramer method was used to conduct further comparisons between levels, adjusting for multiplicity. All p -values were two-sided, and p -values < 0.05 were considered statistically significant. Analyses were performed with SAS Software, version 9.4.

Results

Analyses comparing the parent study to the registry participant eligible sample to the presumed eligible individuals from the registry ($n = 1191$) [9] as well as analyses comparing participants in the current study ($n = 355$) to those who only participated in the parent study ($n = 89$) indicate no differences in relationship status, insurance, mean age of diagnosis, stage at diagnosis, employment, or residence in a metropolitan area. A greater number of participants in the current study had known TNBC status ($p < 0.0001$) compared to those participating only in the parent study. This difference may reflect that recruitment for the current study began one year into the parent study and FCDS increased efforts to document hormone receptor status during that time period.

FCDS data were used to classify participants as triple-negative (TN) (ER-/PR-/Her2/neu-) or non-TN (one or any ER+, PR+, or Her2/neu+present). Borderline and unknown interpretation results reported by FCDS were excluded from classification. Participants with >1 tumor reported in the eligibility dates were classified as TN if any of their tumors were determined to be TN. For participants whose TN status could not be determined from FCDS, supplemental data on ER, PR, and Her2/neu status were abstracted from hospital pathology reports. Fluorescence in situ hybridization (FISH) assays were used to confirm borderline/indeterminate immunohistochemistry (IHC)

results for Her2/neu staining throughout classification, where available. In cases where TN-status could not be determined by FCDS data or medical record review, self-reported TN-status was used, if available. In the current study, 85 participants were TNBC and 245 were non-TNBC. Both groups were similar (p -values > 0.05) with respect to regional stage (TNBC: 58.3%; non-TNBC: 57.8%), age at diagnosis (TNBC: 41.4 ± 5.9 ; non-TNBC: 42.2 ± 6.5), and time since diagnosis (TNBC: 18.5 ± 7.0 ; non-TNBC: 19.8 ± 10.1). TNBC participants more frequently reported chemotherapy, role limitations, and higher levels of depression, anxiety, intrusive thoughts, and avoidant behavior, compared to non-TNBC participants ($p < 0.05$). TNBC participants also had lower FACT-B total scores (90.1 ± 27.9) compared to non-TNBC (98.5 ± 27.6) participants ($p < 0.05$). In addition, TNBC participants had significantly lower emotional and functional wellbeing and BC-specific FACT-B subscale scores ($p < 0.05$). For the full results comparing TN and non-TN, see Table 1.

Women with TNBC

Women in the TNBC group who reported less education, lower income, current health as fair or poor, more role limitations, higher anxiety, depression, distress, cancer worry, and perceived risk of recurrence, also reported lower HRQOL scores ($p < 0.05$) in the univariable analysis. Systemic-level variables significantly associated with lower HRQOL ($p < 0.05$) included: higher life stress, perceived medical discrimination, less social support, birth outside the U.S., less years lived in the U.S., lower levels of future-time orientation, and higher levels of fatalism (see Table 2). In the multivariable analyses, five individual-level factors (income, chemotherapy, current health, role limitation, anxiety) and three systemic-level factors (life stress, collectivism, fatalism) remained significantly associated with total FACT-B scores for the TNBC group which explained 80% of the response variance in HRQOL (see Table 3).

Women with non-TNBC

In univariable analysis, individual-level variables significantly associated with lower HRQOL ($p < 0.05$) in the non-TNBC group included: less education, lower income, lack of private insurance, receiving chemotherapy, self-reported fair or poor health, comorbidities, role limitations, no tobacco use, and higher BMI (see Table 2). Women who reported higher anxiety, depression, distress, cancer worry, and perceived risk of recurrence, also reported lower HRQOL scores ($p < 0.05$). Systemic-level factors associated with lower HRQOL scores were also observed

among those with higher life stress, less social support, perceived medical discrimination, worse perceived patient-provider communication, self-efficacy, being born outside the U.S., more years lived in the U.S., lower levels of future-time orientation, a higher collectivist orientation, and higher levels of fatalism ($p < 0.05$).

In the multivariable model, seven individual-level factors (age at diagnosis, chemotherapy, current health, role limitation, anxiety, depression, cancer worry) and three systemic-level factors (life stress, birth country, present-time orientation) remained significantly associated with FACT-B scores and explained 76% of the variance in HRQOL scores (see Table 3).

