

Examination of race/ethnicity specific [Hispanic vs. non-Hispanic White (NHW)] differences in Patient Reported Outcomes (PROs) among elderly female breast cancer (BC) patients with longitudinal follow-up survey data in the SEER-MHOS database.

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PH 800: Capstone in Public Health

May 6, 2024

Abstract

Background:

Previous literature suggests that there is a disparity between Hispanic and non-Hispanic White (NHW) older adults breast cancer survivors with regards to health-related patient reported outcomes (PROs). In addition, few studies have examined factors that may mediate this association in longitudinal follow-up survey data which was the impetus for our study.

Methods:

Data is from the Surveillance, Epidemiology and End Results- Medicare Health Outcomes Survey (SEER-MHOS). Our analytic sample (n=18,457) is 12,964 NHW and 1,793 Hispanic women with BC diagnosed between 2010-17, and with longitudinal follow-up surveys done through 2019. We used generalized linear models with predictive margins [risk differences (RD) with 95% confidence intervals (CI)] to estimate average controlled direct associations (ACDA) for crude and age/body mass index (BMI)-adjusted physical and mental health PROs [Physical and Mental Component Summary T-Scores (PCS/MCS: are linear transformation of the 0-100 possible range scoring for 8 Veterans RAND 12 Item Health Survey (VR-12) sub-scales, with mean of 50 and standard deviation (SD) of 10, normed to the US population)] by R/E. We performed a series of ACDA controlling for the domains of socioeconomic position (SEP) [household income, poverty level, and education]; comorbid disease [smoking status, diabetes, hypertension]; tumor biology [stage, grade, subtype]; treatment factors [treatment type]; and social support [marital status].

Results:

Hispanic women had a younger age at diagnosis, greater BMIs, and in general had lower household income compared to NHW women. Further, Hispanic women were less likely to be married, more likely to have diabetes, and more likely to have high blood pressure. Observed PRO trends for all women decreased over the 10-year period, but trends remained lowest for Hispanic women in comparison to NHW. In crude models, the MCS/PCS difference was -5.63 (95% CI: -6.54, -4.72) and -3.90 (95% CI: -3.99, -3.82) for Hispanic women compared to NHW. In age/BMI adjusted baseline models, compared to NHW, Hispanic women had significantly lower MCS/PCS scores [-5.23 (95% CI: -6.41, -4.05), and -3.56 (95% CI: -3.89, -3.22), respectively]. For both MCS/PCS scores, the SEP domain mediated the majority of the effect (MCS= 41% and PCS= 63%) with household income having the greatest influence within the domain (MCS= 29% and PCS= 43%). In fully specified models with all 5 mediating domains, the MCS/PCS disparity for Hispanic vs NHW women remained lower [-2.69 (95% CI: -3.43, -1.96), and -0.79 (95% CI: -2.22, 0.63), respectively]. Further, as the MCS difference from the latter model is >2% points, this difference is considered to be more than a minimally important difference; this is however, in contrast to the PCS difference.

Conclusions:

Our findings suggest that the observed R/E PRO disparities between elderly Hispanic and NHW women with BC is largely mediated by SEP, and likely specifically by household income. In addition, after mediation analysis, Hispanic women appear to have an almost 2.7% lower MCS score which remains unexplained and requires further study.

Background

The Problem

For the year 2023, in the United States, it is estimated that breast cancer is the most diagnosed cancer in women (American Cancer Society, 2023). It represents about 30% of all new female cancer cases and for the year 2023, it is estimated that 43,170 women will die from breast cancer (American Cancer Society, 2023). Breast cancer is most common in middle-aged and older women with a median age at diagnosis of 62 (American Cancer Society, 2023). Moreover, it was estimated that the lifetime risk of a woman in the United States developing breast cancer was 13% (1 in 8) for the years 2014-2016 (Surveillance, Epidemiology, and End Results, 2019). In recent years, the incidence of breast cancer has increased by 0.5% each year (American Cancer Society, 2023). As for deaths caused by cancer, breast cancer is also the second leading cause in women following lung cancer (American Cancer Society, 2023). It is estimated that 1 in 39 (2.5%) women will die from breast cancer (American Cancer Society, n.d.).

