Distress Trajectories in Black and White Breast Cancer Survivors: From Diagnosis to Survivorship

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ABSTRACT

Background: Black breast cancer survivors have greater morbidity and mortality than White survivors. However, evidence comparing Black survivors' psychological symptoms with their White counterparts has been mixed. Prior studies have not compared Black and White survivor's distress-related symptom trajectories from pre- to post-treatment – the goal of the current study.

Methods: At three annual visits from shortly after diagnosis to 6 and 18 months post-treatment, 195 women ($n = 163$ White; $n = 32$ Black) reported their cancer-related distress (intrusive thoughts and avoidance), perceived stress, anxiety and depressive symptoms, fatigue, and pain.

Results: Adjusting for age, educational attainment, income, treatment type, stage at diagnosis, and physical comorbidities, Black and White breast cancer survivors had different trajectories of cancer-related distress ($p = .004$), intrusive thoughts about cancer diagnosis and treatment ($p = .002$), perceived stress ($p = .04$), emotional fatigue ($p = .01$), and vigor ($p = .02$). Specifically, among White women, these distress-related symptoms improved from diagnosis to 6 months post-treatment ($ps < 0.0001$) and then remained stable between 6 and 18 months post-treatment, whereas Black women had persistently elevated distress – even 18 months after finishing treatment. Additionally, Black women reported more avoidance of cancer-related thoughts and emotions across visits ($p = .047$). Race was unrelated to the trajectories of anxiety and depressive symptoms, other fatigue subscales, or pain levels ($ps > 0.08$).

Conclusion: Longitudinal assessment of the same breast cancer survivors from diagnosis to early survivorship revealed that Black and White survivors had divergent trajectories of psychological distress symptoms that were not reliably evident at a single timepoint. Overall, White women reported less psychological distress from pre- to post-treatment, but Black women's distress remained high from diagnosis to 18 months post-treatment. If left untreated, Black women's high distress levels may contribute to their poorer health throughout survivorship.

1. Background

Although race is a social construct, long-standing patterns of marginalization, discrimination, and systemic racial injustice have physical and mental health consequences. These consequences extend to breast cancer outcomes: The most shocking example is that Black women have a 41% higher mortality rate than White women upon breast cancer diagnosis (Richardson et al., 2016). Even after surviving breast cancer, Black and White women have divergent experiences. Black survivors who were at least five years post-diagnosis had poorer physical functioning and lower self-rated health than their White peers, independent of cancer and treatment-related factors (Deimling et al.,

2003). In an impressively large sample, Black survivors reported worse physical functioning and general health compared to White survivors, and they reported more role limitations due to physical health, more pain, poorer general health, and lower vitality than those without a cancer history (Paskett et al., 2008). However, there is mixed evidence concerning whether there are mental health differences between Black and White survivors.

One line of evidence suggests that Black survivors' disproportionate physical burden aligns with poorer psychosocial functioning. Among those who underwent a lumpectomy and radiation, Black survivors had poorer social functioning, and in particular lower engagement in household activities, than White survivors (Bourjolly et al., 1999). Also, Black survivors were more likely than White survivors to have elevated cancer-related distress between two to six months post-diagnosis (Vin-Raviv et al., 2013). Black survivors diagnosed within the past year had a mean depressive symptom score that was almost triple that of disease-free Black women, and was approximately 125% the mean of another, mostly White breast cancer survivor sample (Eskelinen and Ollonen, 2011; Sheppard et al., 2013). Young Black women, in particular, are often diagnosed with aggressive subtypes of breast cancer, and a systematic review found that they were more afraid of dying, and had unmet supportive care needs, greater financial distress, and lower physical function than White survivors, older Black survivors, and non-cancer controls (Samuel et al., 2016). Even holding pain levels constant, Black survivors may disproportionately suffer. Black survivors with chronic pain report more depressive symptoms and greater disability than their White peers with similar pain levels (Green et al., 2003). In one study among 199 cancer survivors who were at least two years post-diagnosis, Black survivors reported more pain interference, severity, and disability, and experiencing pain was related to greater depressive symptoms and poorer functioning (Green et al., 2011). These mental health disparities may persist well into survivorship: A large retrospective study found a greater discrepancy in psychological distress between Black people with a cancer history and those without such history than between White people with a cancer history and their non-cancer peers (Alcalá, 2014).

However, another line of research suggests that Black breast cancer survivors may have better mental health than White survivors. Community support and religiosity may bolster Black survivor's mental health (Ashing-Giwa et al., 2004; Bellizzi et al., 2010; Lewis et al., 2012; Samuel et al., 2016). Indeed, nine months post-diagnosis, Black women had better emotional well-being than White women (Janz et al., 2009). Also, among breast cancer survivors who were three to four years post-diagnosis, Black women reported more post-traumatic growth than their White peers (Bellizzi et al., 2010). In another sample of survivors less than five years post-diagnosis, Black women found more meaning in life through cancer than other racial groups, even though they also had more physical dysfunction and a poorer body image (Giedzinska et al., 2004). Although most of the extant literature is cross-sectional, two longitudinal studies showed that Black breast cancer survivors had better mental health-related quality of life and worse physical health-related quality of life than White survivors throughout early survivorship (Bowen et al., 2007; Bradley and Wilk, 2014). However, both longitudinal studies assessed quality of life rather than distress symptoms, averaged symptoms across time rather than examining symptom trajectories, and did not use statistical models that account for the high correlation between an individual's repeated measurements.

Other methodological issues may be responsible for prior mixed findings. Firstly, covariates matter, and socioeconomic status is a critical factor to consider: Among survivors who were six to eight years post-diagnosis, Black women reported lower overall quality of life, including worse physical, psychosocial, and marital functioning, but adjusting for socioeconomic status eliminated these differences (Ashing-Giwa et al., 2004). Secondly, most self-report psychological symptom measures were developed and tested among White people, and therefore, they may not fully capture Black survivors' symptoms – thereby

underestimating their distress (Zhang et al., 2015). For example, depressed Black survivors report insomnia and fatigue more often and sadness, frustration, and intrusive thoughts less often than depressed White survivors (Zhang et al., 2015). Therefore, using multiple sensitive measures of distress may more accurately assess racial differences.