Discussion

The total FACT-B scores in our study are lower than those generally reported among BC patients in prior studies, where average total score is commonly ≥ 100 [26–30]. Our findings that the TNBC group scored 8.4 points lower on HRQOL compared to those in the non-TNBC group exceeds the established clinically significant difference of 7–8 points for the FACT-B total score [31]. In subsequent analyses, we identified commonalities and differences in individual and systemic variables associated with HRQOL.

For both groups, individual-level factors associated with lower HRQOL in multivariate models included receipt of chemotherapy, poorer self-reported current health, more role limitations, and greater anxiety. Regardless of TN status, those receiving chemotherapy must cope with the long-term physical impact of treatment (e.g., fatigue, weight gain, decline in cognitive function [32]), which likely affects perceived and actual physical functioning. Our findings that general life stress was the only systemic factor associated with HRQOL in both groups support a recent review suggesting the particularly salient role of stress for young Black BC survivors [33]. Our results contrast those of a study of 280 African American and Hispanic BC survivors, in which life stress was not significantly associated with HRQOL [34]. However, this study included baseline data from minority BC survivors who agreed to participate in a randomized controlled trial to reduce depressive symptoms [34].

The models for the TNBC and non-TNBC groups also had different individual and systemic factors associated with HRQOL. In the non-TNBC multivariate model, patients diagnosed at younger ages reported lower HRQOL, mirroring results of another study of BC patients diagnosed at age ≤ 50 [35]. Prior reviews suggest that poorer HRQOL in younger patients may be a function of more aggressive disease. However, we did not observe this association with age for TNBC participants (who arguably

Table 1 Individual and Systemic Factors for TNBC and non-TNBC (*n* = 355)

Measures/variables	Total (<i>n</i> = 355) <i>n</i> (%); m (SD)	TNBC (<i>n</i> = 85) <i>n</i> (%); m (SD)	Non- TNBC (<i>n</i> = 245) <i>n</i> (%); m (SD)	<i>p</i> value
Individual-level factors				
Demographic characteristics				
Current age (years)	43.9 (6.5)	43.0 (6.0)	43.9 (6.7)	0.10
Relationship status (partnered)	138 (39.0)	39 (45.9)	90 (36.9)	0.16
Education				
6–10th grade	17 (4.8)	1 (1.2)	14 (5.8)	0.12
11–12th, GED or equivalent	71 (20.2)	20 (23.5)	43 (17.7)	
Vocational or some college	125 (35.5)	34 (40.0)	81 (33.3)	
Graduated college or higher	139 (39.5)	30 (35.3)	105 (43.2)	
Income				
<15K	69 (19.5)	18 (21.2)	49 (20.1)	0.76
15K–24,999	51 (14.4)	13 (15.3)	30 (12.3)	
25K–49,999	101 (28.5)	22 (25.9)	71 (29.1)	
50K–89,999	79 (22.3)	18 (21.2)	57 (23.4)	
90K+	29 (8.2)	10 (11.8)	19 (7.8)	
Other	25 (7.1)	4 (4.7)	18 (7.4)	
Insurance status (private)	153 (51.2)	39 (53.4)	104 (50.5)	0.76
Cancer-related medical factors				
Cancer stage regional/distant (vs. localized)	162 (46.4)	35 (41.7)	118 (48.8)	0.31
Age at diagnosis (years)	42.2 (6.3)	41.4 (5.9)	42.2 (6.5)	0.12
Time since diagnosis (months)	19.9 (9.7)	18.5 (7.0)	19.8 (10.1)	0.76
Type of surgery				
Lumpectomy (yes)	138 (40.1)	38 (45.2)	89 (37.7)	0.53
Mastectomy (yes)	83 (24.1)	16 (19.1)	59 (25.0)	
Bilateral mastectomy (yes)	122 (35.5)	30 (35.7)	87 (36.9)	
Adjuvant therapy				
Radiation (yes)	223 (62.8)	59 (69.4)	149 (60.8)	0.19
Chemotherapy (yes)	278 (78.8)	79 (92.9)	179 (73.7)	<0.01
Hormonal therapy (yes)	67 (18.9)	13 (15.3)	50 (20.4)	<0.01
Health status				
Current general health				
Very good or excellent	148 (41.7)	30 (35.3)	110 (44.9)	0.17
Good	135 (38.0)	41 (48.2)	83 (33.9)	
Fair or Poor	72 (20.3)	14 (16.5)	52 (21.2)	
Comorbidity (diabetes or osteoporosis)	74 (20.9)	17 (20.0)	45 (18.4)	0.75
Role limitations (yes)	296 (83.4)	65 (76.5)	211 (86.12)	0.04
Current BMI ^a	30.4 (6.4)	31.1 (6.3)	30.0 (6.3)	0.08
Current tobacco use (yes)	32 (9.0)	4 (4.7)	25 (10.2)	0.29
Psychological wellbeing				
HADS ^b anxiety	6.7 (4.4)	7.7 (4.7)	6.3 (4.3)	0.02
HADS depression	4.4 (3.9)	5.3 (4.1)	4.0 (3.7)	0.01
R-IES ^c total score	29.3 (18.5)	33.9 (18.5)	27.2 (18.3)	<0.01
R-IES intrusive thoughts	14.4 (9.8)	16.8 (9.8)	13.4 (9.8)	<0.01
R-IES avoidant behavior	14.9 (10.1)	17.1 (10.2)	13.8 (10.0)	0.01
Cancer worry	2.1 (1.0)	2.3 (1.0)	2.0 (0.9)	0.03
Perceived risk of recurrence (%)	22.0 (29.7)	25.4 (31.8)	20.5 (28.6)	0.41