Though the trend in number of deaths has decreased over the years with an increase in early detection via screenings and awareness, this decrease has plateaued overtime (American Cancer Society, n.d.). Therefore, the number of cancer survivors in the United States does continue to increase where in women, breast cancer had the greatest level of survivorship for the year 2019 (Miller et al., 2019). Currently, it is thought that there are more than 4 million breast cancer survivors living in the United States.

Health-Related Quality of Life and Patient Reported Outcomes

Breast cancer is a complex health outcome that results in more than a diagnosis and/or death and it has the potential to affect many aspects of a person's physical and mental health (Kent et al. 2015). An assessment of this impact is by looking at the Health-Related Quality of Life for an individual (HRQOL) (Trask et al., 2009). This assessment is important because it encompasses daily factors that a provider is unable to understand with a quick examination and its assessment may further guide necessary treatment. Further, the HRQOL of an individual can be quantified via patient reported outcomes (PROs) which is a patient self-reported status of health without regard for interpretation of a clinician or researcher (International Society of Quality of Life, n.d.). These PROs are obtained using scales or questionnaires and allow for a more in-depth approach to understanding the challenges patients and specifically cancer patients may face (Kent et al., 2016). This includes physical and/or mental component scores that include aspects like physical functioning, role limitations due to emotional problems, mental health and more which become more crucial barriers to assess as patients become older as their limitations and risk for comorbidities are bound to increase or become more severe (Kent et al., 2016; National Cancer Institute, 2023).

Some studies that measured PROs suggest that cancer survivors have worse rated physical health status than individuals without a cancer diagnosis (Kent et al., 2015). Though Kent et al. found the mental health component to be comparable among both groups, cancer survivors scored worse for the Role-Emotional and Social Functioning scales when compared to those without cancer. Because these results are only preliminary, there is a need to further investigate the effects cancer may cause

once disease has begun as measured via patient reported outcomes of an individual (International Society of Quality of Life, n.d.; Fitzsimmons et al. 2009). Though breast cancer is already a concerning problem as a whole and will negatively impact all patients diagnosed, there are disparities to consider that may also occur within this sphere.

PRO Disparities Between Hispanic and NHW Breast Cancer Survivors

Studies show that though Hispanic women have a lower incidence of breast cancer compared to non-Hispanic White women (NHW), the rate at which incidence is increasing is higher in Hispanic women (Miller et al., 2021; Pinheiro et al., 2011). Health-related quality of life (HRQOL) is an impact used to measure someone's health status. Commonly associated with HRQOL are patient reported outcomes (PROs) measurements of a patient's health that is elicited from the patient. Further, an example of a potential disparity within the PROs of some individuals is measured across racial and ethnic groups (Giaquinto et al. 2022; Jackson et al., 2021). Previous studies show that select PROs are worse among Hispanic breast cancer patients compared to NHW breast cancer patients (Jackson et al., 2021; Lee et al. 2023; Rincon et al. 2020). Specifically, among cancer patients overall, Hispanics had lower Physical Component Summary and Mental Component Summary scores compared to NHW individuals (Rincon et al., 2020). Another study, Ashing-Giwa et al., (2007) sampled breast cancer survivors and found that Hispanic women reported the lowest HRQOL scores compared to African-, Asian- and White- Americans, specifically among all domains: physical, social/family, emotional, and functional. Further, years since diagnosis, role limitation, emotional well-being, patient-doctor relationship, life stress, number of comorbidities

and social support were some of the significant HRQOL determinants found (Ashing-Giwa et al., (2007). Given the United States' large and growing population of Hispanic immigrant women, this potential association can be further studied through an acculturation lens, specifically using language as an indicator for nativity or immigration status (American Immigration Council, 2023; Thomson & Hoffman-Goetz, 2009).

Acculturation

When exploring the relationship between English proficiency and self-rated health among Latina breast cancer survivors, García-Jimenez et al. (2014) found that breast cancer self-efficacy and inner peace acted as mediators for this relationship which highlights the potential importance of language. Further, Balazy et al. (2019) found that in general, non-English speaking patients had greater odds of later stage disease than did English speaking patients again suggesting a potential cultural difference that can be explained by nativity and hence language. This was further exacerbated when looking at women over the age of 50 where non-English speaking patients presented with a more advanced stage than did those that were English speakers. Therefore, because there is some evidence to support the potential disparity observed in the HRQOL among non-English speakers from a cross-sectional lens, it is important to assess a step further and evaluate the long-term effects among this specific population (Rincon et al., 2020). For the purposes of this analysis, the sample size was too small, therefore, though measuring how acculturation may influence PROs, we were unable to do so.