1.1. The current study

The current study investigated distress trajectories of Black and White breast cancer survivors from shortly after diagnosis through early survivorship. Distress comprises both psychological and physical symptoms (National Comprehensive Cancer Network, 2021), so we used a wide variety of self-report measures, including perceived stress, anxiety and depressive symptoms, cancer-related distress, fatigue, and pain. Based on well-replicated findings of health disparities between Black and White breast cancer survivors (Paskett et al., 2008; Richardson et al., 2016; Yoon et al., 2008), we hypothesized that Black survivors would report persistently heightened psychological and physical distress symptoms across time, compared to their White peers. Our prior publication identified a relationship between cancer-related distress and inflammation in this sample of breast cancer survivors (Renna et al., 2020), so in post-hoc analyses we examined whether there were racial differences in overall levels or trajectories of inflammation.

2. Methods and materials

2.1. Study design and participants

Women were recruited from The Ohio State University cancer clinics for a parent study that addressed fatigue in breast cancer survivorship. Women with stage IV cancer, a prior history of cancer (excluding basal or squamous cell skin carcinomas), or significant visual, auditory, or cognitive impairments were excluded. Overall, 215 women completed Visit 1, including 163 White, 32 Black, 8 Asian, 5 Native American, and 1 participant who selected "other race." In line with our goal of comparing Black and White breast cancer survivors' distress symptom trajectories, we included only Black and White women and reached final sample size of 195. Eight Black survivors and 24 White survivors did not complete all three visits, but the between-group difference in attrition was not significant ($p = .44$). Also, there were no differences in the outcomes of interest between those who dropped out and those who did not ($ps > 0.33$). These participants had their blood drawn and completed questionnaires shortly after their malignant diagnosis and prior to cancer treatment (Visit 1), as well as at Visits 2 and 3, which were 6 and 18 months post-treatment, respectively. The Ohio State University Institutional Review Board approved the study, and all participants provided written consent.

2.2. Cancer-related distress

The 15-item Impact of Event Scale (IES) is a widely-used self-report measure that measured how frequently over the past week participants had experienced intrusive thoughts (e.g., "Pictures about it popped into my mind") or periods of avoidance (e.g., "I tried to remove it from my memory") (Horowitz et al., 1979). We modified the instructions to ask specifically about distress related to cancer diagnosis and treatment (Salsman et al., 2015), and therefore the global and subscale scores specifically assess cancer-related distress. In our sample, internal consistency reliability in this sample ranged from $\alpha = 0.89$ –0.90 across visits.

2.3. Perceived stress, depression, and anxiety

The Perceived Stress Scale short form (PSS-4; $\alpha s = 0.80$–0.86) (Cohen, 1988) asked how frequently in the past week survivors experienced certain stressful thoughts or feelings (i.e., "felt that you are

unable to control the important things in your life") on a five-point scale from "not at all" to "very often."

The 20-item Center for Epidemiological Studies Depression Scale (CES-D; αs = 0.88–0.92) indexed the frequency of depressive symptoms over the past week (Radloff, 1977). It sensitively detects depression in both community and clinical samples (Basco et al., 1997). It is a valid and reliable measure of breast cancer survivors' depressive symptoms (Hann et al., 1999).

The 21-item Beck Anxiety Inventory (BAI; αs = 0.89–0.91) assessed anxiety symptoms experienced in the past week and was developed to discriminate anxiety from depression while still converging with other anxiety measures (Beck et al., 1988).

2.4. Vigor, fatigue, and pain

The 30-item Multidimensional Fatigue Symptom Inventory - Short Form (MFSI-SF; α = 0.87 at all visits) was developed to capture the wide range of behavioral, cognitive, somatic, and emotional fatigue symptoms that cancer survivors experience (Stein et al., 2004, 1998). It asked participants how true each fatigue-related statement has been for them over the past week. It has five subscales (general, physical, emotional, and mental fatigue, as well as vigor). The total score is the sum of these subscales minus vigor. Participants also rated their average pain levels in the past week on a 11-point Likert scale ranging from 0 ('no pain') to 10 ('as bad as you can imagine').

2.5. Covariates

Women self-reported their age, race, and education. At each visit, they also reported their annual pre-tax household income. Medical records provided staging and treatment information. The widely-used Charleston Comorbidity Index (CCI), originally tested among breast cancer survivors, indexed comorbidities (Charlson et al., 1987). The CCI predicted two-year non-cancer mortality among a large sample of breast cancer patients (Klabunde et al., 2007).

2.6. Inflammation assays

Nurses collected fasting blood samples between 7:00 and 9:00 AM to control for diurnal variation. Serum C-reactive protein (CRP) was measured using a chemiluminescence methodology via the Immulite 1000 (Siemens Healthcare Diagnostics, Inc., Deerfield, IL). Sensitivity for the assay was 0.3 mg/L. The intra-assay coefficient of variation (CV) was 3.1%, and the inter-assay CV was 7.3%. Serum levels of tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6), interleukin-1β (IL-1β), and interleukin-8 (IL-8) were measured using an electrochemiluminescence method with Meso Scale Discovery kits, and read using the Meso Scale Discovery Sector Imager 2400 (Meso Scale Discovery, Rockville, MD). Sensitivity was 0.37 pg/mL, 0.26 pg/mL, 0.18 pg/mL, and 0.10 pg/mL for TNF-α, IL-6, IL1β, IL-8, respectively. The intra-assay and inter-assay CVs for TNF-α were 4.32% and 5.30%, respectively; corresponding values were 1.43% and 4.42% for IL-6, 4.15% and 4.03% for IL-1β, and 2.76% and 4.35% for IL-8. Each women's frozen samples were assayed for all inflammatory markers in one run using the same controls for all time points for each person. Inflammatory markers were log transformed to better approximate normality of residuals. A z-score composite of serum cytokines was calculated to obtain a summary measure of inflammation. This method was previously used to index overall inflammation in this sample (Renna et al., 2020).