Table 1 continued

Measures/variables	Total (<i>n</i> = 355) <i>n</i> (%); <i>m</i> (SD)	TNBC (<i>n</i> = 85) <i>n</i> (%); <i>m</i> (SD)	Non- TNBC (<i>n</i> = 245) <i>n</i> (%); <i>m</i> (SD)	<i>p</i> value
Perceived risk of recurrence relative				
Lower	165 (49.1)	41 (50.6)	115 (49.6)	0.67
About the same	91 (27.1)	19 (23.5)	65 (28.0)	
Higher	80 (23.8)	21 (25.9)	52 (22.4)	
Systemic-level factors				
Socioecological characteristics				
Urban life stress Mean (SD)	39.2 (13.1)	39.4 (13.5)	39.1 (13.3)	0.84
Social support (overall MOS ^d)	4.2 (0.8)	4.1 (0.8)	4.2 (0.8)	0.22
Emotional/informational support	4.1 (0.9)	4.0 (0.8)	4.1 (0.9)	0.26
Tangible support	4.2 (1.0)	4.2 (1.0)	4.2 (1.0)	0.49
Affectionate support	4.4 (0.9)	4.4 (0.9)	4.4 (0.9)	0.50
Positive social interaction	4.1 (1.0)	4.0 (1.1)	4.2 (1.0)	0.25
Health care system factors				
Medical discrimination (yes to any question)	104 (29.6)	30 (35.3)	69 (28.4)	0.27
IPC ^e perceived provider communication	12.8 (3.4)	12.9 (3.4)	12.8 (3.3)	0.59
PEPPI ^f Self-Efficacy	31.0 (6.0)	30.3 (6.7)	31.4 (5.8)	0.29
Cultural factors				
Birth country (U.S.)	280 (78.9)	73 (85.9)	185 (75.5)	0.05
Time in US (Years) Mean (SD)	39.3 (11.3)	39.5 (10.1)	38.7 (11.8)	0.94
AA women's cultural belief				
Religiosity	33.1 (3.6)	33.5 (2.7)	32.9 (3.9)	0.75
Present-time orientation	11.7 (2.9)	11.7 (2.9)	11.6 (2.7)	0.82
Future-time orientation	15.5 (2.5)	15.5 (2.8)	15.5 (2.4)	0.95
Collectivism	17.6 (2.4)	17.8 (2.1)	17.5 (2.5)	0.66
Fatalism (overall)	45.0 (7.3)	44.7 (7.9)	45.2 (6.8)	0.98
Pre-determinism	9.8 (0.9)	9.9 (0.6)	9.8 (0.9)	0.23
Luck	7.2 (2.0)	6.9 (2.1)	7.3 (2.0)	0.07
Pessimism	12.8 (3.2)	12.6 (3.7)	12.8 (3.0)	0.70
HRQOL				
FACT-B overall	96.5 (27.8)	90.1 (28.0)	98.5 (27.6)	0.01
Physical wellbeing	19.3 (7.1)	18.2 (8.1)	19.6 (6.8)	0.32
Social wellbeing	19.5 (6.8)	18.7 (6.3)	19.7 (7.0)	0.12
Emotional wellbeing	18.6 (5.0)	17.5 (5.1)	19.0 (4.9)	0.01
Functional wellbeing	18.1 (7.3)	16.7 (7.6)	18.6 (7.1)	0.04
Breast cancer scale	20.9 (7.9)	19.0 (7.5)	21.5 (8.0)	0.01