Finally, there is a lack of data on aging trajectories for Hispanics compared to NHW women, specifically in those experiencing breast cancer survivorship. Therefore,

the findings of this analysis may inform this potential disparity regarding HQRL/PROs differences with age trajectories, while also informing other factors, if any, that influence it. This will contribute to the field by addressing a critical gap in knowledge which can inform future policy.

Objectives

In summary, prior studies suggest that NHW/NHB R/E disparities exist for HQRL/PROs in BC survivors and there is limited data on factors that potentially mediate these effects (given the observational nature of the present study, we refer to these as direct and indirect associations) particularly in patients with longitudinal follow-up data. In addition, there is limited data regarding R/E aging trajectories that may identify which BC survivors are most at risk for an accelerated aging phenotype characterized by worsening PROs over time as most prior studies have used only baseline rather than longitudinal follow-up data. Hence, the primary objective of this project is to examine these knowledge gaps.

Project Aims and Central Hypothesis

This project uses secondary analysis of currently available US population-based BC data from SEER-MHOS to examine the extent to which Hispanic/NHW differences (a) exist in physical and mental health PROs (PCS/MCS levels and sub-scales) [in elderly BC patients who have completed the Medicare Health Outcomes Survey (MHOS) baseline and follow-up surveys] (b) and are mediated by specific risk-domains including socioeconomic position (SEP: household income, poverty level, and education

status), social support (marital status), tumor biology (clinical stage, grade, molecular subtype), comorbid disease, and treatment factors (local vs. systemic therapy), among patients who have completed the baseline and follow-up surveys.

The second primary aim of this project is to evaluate Hispanic/NHW-specific aging trajectories by examining interactions using age- and follow-up cohort-stratified models among patients. This part of the analysis will largely use follow-up surveys.

We hypothesize that race/ethnicity-specific differences in survivor patient reported outcomes exist for elderly women with breast cancer and are mediated by socioeconomic status, level of social support, clinical stage, molecular type, and treatment factors. We also hypothesize that this association is modified by age at diagnosis, body mass index, and presence of comorbid disease.

Methods

This analysis used a population-based sample from the Surveillance, Epidemiology and End Results-Medical Health Outcomes Survey (SEER-HOS) linked database with physical and mental health patient reported outcomes, provided as Physical and Mental Component Summary T-Scores.

Study Population

The population sample includes NHW and Hispanic women with survey data after a diagnosis of breast cancer and with a diagnosis between 2010 and 2017. Follow up surveys were through the year 2019. There is a total of 2,652 baseline surveys and 956 follow up surveys for Hispanic women. For NHW women, there were a total of 17,732 baseline and 7,993 follow-up surveys. To be included in the sample, all NHW and

Hispanic women in the SEER-MHOS datafile required a diagnosis of first primary breast cancer. Participants were excluded if they had a diagnosis of cancer of any other site, prior to the breast cancer diagnosis (excluding non-melanoma skin cancer) and missing information on stage or subtype.

Variables:

Outcome

Outcome variables were VR-12 instrument PRO variables: All of the scale measures were available as T-scores and the Physical Component Summary T-score included: physical functioning, role physical, bodily pain, and general health. The Mental Component Summary T-score included: vitality, social functioning, mental health, role-emotional.

Exposure

For examining the degree that PROs may vary by race/ethnicity, the variables used were Hispanic and NHW. Because the dataset has data on individuals without an eligible cancer diagnosis, we ensured their cancer status through the identification of a binary (bin) cancer status variable (binary indicating yes or no here after).

Other variables

Other variables of interest for identification of potential confounding or to identify surveys included smoking status (bin), diabetes (bin), hypertension status (bin), survey type (baseline or follow-up), survey date (date of survey), and survey sequence (MHOS survey counter; a continuous integer).