2.7. Statistical analysis

We first compared Black and White survivors on all covariates using *t*-tests and chi-square. Next, we constructed hierarchical linear models for each outcome, which accounted for the high within-subject correlations of repeated measurements of the outcome variables. One advantage of this modeling approach is that it does not exclude a participant from the model if they have a missing datapoint. These models had an unstructured covariance matrix and used the Kenward-Rogers degrees of freedom adjustment. To compare groups' psychological symptom trajectories over time, we used the interaction between visit and race to predict distress-related outcomes. If the interaction term was non-significant, it was removed from the model to test the main effect of race. When the interaction was significant, we conducted post-hoc tests to see whether the within-race slopes and between-race symptoms at each visit were significant. We first report unadjusted results and then report the results adjusted for age (continuous), income at each visit (<\$25,000; \$25,000 – \$50,000; \$50,000 – \$75,000, \$75,000 – \$100,000; >\$100,000), education (high school, some college, college graduate, graduate or professional training), chemotherapy treatment (yes or no), radiation treatment (yes or no), cancer stage at diagnosis (0, I, IIA, IIB, IIIA-C) and comorbidities (continuous). Only adjusted models with a significant race or race*visit effect are depicted in the figures and tables. White survivors were more likely than Black survivors to take hormone therapy (χ^2 (1)= 7.90, p = .005), but a sensitivity analysis revealed that results were very similar when adjusting for hormone treatment. We also conducted post-hoc analyses using the same adjusted hierarchical linear models with the interaction of race and visit predicting the CRP and the inflammatory composite score in separate models. Overall, 181 women had CRP data and 158 women had all inflammatory cytokine data. Two-tailed tests were conducted and an alpha level of .05 was used. Analyses were conducted in SAS version 9.4 (Cary, NC).

3. Results

3.1. Demographic information

Of the 195 women included in the sample, 16% (n = 32) were Black. In total, 4 participants (3 White survivors, 1 Black survivor) self-identified as Hispanic/Latina. Overall, 176 (n = 149 White, n = 27 Black) and 160 (n = 135 White, n = 25 Black) women returned for Visits 2 and 3, respectively. Ages ranged from 26 to 88 years old, with a mean and median of 55. The sample was highly educated: 51% had graduated from college, including 26% who pursued graduate or professional training. Over half of the sample (52%) had an annual pre-tax household income of at least \$50,000. A majority of the sample (63%) was diagnosed with Stage 0 or I cancer, while 17% had Stage IIA, 10% had Stage IIB, and 10% had Stage III. In terms of treatment, 44% received chemotherapy and 54% received radiation. Visit 1 took place an average of 19.0 days (SD=13.7) post-diagnosis and 21.2 days (SD = 17.5) before treatment. Excluding continued hormonal treatment, cancer treatment lasted for an average of 155.2 days (SD = 131.7) between Visit 1 and Visit 2. White cancer survivors had higher incomes (p < .001), more years of education (p = .04), and fewer comorbidities (p = .005) than their Black counterparts but did not differ on any other variable of interest including treatment type or stage at diagnosis (ps > .31). However, Black patients had a longer gap between Visit 1 and the start of treatment (M=27.0, SD = 22.6 days) than White women (M=19.9, SD=15.8 days, $t(190)$ = −2.2, p = .04), even though they did not differ in time since diagnosis (Black: M = 15.9, SD = 11.9 days, White: M = 19.6, SD = 14.0 days, $t(192)$ = 1.4, p = .17). During the study, none of the participants had an early recurrence or additional cancer diagnosis. See Table 1 for the sample's demographic information and Table 2 for zero-order correlations.

3.2. Cancer-related distress trajectories

3.2.1. Unadjusted trajectories

Results were similar for adjusted and unadjusted models. In unadjusted models, cancer-related distress ($F(2, 341)$ = 4.1, p = .02) and intrusive thought ($F(2, 343)$ = 6.4, p = .002) trajectories differed by

Table 1
Sample information at Visit 1.

		Black (n = 32)		White (n = 163)	
		N (%)	M (SD)	N (%)	M (SD)
Age			54.4(13.3)		55.6(10.7)
Comorbidities			1.3(1.6)		0.6(1.2)
*					
Education*	High School	14(43.8)		41 (25.2)	
	Some College	9(28.1)		32(19.6)	
	College Grad	4(12.5)		44(27.0)	
	Grad Training	5(15.6)		46(28.2)	
Income*	<$25,000	16(53.3)		17(11.4)	
	$25,000-$50,000	7(23.3)		38(25.5)	
	$50,000-$75,000	3(10.0)		23(15.4)	
	$75,000-$100,000	1(3.3)		25(16.8)	
	$100,000+	3(10.0)		46(30.8)	
Stage	0	7(23.3)		27(16.6)	
	I	12(40.0)		76(46.6)	
	IIA	8(26.7)		24(14.7)	
	IIB	2(6.7)		18(11.0)	
	III	1(3.3)		18(11.0)	
Chemo	Yes	13(41.9)		73(44.8)	
	No	18(58.1)		90(55.2)	
Radiation	Yes	18(56.3)		88(54.0)	
	No	14(43.8)		75(46.0)	

* $p < .05$ for the between-group differences

race, but avoidance trajectories did not ($p = .29$). However, White survivors' overall avoidance was lower than Black survivors' ($F(1, 192) = 4.8$, $p = .03$). In terms of distress and intrusive thought trajectories, White survivors had steeper declines (distress: $B = -14.4$, $SE = 1.3$, $t(336) = -11.5$, $p < .0001$; intrusion: $B = -8.1$, $SE = 0.7$), $t(338) = -12.2$, $p < .0001$) than black survivors (distress: $B = -7.8$, $SE = 3.0$, $t(349) = -2.6$; $p = .009$; intrusion: $B = -4.0$, $SE = 1.6$, $t(350) = -2.5$, $p = .01$) from shortly after diagnosis to six months later. However, neither race experienced significant declines in distress or intrusive thoughts between 6 and 18 months ($ps > .05$).

In terms of racial differences in symptoms at each visit, there were no differences in distress or intrusive thoughts shortly after diagnosis ($ps > .38$), but White survivors had lower distress at 6 ($B=-6.9$, $SE=3.2$, $t(410) = -2.16$, $p = .03$) and 18 months ($B = 9.1$, $SE = 3.2$, $t(413)= -2.8$, $p = .005$) post-treatment and fewer intrusive thoughts at 18 months ($B = 4.6$, $SE = 1.7$, $t(417) = -2.7$, $p = .007$), but not 6 months ($p = .10$), post-treatment.

3.2.2. Adjusted trajectories

In adjusted models, Black and White breast cancer survivors had different trajectories of cancer-related distress ($F(2, 291) = 5.6$, $p = .004$) and specifically intrusive thoughts ($F(2, 293)= 6.18$, $p = .002$) but not avoidance ($p = .06$). However, Black survivors reported higher overall levels of avoidance ($F(1, 188)= 4.0$, $p = .047$). In terms of symptom trajectories, White breast cancer survivors' cancer-related distress ($B=-14.5$, $SE = 1.4$, $t(290)= -10.6$, $p < .0001$) and intrusive thoughts ($B = -8.1$, $SE = 0.7$, $t(291) = -10.9$, $p < .0001$) lessened from shortly after diagnosis to 6 months post-treatment and then did not change between 6 and 18 months post-treatment ($ps > .07$), but Black survivors' cancer-related distress did not change over time ($ps > .16$) (Fig. 1). See Table 3 for within-group slopes.