^a Body mass index^b Hospital anxiety and depression scale^c Revised impact of event scale^d Medical outcomes study social support survey^e Interpersonal processes of care survey^f Perceived efficacy in patient-provider interactions

have more aggressive disease) [36]. For the non-TNBC group, depression and cancer worry were also associated with lower HRQOL. It is possible that in the non-TNBC

group, our baseline assessment (~18 months post diagnosis) coincides with the transition from completion of active treatment to surveillance. The less frequent

Table 2 Univariable analysis for women with TN ($n = 85$) and non-TN status ($n = 245$)

Variables	TN ($n = 85$)		Non-TN ($n = 245$)	
	Regression coefficient or average of fact B score	p -value	Regression coefficient or average of fact B score	p -value
Current age	−0.954	0.06	−0.408	0.13
Relationship status				
Not partnered	86.5	0.21	97.4	0.37
Partnered	94.2		100.7	
Education				
6–10th grade	39	0.01	89.2	<0.01
11–12th, GED or equivalent	80.8		88.6	
Vocational or some college	86.4		96	
Graduated college or higher	101.8		105.7	
Income				
<25K	76.8	<0.01	88.8	<0.01
25K–49,999	97.8		100	
≥50 K	96		109.2	
Insurance				
Other	85	0.06	90.3	<0.01
Private	97.2		107.6	
Cancer stage				
Localized	92.5	0.41	101.3	0.13
Regional or distant	87.2		95.9	
Age at DX ^a	−1.006	0.052	−0.411	0.13
Month since DX	−0.132	0.76	−0.069	0.69
Type of surgery				
Lumpectomy	88.5	0.27	97.8	0.72
Mastectomy	82.5		97.4	
Bilateral mastectomy	96.1		100.7	
Radiation				
No	98.1	0.08	102.4	0.08
Yes	86.4		96	
Chemotherapy				
No	98.1	0.47	107.5	0.003
Yes	89.4		95.4	
Hormonal therapy				
Yes	80	0.35	98	0.3
No	92.7		102.4	
Don't know	85.7		94.4	
Current health				
Very good or excellent	107.1	<0.01	110.2	<0.01
Good	84.6		99.2	
Fair or poor	68.7		72.8	
Comorbidity				
No	90.4	0.83	101.1	0.002
Yes	88.7		87	
Role limitation				
No	98.1	<0.01	104.5	<0.01
Yes	64.8		62.4	

Table 2 continued

Variables	TN (<i>n</i> = 85)		Non-TN (<i>n</i> = 245)	
	Regression coefficient or average of fact B score	<i>p</i> -value	Regression coefficient or average of fact B score	<i>p</i> -value
Current tobacco use				
No	90	0.64	100.6	0.001
Yes	83.3		81.7	
Current BMI ^b	−0.166	0.74	−1.09	<0.01
HADS ^c anxiety	−3.68	<0.01	−4.561	<0.01
HADS depression	−5.088	<0.01	−5.156	<0.01
R-IES total score	−0.718	<0.01	−0.861	<0.01
R-IES ^d intrusive thoughts	−1.355	<0.01	−1.567	<0.01
R-IES avoidant behavior	−1.088	<0.01	−1.417	<0.01
Cancer worry	−14.998	<0.01	−17.835	<0.01
Perceived risk of recurrence (%)	−0.25	0.01	−0.3	<0.01
Perceived risk of recurrence relative				
Lower	94.4	0.38	101.4	0.24
About the same	83.5		94.5	
Higher	90.3		96.2	
Urban life stress	−1.43	<0.01	−1.532	<0.01
Social support (overall MOS ^e)	13.101	<0.01	16.062	<0.01
Medical discrimination				
No to all items	94.1	0.01	102.4	<0.01
Yes to any question	82.9		88.4	
IPC ^f perceived provider communication	0.771	0.40	2.218	<0.01
PEPPI ^g self efficacy	0.753	0.10	1.346	<0.01
Birth country				
Other	87.7	0.048	95.8	<0.01
US	105.5		107.1	
Years lived in US	−0.807	0.01	−0.463	<0.01
Religiosity	0.328	0.77	−0.167	0.72
Present-time orientation	−2.012	0.06	−0.459	0.48
Future-time orientation	2.237	0.04	1.787	0.02
Collectivism	−2.151	0.14	1.407	0.047
Fatalism	−0.945	0.02	−1.087	<0.01