Mediators:

To examine what potential mediators could be influencing the relationship between race and PROs T-scores, the variables household income, educational status, marital status, neighborhood poverty level, stage, grade of tumor differentiation, subtype and therapy were included in the analysis. Household income was categorized and coded as – 0 = >\$100,000 1 = \$80,000-99,999– 2 = \$50,000-79,999, 3 = 40,000-49,999 4 = 30,000-39,999, 5 = 20,000-29,999, 6 = 10,000-19,999, 7 = 5,000-9999 and 8 = \$<5,000. Education status was categorized and coded – 0 = > high school, 1 = high school, and 2 = < high school. Marital status was categorized and coded – 0 = married, 1 = not married. Neighborhood poverty level was coded – 0 = low to moderate poverty, 1 = high poverty. Stage of breast cancer was coded as 0 = local, 1= regional, and 2 = distant. The grade of tumor differentiation was coded – 0 = well, 1 = moderate, 2 = poor. The cancer subtype was coded – 0 = luminal A, luminal B (ER/PR+/HER2+), 1 = HER2+-type, and 3 = triple negative. The therapy received was coded – 0 = none/unknown, 1 = localized (surgery and/or radiation only), and 2 = systemic (with or without local).

Effect modifiers

Effect modification was assessed for this analysis. Variables assessed were age at diagnosis, multimorbidity, and BMI. Age at diagnosis was coded as continuous. BMI was calculated as both continuous BMI and categorical, coded – 0 = <20, 1 = 20 – <25, 2 = 25 - <30, 3 = 30 - <35 and 4 = 35+ but for all models was used as continuous.

Statistical analysis:

General descriptive characteristics of the sample will be provided in Table 1. Multivariable GLM (with identity link) and MBS (predictive margins) were used to estimate (prevalence)

RDs with 95% CIs in PRO T-scores with evaluation of a series of ACDA for mediation analyses. Significant interaction terms between race/ethnicity and all other covariates will be included in the fully specified and adjusted GLM models. Marginal effects for predicted PRO risk will be obtained using derivatives to explore response surfaces. Results will be expressed as the race/ethnicity comparison difference that remains after equalizing for specific mediator domain/s of interest, and production of complex stratified-estimates of average marginal effects and marginal effects at representative values for demonstration of age trajectories. Marginal effects at representative values will be used to explore the probability of worsening PROs at 5 and 10 years in the future and use contrast statements to compare these with results in the present. Then the combined results from mediation and interaction analysis will be used to characterize an accelerated aging phenotype. Finally, these results will be discussed in the context of estimating minimally important differences (MID) per Hays et al. (2005) and the associated strengths and weaknesses. Analyses will be conducted using Stata version 18, and all tests are 2-sided with a significance threshold of 0.05.

Results

As seen on Tables 1 and 2, regarding the baseline surveys the average age at diagnosis for Hispanic women was 72 and 75 for NHW. The average BMI for Hispanic women was 30.0 and 29.0 for NHW women. In general, NHW women had a higher education, greater levels of household income and lower levels of poverty compared to Hispanic women. Additionally, a lower percentage of Hispanics were ever smokers and never married, but a higher percentage had high blood pressure and been diagnosed

with diabetes compared to NHW women. Frequencies among therapy types (Localized, systemic, or unknown) were similar between Hispanic and NHW women with the most frequent in both racial/ethnic groups being systemic therapy.

Table 1: Distribution of Selected Characteristics by Mental Component Scores (MCS), Race/Ethnicity for Baseline and Follow up (Survey Type)