Comparing symptoms at each visit, Black and White women did not differ in cancer-related distress ($p = .74$) or intrusive cancer-related thoughts ($p = .17$) prior to cancer treatment. However, Black breast cancer survivors had higher distress at 6 months ($B=8.5$, $SE=3.9$, $t(379)= 2.2$, $p = .03$) and 18 months ($B=10.1$, $SE=3.8$, $t(372)= 2.6$, $p = .009$) after treatment, and more intrusive thoughts at 18 months ($B=4.0$, $SE=2.0$, $t(380)= 2.0$, $p = .047$) – but not 6 months ($p = .13$) – after treatment compared to their White counterparts. See Table 4 for racial differences at each visit.

In terms of covariates, older women had lower cancer-related distress ($p = .002$) and intrusive thoughts ($p < .0001$). Also, those with fewer comorbidities had fewer intrusive thoughts ($p = .03$).

3.3. Perceived stress, depression, and anxiety trajectories

3.3.1. Unadjusted trajectories

Black and White survivors had a different trajectory of perceived stress ($F(2, 344) = 5.5$, $p = .005$), but not anxiety or depressive symptoms ($ps>.05$). However, Black survivors' overall anxiety ($F(1, 198)= 4.5$, $p = .04$) and depressive symptoms ($F(1, 197)= 6.0$, $p = .02$) were higher than White survivors'. In terms of symptom trajectories, White survivors' perceived stress ($B=1.4$, $SE=0.3$, $t(339)= -5.2$, $p < .0001$) declined over the first six months of the study, while Black survivors' did not ($ps > .77$).

Although there was no between-race difference in perceived stress shortly after diagnosis ($p > .65$), White survivors had at least marginally lower perceived stress 6 months ($B=1.3$, $SE=0.7$, $t(400)= -1.8$, $p = .07$) and 18 months later ($B=1.9$, $SE=0.7$, $t(403)= -2.7$, $p = .007$).

3.3.2. Adjusted trajectories

Perceived stress trajectories differed by race ($F(2, 291)= 3.2$, $p = .04$). White survivors' perceived stress decreased from post-diagnosis to 6 months post-treatment ($B=1.5$, $SE=0.3$, $t(289)= -5.1$, $p < .0001$), and then did not change between 6 and 18 months after treatment ($p = .69$), but Black women's stress levels remained unchanged from one visit to the next ($ps>.69$) (Fig. 2). Black and White
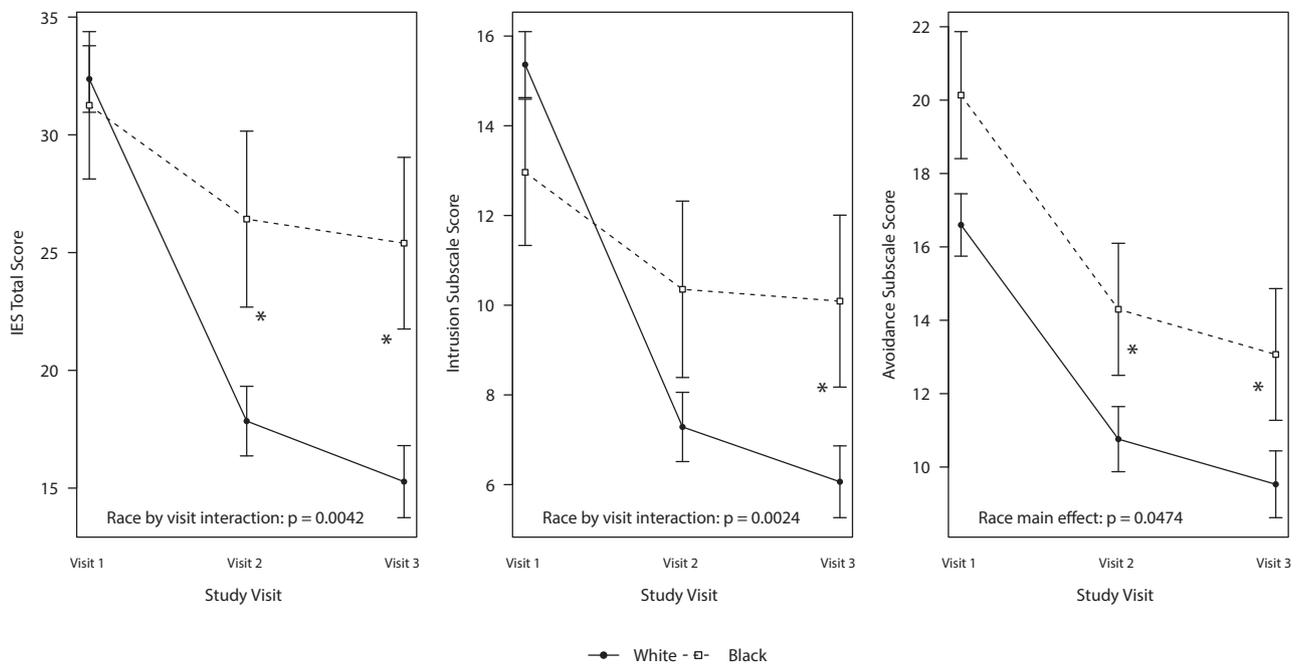
Table 2
Zero-Order Correlations Between Study Variables at Visit 1.