^a Diagnosis^b Body mass index^c Hospital anxiety and depression scale^d Revised-impact of event scale^e Medical outcomes study social support survey^f Interpersonal processes of care survey^g Perceived efficacy in patient-provider interactions

evaluation, monitoring, and support at this time, despite continued physical and psychosocial effects of diagnosis and treatment, may increase negative emotions [6, 37, 38].

For the TNBC group, lower HRQOL was also associated with lower income. While prior studies have found that Black BC survivors with lower income also report lower HRQOL [12], none specifically examined this effect

separately based on TN status. It is possible that income may be a particularly salient indicator of HRQOL for the TNBC patients who earn less income and may be more affected by the increased financial burden (e.g., out-of-pocket medical expenses) associated with shorter median time to relapse and higher likelihood of metastases compared to the other BC subtypes [39].

Table 3 Multivariable predictors of FACT-B for women with TNBC and non-TNBC

Variables	TNBC (<i>n</i> = 77)		Non-TNBC (<i>n</i> = 238)	
	Regression coefficient or average of Fact-B score	<i>p</i> -value	Regression coefficient or average of FACT-B score	<i>p</i> -value
Income				
<25K	89.3	0.041	Not significant	
25 K–49,999	86.2			
≥50 K	96.2			
Age at DX ^a	Not significant		−0.39	0.006
Chemotherapy				
No	96.7	0.035	100.1	0.002
Yes	84.4		93.6	
Current health ⁺				
Very good or excellent	103.9	<0.0001	100.2	0.048
Good	85.6		96.9	
Fair or poor	82.1		93.5	
Role limitation				
No	96.8	0.001	102.2	0.001
Yes	84.2		91.5	
HADS ^b anxiety	−1.647	0.0002	−1.084	0.0008
HADS depression	Not significant		−1.444	<0.0001
Cancer worry	Not significant		−4.65	0.0001
Urban life stress	−0.756	<0.0001	−0.725	<0.0001
Birth country				
Other	Not significant	94.1	0.012	0.012
U.S.		99.6		
Present-time orientation	Not significant		−0.714	0.033
Collectivism	−2.231	0.004	Not significant	
Fatalism (overall)	−0.594	0.009	Not significant	

^a Diagnosis

^b Hospital Anxiety and Depression Scale

* Participants with income ≥50 K has higher Fact B score than those with income 25K–49,999 ($p = 0.048$). No other significant difference found ($p > 0.05$)

⁺ Participants with Very good or excellent has significantly higher Fact B score than those with fair or poor ($p = 0.04$). No other significant difference detected ($p > 0.05$)

An additional systemic-level factor in the non-TNBC group associated with lower HRQOL was birth outside the U.S. While the role of foreign-born status has been explored in the context of BC screening among Blacks [40, 41], few studies have examined the status on BC survivors' HRQOL. Given the growing Black immigrant U.S. population [42], and the disproportionate representation of Blacks diagnosed with BC ≤ age 50 [1], understanding HRQOL in this group warrants further study. For the TNBC group, lower HRQOL was also associated with a collectivist orientation and holding fatalistic beliefs. A collectivist orientation may value minimizing stress/burden on family members over seeking support from others [37, 43, 44]. Fatalistic beliefs may also negatively affect

HRQOL, particularly among those with TNBC who are more likely to receive a poorer prognosis and have fewer treatment options. This may reinforce the fatalistic belief that efforts to treat the cancer are futile [45].