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Race											
2. Age	-0.04										
3. Income	**-0.34**	**-0.17**									
4. Comorbidities	**0.20**	**0.17**	**-0.17**								
5. Chemo	-0.02	-0.12	-0.13	-0.05							
6. Radiation	0.02	0.09	-0.01	0.13	0.13						
7. CES-D	0.07	**-0.28**	**-0.18**	0.04	0.04	-0.03					
8. BAI	0.05	**-0.21**	**-0.25**	**0.18**	0.12	-0.14	**0.76**				
9. IES	0.01	**-0.22**	-0.07	0.04	0.03	0.03	**0.59**	**0.59**			
10. PSS-4	-0.03	**-0.25**	**-0.16**	-0.02	**0.15**	0.01	**0.70**	**0.66**	**0.46**		
11. Average Pain	**0.29**	0.01	**-0.40**	**0.31**	-0.01	-0.02	**0.35**	**0.44**	0.13	**0.31**	
12. MFSI total	0.04	**-0.28**	**-0.25**	0.14	0.09	-0.09	**0.83**	**0.78**	**0.51**	**0.71**	**0.44**

$p < .05$; CES-D=Center for Epidemiological Studies Depression Scale; BAI=Beck Anxiety Index; IES=Impact of Events Scale; PSS-4 = Perceived Stress Scale, Short Form; MFSI = Multidimensional Fatigue Symptom Inventory

Fig. 1. Cancer-Related Distress Trajectories by Race. From shortly after diagnosis to approximately 20 months post-treatment, Black and White breast cancer survivors differed in their trajectories of cancer-related distress (p = .004) and intrusive thoughts (p = .002), and Black women had higher levels of avoidance when averaged across all visits (p = .047). IES=Impact of Events Scale; *p < .05 for between-race comparison at each visit. Models adjusted for age, income, education, cancer stage and treatment type, and comorbidities.

Table 3
Between-Visit Slopes by Race for Significant Race by Visit Interactions.

Measure	Timeframe	Race	Slope Estimate	SE	DF	t-value	p-value
IES	Visit 1 to Visit 2	White	-14.523	1.370	290	-10.600	$< .0001*$
		Black	-4.832	3.505	302	-1.380	.169
	Visit 2 to Visit 3	White	-2.571	1.446	281	-1.780	.077
		Black	-1.022	3.706	270	-0.280	.783
Intrusive thoughts	Visit 1 to Visit 2	White	-8.078	0.743	291	-10.870	$< .0001*$
		Black	-2.608	1.890	305	-1.370	.170
	Visit 2 to Visit 3	White	-1.222	0.785	281	-1.560	.121
		Black	-0.263	2.014	270	-0.130	.896
PSS, short	Visit 1 to Visit 2	White	-1.536	0.303	289	-5.070	$< .0001*$
		Black	0.133	0.777	303	0.170	.865
	Visit 2 to Visit 3	White	0.126	0.320	278	0.400	.693
		Black	0.319	0.823	269	0.390	.699
MFSI, emotional fatigue	Visit 1 to Visit 2	White	-4.248	0.446	287	-9.520	$< .0001*$
		Black	-0.964	1.145	301	-0.840	.401
	Visit 2 to Visit 3	White	-0.343	0.471	277	-0.730	.468
		Black	-0.632	1.212	267	-0.520	.602
MFSI, vigor	Visit 1 to Visit 2	White	3.228	0.483	288	6.690	$< .0001*$
		Black	-0.331	1.239	301	-0.270	.790
	Visit 2 to Visit 3	White	0.106	0.509	278	0.210	.835
		Black	0.948	1.308	269	0.720	.469

IES=Impact of Event Scale, PSS=Perceived Stress Scale, MFSI=Multidimensional Fatigue Symptom Inventory; *p < .05. Models adjusted for age, income, education, cancer stage and treatment type, and comorbidities.

survivors' depressive and anxiety symptom trajectories did not differ (ps > 0.11).

At each visit, Black and White women's perceived stress levels were not different (ps >.14). Race was unrelated to depressive and anxiety symptoms across visits (ps > .65), but depressive symptoms declined across visits ($F_{(2, 295)}= 5.3$, p = .005), alongside a marginal decline in anxiety ($F_{(2, 294)}= 2.9$, p = .056).

Significant covariates were as follows: older women and those with higher incomes had lower perceived stress levels and depressive symptoms across visits (ps < .01). Also, older women and those with fewer comorbidities had lower anxiety symptoms across visits (ps < .03).

3.4. Vigor, fatigue, and pain trajectories

3.4.1. Unadjusted trajectories

Black and White women had different trajectories of vigor ($F_{(2, 341)}= 5.3$, p = .005) and emotional fatigue ($F_{(2, 340)}= 4.6$, p = .01), and a marginally different trajectory of total fatigue ($F_{(1, 197)}= 4.5$, p = .05) but not any other fatigue or pain measure (ps > .28). However, White survivors' mental fatigue ($F_{(1, 195)}= 4.1$, p = .04), general fatigue ($F_{(1, 196)}= 4.0$, p = .046), physical fatigue ($F_{(1, 192)}= 11.4$, p = .0009), and pain ratings ($F_{(1, 194)}= 18.6$, p < .0001) were lower across visits. In terms of symptom trajectories, White survivors' vigor (B=3.1, SE=0.4, t(336)= 7.3, p < .0001), emotional fatigue (B=4.3,

Table 4
Between-Race Differences at each Visit for Significant Race by Visit Interactions.

Measure	Visit	White vs. Black Estimate	SE	DF	t-value	p-value
IES	1	1.116	3.319	289	0.34	.737
	2	-8.575	3.898	379	-2.20	.028*
	3	-10.124	3.844	372	-2.63	.009*
Intrusive thoughts Subscale	1	2.401	1.731	300	1.39	.166
	2	-3.068	2.053	387	-1.49	.136
	3	-4.027	2.022	380	-1.99	.047*
PSS short	1	1.043	0.719	294	1.45	.148
	2	-0.626	0.849	383	-0.74	.461
	3	-0.819	0.837	377	-0.98	.329
MFSI emotional fatigue	1	2.191	1.073	289	2.04	.042*
	2	-1.093	1.263	380	-0.87	.387
	3	-0.804	1.245	373	-0.65	.519
MFSI vigor	1	-3.892	1.189	284	-3.27	.001*
	2	-0.333	1.392	376	-0.24	.811
	3	-1.175	1.373	369	-0.86	.393

IES=Impact of Event Scale, PSS=Perceived Stress Scale, MFSI=Multidimensional Fatigue Symptom Inventory; *p < .05. Models adjusted for age, income, education, cancer stage and treatment type, and comorbidities.

SE=0.4, $t(335)$= −10.7, $p < .0001$), and total fatigue (B=5.1, SE=1.5, $t(336)$= −3.3, $p = .001$) improved in the first 6 months of the study, unlike Black survivors ($ps > .05$). Between 6 and 18 months, these symptoms did not change for either race ($ps > .23$).

In terms of racial differences in symptoms at each visit, Black women had marginally higher vigor at the first visit (B=2.1, SE=1.1, $t(332)$= 1.9, $p = .053$), but this advantage disappeared 6 and 18 months later ($ps > .24$). There were no differences in emotional fatigue or total fatigue shortly after diagnosis ($ps > .57$), but White women had lower emotional and total fatigue 6 months (emotional: B=-2.1, SE=1.1, $t(390)$= −1.96, $p = .05$; total: B= -10.3, SE= 4.5, $t(358)$= −2.3, $p = .02$) and 18 months later (emotional: B=-2.5, SE=1.1, $t(393)$= −2.3, $p = .02$; total: B = -10.9, SE= 4.5, $t(361)$= −2.4, $p = .02$).

3.4.2. Adjusted trajectories

Vigor ($F(2, 290)$= 4.1, $p = .02$) and emotional fatigue ($F(2, 291)$= 4.6, $p = .01$) trajectories differed between Black and White survivors. From shortly after diagnosis to 6 months after treatment, White women's vigor increased (B=3.2, SE=0.5, $t(288)$= 6.7, $p < .0001$), but Black women's vigor did not change ($p = .79$), and there were no changes from 6 to 18 months post-treatment for either race ($ps>.47$). Similarly, White survivors' emotional fatigue decreased from post-diagnosis to 6 months post-treatment (B=-4.2, SE=0.5, $t(287)$= −9.5, $p < .0001$), and then remained unchanged from 6 to 18 months post-

treatment ($p = .47$). Black women's vigor did not change from one visit to the next ($ps > .40$). See Fig. 3. There were no racial differences in any other symptom trajectory, including pain, general fatigue, mental fatigue, physical fatigue, or total fatigue ($ps > .08$). Also, overall fatigue and pain levels did not differ by race ($ps > .25$).

Comparing symptoms at each visit, Black survivors reported more vigor than White survivors prior to treatment (B=3.9, SE=1.2, $t(284)$= 3.27, $p = .001$), but then did not differ from White survivors at the two post-treatment visits ($ps > .39$). Similarly, Black survivors had less emotional fatigue prior to treatment (B=-2.2, SE=1.1, $t(289)$= −2.0, $p = .04$), but then did not differ from White survivors at the two follow-up visits ($ps > .38$).

In terms of covariates, those who were older reported greater total and general fatigue ($ps < .001$). Those with more comorbidities also reported greater general fatigue ($p = .047$). Older women and those with higher incomes had lower emotional and mental fatigue ($ps < .001$). Also, women with higher incomes and fewer comorbidities had lower physical fatigue ($ps < .03$).

3.5. Race and inflammation trajectories

Black and White survivors did not have different trajectories or overall levels of inflammatory cytokines ($p > .54$). Also, there was no racial difference in overall levels or trajectories of CRP ($ps > .17$).

4. Discussion

In this longitudinal study of early breast cancer survivorship, we observed important differences in cancer-related distress, intrusive thoughts, avoidance, perceived stress, emotional fatigue, and vigor between Black and White women that persisted even with the inclusion of socioeconomic and health-related covariates. Specifically, White survivors' cancer-related distress, perceived stress, and emotional fatigue declined, and their vigor increased from shortly after diagnosis (Visit 1) to approximately 6 months post-treatment (Visit 2); however, Black survivors did not experience these same improvements. Instead, Black survivors' psychological distress remained high across time, despite treatment completion and months of recovery. In fact, even after treatment, Black women's intrusive thoughts about their cancer diagnosis and treatment remained well above trauma survivors' mean ratings of intrusive thoughts about a past "upsetting event" (Briere and Elliott, 1998). Of note, these differences emerged even though, in adjusted models, Black survivors did not report higher levels of pain or physical fatigue across time compared to White survivors, suggesting that the observed differences in psychological distress and emotional fatigue trajectories do not simply reflect disproportionate physical burden.
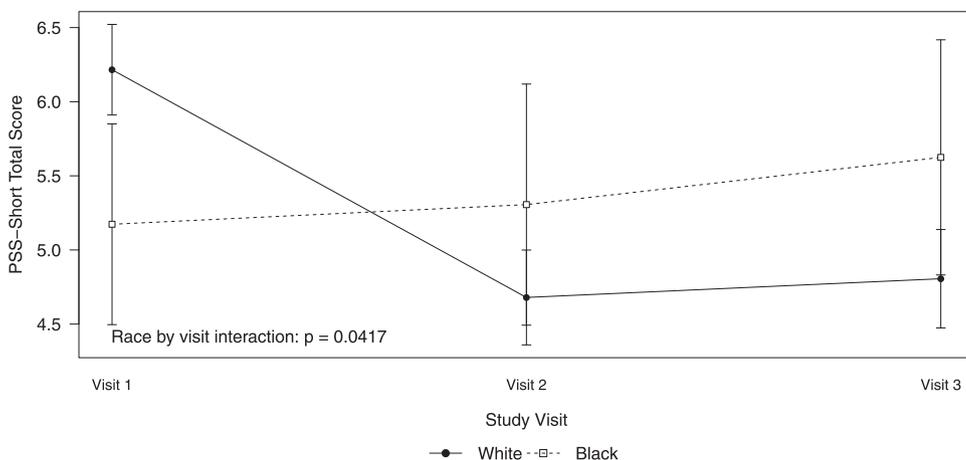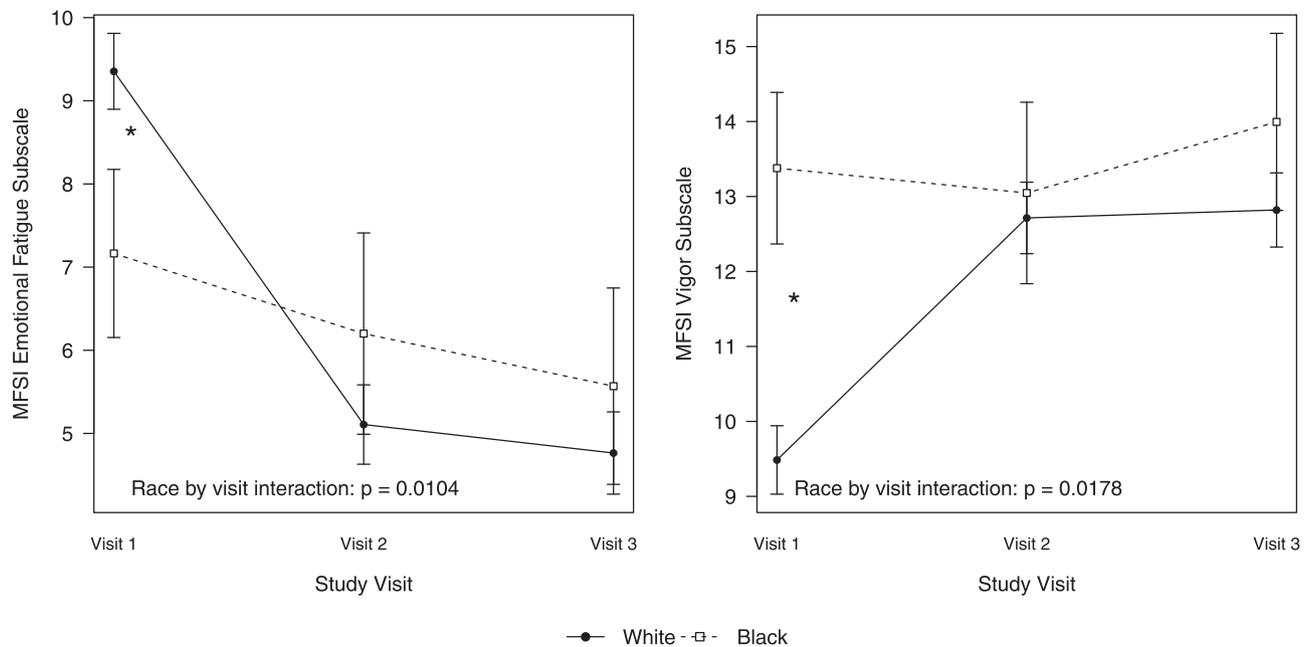