Study findings suggest future HRQOL interventions for younger Black BC survivors should address the impact of chemotherapy, physical functioning, and anxiety, regardless of TN status. These interventions should consider the stress that may be experienced in the transition from patient to survivor [38]. Although few interventions to improve HRQOL have been specifically developed and tested in Black BC survivors, available results show improved psychological outcomes [46, 47]. Our study demonstrates the need for continued testing and refinement of these

interventions in larger samples of Black BC survivors. A recent review called for lifestyle modification interventions to improve HRQOL in Black BC survivors, who are more likely to be obese [6], reports low levels of physical activity, and higher levels of dietary fat [48–51]. A few pilot studies that address physical functioning in Black BC survivors have yielded mixed results with modest effects on physical and HRQOL outcomes [52–54]. However, none of these studies reported outcomes based on TNBC status.

While available interventions appear to address the psychosocial, cultural, and physical functioning associated with HRQOL in Black BC survivors, our study suggests that TNBC status may be an important consideration when developing/adapting, refining, and implementing and evaluating existing or new interventions. Specifically, improving HRQOL in non-TNBC patients may require greater attention to psychosocial variables beyond anxiety to address more cancer-specific psychosocial concerns. Additionally, younger and foreign-born BC survivors appear to have poorer quality of life and may benefit from targeted interventions. For TNBC patients, additional attention should be given to the potential financial impact of cancer as well as cultural beliefs.

A review identified only six published studies from 1995 to 2015 that examined HRQOL in Black women and included those diagnosed ≤ 50 years old; the largest of which included 175 participants [33, 55]. While a recent 2016 study included a large sample of Black BC patients diagnosed $< \text{age } 50$ ($n = 480$) from the Carolina Breast Cancer Study, their analysis of HRQOL included few patient reported psychological, socioecological, health care system, or cultural factors [30]. Thus, the current fills a notable gap in the literature, and is among the first to examine HRQOL among Black TNBC and non-TNBC survivors [33]. Strengths of our approach include the use of a cancer registry to recruit a diverse sample of patients, employing a theoretical clinically and culturally relevant framework, and a focus on younger Black women.

Study findings should also be considered in light of certain limitations. First, there may be additional factors related to HRQOL such as participation in support groups and follow-up care and support by the patient's oncology and/or primary care team that were not assessed in our study. However, the multivariable models for the TNBC and non-TNBC groups accounted for 80% and 76% of the variance in HRQOL, respectively, suggesting we considered the majority of relevant variables. Second, participants were recruited from a single state; thus, findings may not be generalizable beyond Florida. However, our participants are representative of the larger state registry of BC patients [9] and received care in a variety of clinical and geographic locations enhancing study generalizability. Third, women

with TNBC may be underrepresented in our study due to survival bias.

Our findings demonstrate clinically meaningful differences in HRQOL among TNBC and non-TNBC patients. Additionally, we identify key individual and systemic-level factors that are common to both groups as well as unique differences. These findings can be used to identify relevant intervention content to support young Black BC survivors.

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Author Contributions Drs. Vadaparampil and Pal had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Donovan, Holt, Ashing, Pal. *Collection and assembly of data:* Christie, Augusto, Pal. *Data analysis and interpretation:* Vadaparampil, Christie, Donovan, Kim, Kasting, Halbert, Pal. *Manuscript writing:* Vadaparampil, Christie, Donovan, Kim, Augusto, Kasting, Holt, Ashing, Halbert, Pal. *Final approval of manuscript:* Vadaparampil, Christie, Donovan, Kim, Augusto, Kasting, Holt, Ashing, Halbert, Pal. *Agree to be accountable for all aspects of the work, including ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved:* Vadaparampil, Christie, Donovan, Kim, Augusto, Kasting, Holt, Ashing, Halbert, Pal.

Compliance with ethical standards

Conflict of interest STV has received research funding from Myriad Genetics Laboratory. JC, KAD, JK, BA, MLK, CLH, KA, CHH, and TP have no conflicts of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of from the University of South Florida and the Florida Department of Health Institutional Review Boards.

Informed consent Written informed consent was obtained from all individual participants included in the study.

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