Fig. 2. Perceived Stress Trajectory by Race. Black and White women had divergent trajectories of perceived stress across visits ($p = .04$). Although there were no between-race differences at any visit ($ps > .14$), White survivors had numerically higher perceived stress levels than Black survivors shortly after diagnosis, which then significantly declined from pre-treatment to 6 months post-treatment ($p < .0001$). Black survivors did not experience this decline in perceived stress, and therefore had numerically higher perceived stress levels than their White peers 6 and 18 months after treatment. PSS-Short=Perceived Stress Scale. Models adjusted for age, income, education, cancer stage and treatment type, and comorbidities.

Fig. 3. Fatigue and Vigor Trajectories by Race. Black and White breast cancer survivors had different emotional fatigue ($p = .01$) and vigor ($p = .02$) trajectories across visits. Although White women reported more emotional fatigue ($p = .04$) and less vigor ($p = .001$) than Black women before treatment (Visit 1), their symptoms signficantly improved by 6 months post-treatment (Visit 2) ($ps < 0.0001$), whereas Black women's fatigue and vigor did not change across time ($ps > 0.40$). Models adjusted for age, income, education, cancer stage and treatment type, and comorbidities.

The pattern of results in our adjusted versus unadjusted models warrants discussion. In unadjusted models, Black women had higher overall levels of anxiety and depressive symptoms, as well as mental fatigue, general fatigue, physical fatigue, and pain – but these differences disappeared once accounting for socioeconomic and health-related factors. Indeed, White survivors had higher incomes and educational attainment and fewer comorbidities than their Black counterparts. Therefore, it is particularly notable that racial differences in cancer-related distress, intrusive thoughts, avoidance, perceived stress, emotional fatigue, and vigor persisted after accounting for these covariates. This pattern of results suggests that while socioeconomic and health-related differences may account for Black women's elevated physical symptoms, they do not fully explain their mental and emotional symptoms. Even 18 months after finishing treatment, Black survivors' cancer-related distress, perceived stress, emotional fatigue, and vigor did not change from their pre-treatment levels. Anxiety and depressive symptoms are commonly assessed in primary care settings, but if this is the extent of psychological assessment, these results suggest that healthcare providers may be unaware of amplified and lasting psychological distress among Black breast cancer survivors even months after treatment completion.

Prior research points to several different factors that may help to explain Black breast cancer survivors' higher symptom burden. Compared to their White counterparts, Black breast cancer survivors experience more financial strain in breast cancer survivorship: in a large North Carolinian sample, Black breast cancer survivors were more likely to experience job loss, transportation barriers, income loss, and overall financial impact than White women – even after adjusting for baseline socioeconomic status (Wheeler et al., 2018). Prior experiences of racism can fuel distrust of the medical system (Mouslim et al., 2020) and poor patient-provider communication (Yoon et al., 2008), which further complicates survivorship. Treatment delays and poorer quality care are particularly troubling in light of Black patients' greater likelihood of receiving a more severe diagnosis, which contributes to their heightened mortality rates (Curtis et al., 2008). In sum, a cancer diagnosis and treatment are universally stressful, but may be even more so for women from a historically marginalized group who may experience a lack of

control, fewer resources, and discrimination throughout treatment and early survivorship.

Intriguingly, these differences in psychological distress emerged even though our sample of breast cancer survivors differed from other samples in notable ways. For instance, unlike other samples of breast cancer survivors (e.g., Smith-Bindman et al., 2006), the Black women in our sample did not have a higher stage at diagnosis than White women. Therefore, greater disease severity did not explain our findings, nor did socioeconomic differences, as we adjusted for observed income and educational differences. Also, our participants were all treated at the same cancer clinic, which may have helped to reduce treatment differences. Therefore, in other samples, Black women's higher stage at diagnosis and treatment differences may not be wholly responsible for elevated distress. Indeed, these atypical sample characteristics may help to explain why we did not observe divergent pain, physical fatigue, anxiety, and depressive symptom trajectories, and further research on these symptom trajectories is warranted.

Our results clarify and expand the prior mixed findings concerning Black and White breast cancer survivors psychological symptoms, in which researchers commonly compared races at a single timepoint (e.g., Janz et al., 2009), combined several races into a "non-White" group (e. g., Syrowatka et al., 2017), or did not examine symptom trajectories despite having longitudinal data with repeated measurements of the same outcomes (e.g., Bradley and Wilk, 2014). Following the same breast cancer survivors throughout treatment and early survivorship provided a unique window into how race factored into individuals' own symptom trajectories. Importantly, in our study, there were several occasions in which Black and White survivors' distress-related symptoms did not differ, and a cross-sectional snapshot of symptoms would have incorrectly suggested that there were no disparities. For instance, Black and White women did not differ in cancer-related distress prior to treatment or perceived stress before or after treatment. Even so, analysis of their symptom trajectories revealed that White women's cancer-related distress and perceived stress declined from pre-treatment to 6 months post-treatment – an improvement that Black women did not experience. As another example that cross-sectional analyses may not capture the whole story, Black women had *lower* emotional fatigue and

higher vigor than White women before treatment but then did not experience the same gains as White women from pre-treatment to 6 months post-treatment. More robust community support or greater religious engagement among Black survivors may help to explain these post-diagnosis, pre-treatment differences (Bellizzi et al., 2010; Lewis et al., 2012), but nonetheless, these differences eroded over time as White women's emotional fatigue and vigor improved over time, unlike Black women's. Overall, these findings point to the need for further examination of psychological symptom trajectories by race to better identify those who are at risk for elevated and persistent psychological distress.

4.1. Health implications

Black women's ongoing experience of cancer-related distress – even 1.5 years after treatment ended – may help to explain their reliably poorer health outcomes (Richardson et al., 2016). The perseverative cognition hypothesis asserts that both worry and rumination can prolong the physiological stress response such that it starts long before and lasts long after the actual stressor (Brosschot et al., 2006). Indeed, our findings showed that Black breast cancer survivors reported enduring intrusive thoughts about their cancer diagnosis and treatment. The physiological concomitants of such perseverative cognition include higher systolic and diastolic blood pressure, higher heart rate and cortisol, and lower heart rate variability (Ottaviani et al., 2016), which can increase risk for cardiovascular morbidity and mortality (Thayer et al., 2010). Our lab has shown that when a breast cancer survivor's own cancer-related distress was higher than her own average, so was her systemic inflammation (Renna et al., 2020) – yet another risk factor for morbidity, accelerated aging, and early mortality (Franceschi et al., 2000; Reuben et al., 2002). However, in our sample, we did not find evidence of elevated inflammation or steeper inflammatory trajectories among Black survivors to mirror their heightened distress. One explanation for this null result is that prior research has revealed critical distinctions in proinflammatory biology based on race (e.g., low prevalence of soluble IL-6 receptors among Black people) (Coe et al., 2011). Even so, chronic intrusive thoughts and avoidance, as observed in our Black survivors, are linked to cardiovascular disease (Denollet et al., 2010; Ferketich and Binkley, 2005; Penninx et al., 2001) – one of the most frequent causes of death among breast cancer survivors (Sturgeon et al., 2019). Therefore, our finding of persistently heightened psychological distress among Black breast cancer survivors – a phenomenon that cross-sectional analyses miss – provides a logical contextual backdrop for their widely-recognized physical health disparities.

4.2. Clinical relevance

We oriented our analysis around distress because the National Comprehensive Cancer Network identified distress as a multifactorial experience that exists along a continuum ranging from sadness to anxiety, depression, and even existential crises (National Comprehensive Cancer Network, 2021). Although not a psychiatric diagnosis, distress is a clinically significant patient experience that can interfere with treatment and recovery, and therefore necessitates assessment and intervention (National Comprehensive Cancer Network, 2021). Distress can impact (and is impacted by) patient-provider communication, treatment delivery and outcomes, quality of life in survivorship, immune function, cancer recurrence, and the development of comorbidities (National Comprehensive Cancer Network, 2021, Renna et al., 2020,; Wang et al., 2020).

These results underscore the need to evaluate patient distress at multiple timepoints across their survivorship, which is not currently universally mandated. Current accreditation requirements from the American College of Surgeons Commission on Cancer require psychosocial distress screening at one timepoint during the patient's first course of treatment and do not require distress screening throughout survivorship (Commission on Cancer, 2020). New National Comprehensive Cancer Network Clinical Practice Guidelines for Distress Management suggest that "ideally patients should be screened for distress at every medical visit" (National Comprehensive Cancer Network, 2021), and our results support this guidance. Without routine screening of psychosocial distress across survivorship, survivors, especially Black survivors', needs may go unmet.

Physicians can have difficulties identifying distress. Among a large sample of German cancer survivors, physicians often underestimated patients' distress, producing low concordance between patient and physicians' ratings of patients' distress (kappas <0.01, sensitivity < 13%), (Werner et al., 2012). Even if cancer patients deny anxiety or depressive symptoms, physicians can ask specifically about cancer-related distress, another important indicator for psychotherapeutic intervention (National Comprehensive Cancer Network, 2021). Moreover, the National Comprehensive Cancer Network recommends including educational programs to bolster oncologists' accuracy in distress assessment (National Comprehensive Cancer Network, 2021).

4.3. Strengths and limitations

This study's longitudinal data from Black and White breast cancer survivors provided a more complete picture of their distress. Another strength was the timing of repeated assessments, starting shortly after diagnosis and before treatment, and ending about two years later – after both primary and adjuvant cancer treatment. This timeframe provided a window into these women's initial reaction and adjustment to the diagnosis and the looming prospect of treatment, as well as their psychological state in the aftermath of treatment. The repeated use of a wide variety of distress measures – beyond the psychological symptom battery commonly used in clinical practice – was yet another strength. Lastly, our analytic strategy examined both within-race slopes and between-race differences at each visit. It also accounted for possible confounds (age, income, education, chemotherapy and radiation treatment, cancer stage at diagnosis, comorbidities), as well as the high within-subject correlations inherent in repeated measurement. Despite these strengths, the results are limited by the considerable difference in group size, and specifically the small sample size of Black survivors. Also, these findings do not generalize to other ethnic or racial minorities or other cancer types, so more research on distress trajectories in these populations is warranted. Although we had too few Hispanic/Latina individuals to consider ethnicity, the intersectionality of race and ethnicity is an important consideration for future work tracking psychological symptom trajectories in breast cancer survivorship. Lastly, the simplistic Black and White group categorization does not account for the unique backgrounds and experiences within each group, including experiences of discrimination and racism throughout the cancer trajectory.

5. Conclusions

In this longitudinal observational study, Black breast cancer survivors did not experience the improvements in cancer-related distress, perceived stress, vigor, and emotional fatigue that White survivors did after receiving treatment. Instead, these distress-related symptoms remained persistently elevated among Black survivors, even though their anxiety and depressive symptoms, physical fatigue, and pain levels did not diverge from their White peers. These data suggest that even after treatment, Black breast cancer survivors may experience lingering psychological symptoms that can diminish their quality of life and even increase risk for cancer recurrence or cardiovascular disease – the most common cause of death among this population (Sturgeon et al., 2019). Screening for and addressing these problems throughout survivorship is essential to reducing the health disparities seen in Black breast cancer survivors.

Declaration of Conflict of Interest

All authors declare no conflicts of interest.

Acknowledgements

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