Variable	Baseline						Follow up					
	White			Hispanic			White			Hispanic		
	<50	50-100	Total	<50	50-100	Total	<50	50-100	Total	<50	50-100	Total
Age at diagnosis												
(continuous) N (%)	76 (10)	78 (8)	74 (10)	70 (11)	73 (10)	72 (11)	76 (10)	78 (8)	77 (8)	73 (10)	76 (8)	74 (9)
BMI (Continuous)												
N (%)	29 (7)	28 (6)	29 (6)	30 (6)	29 (6)	30 (6)	29 (7)	28 (6)	28 (6)	30 (6)	29 (6)	30(6)
Education N (%)												
> HS Diploma	1852 (40)	4750 (50)	6856 (46)	182 (17)	249 (27)	468 (21)	1295 (39)	3535 (50)	5031 (46)	126 (18)	159 (26)	306 (22)
HS Diploma	1695 (37)	3529 (37)	5463 (37)	276 (25)	270 (30)	577 (26)	1320 (40)	2662 (37)	4180 (38)	146 (21)	198 (33)	25 (22)
<HS Diploma	929 (20)	1086 (11)	2127 (14)	595 (54)	368 (40)	1072 (49)	622 (19)	818 (11)	1524 (14)	384 (56)	228 (38)	668 (48)
Household Income N (%)												
\$100,000+	83 (2)	420 (4)	520 (4)	6 (1)	15 (2)	22 (1)	68 (2)	330 (5)	408 (4)	5 (1)	6 (1)	11 (1)
\$80,000-\$99,999	79 (2)	341 (4)	433 (3)	3 (0)	9 (1)	12 (1)	51 (2)	232 (3)	297 (3)	3 (0)	4 (1)	8 (1)
\$50,000-\$79,999	276 (6)	1079 (11)	1400 (9)	20 (2)	38 (4)	59 (3)	199 (6)	762 (11)	1004 (9)	7 (1)	28 (5)	35 (3)
\$40,000-\$49,999	293 (6)	809 (8)	1146 (8)	36 (3)	43 (5)	85 (4)	244 (7)	630 (9)	896 (8)	16 (2)	26 (4)	43 (3)
\$30,000-\$39,999	459 (10)	1069 (11)	1579 (11)	56 (5)	64 (7)	129 (6)	323 (10)	772 (11)	1134 (10)	21 (3)	45 (8)	80 (6)
\$20,000-\$29,999	750 (16)	1474 (15)	2311 (16)	98 (9)	107 (12)	211 (10)	614 (18)	1235 (17)	1905 (17)	70 (10)	82 (14)	159 (11)
\$10,000-\$19,999	1207 (26)	1583 (17)	2923 (20)	251 (23)	229 (25)	518 (24)	851 (26)	1252 (18)	2183 (20)	193 (28)	131 (22)	342 (24)
\$5,000-\$9,999	402 (9)	431 (5)	868 (6)	247 (22)	129 (14)	414 (19)	282 (8)	289 (4)	604 (6)	131 (19)	85 (14)	227 (16)
<\$5,000	210 (5)	199 (2)	435 (3)	125 (11)	59 (6)	197 (9)	119 (4)	137 (2)	282 (3)	81 (12)	36 (6)	128 (9)

Missingness:

White Baseline

MCS: 634 (4.29%); BMI: 3777 (25.56%), Education: 329 (2.23%), Household income: 3160 (21.39%)

Hispanic Baseline

MCS: 192 (8.71%) BMI: 421 (19.10%), Education: 87 (3.95%), Household income: 557 (25.27%)

White F/U

MCS: 502 (4.58%), BMI: 2027 (18.51%), Education 215 (1.96%), Household income 2237 (20.43%)

Hispanic F/U

MCS: 113 (8.05%), BMI: 246 (17.52%) Education: 61 (4.34%), Household income: 371 (26.42%)

Full table in appendix

Table 2: Distribution of Selected Characteristics by Physical Component Scores (PCS), Race/Ethnicity for Baseline and Follow up (Survey Type)

Variable	Baseline						Follow up					
	White			Hispanic			White			Hispanic		
	<50	50-100	Total	<50	50-100	Total	<50	50-100	Total	<50	50-100	Total
Age at diagnosis												
(continuous) N (%)	74 (10)	75 (9)	74 (10)	71 (11)	73 (10)	72 (11)	77 (9)	77 (8)	77 (8)	74 (10)	76 (8)	75 (9)
BMI (Continuous) N (%)												
(%)	29 (7)	26 (5)	29 (6)	30 (6)	27 (6)	30 (6)	29 (6)	26 (5)	28 (6)	30 (6)	27 (6)	30 (6)
Education N (%)												
> HS Diploma	4396 (43)	2208 (55)	6856 (46)	328 (20)	103 (31)	468 (21)	3439 (44)	1391 (54)	5031 (46)	221 (20)	64 (33)	306 (22)
HS Diploma	3827 (38)	1397 (35)	5463 (37)	434 (26)	112 (34)	577 (26)	3101 (39)	881 (34)	4180 (38)	288 (26)	56 (29)	369 (26)
<HS Diploma	1655 (16)	360 (9)	2127 (14)	856 (51)	107 (32)	1072 (49)	1180 (15)	260 (10)	1524 (14)	541 (49)	71 (36)	668 (48)
Household Income N (%)												
\$100,000+	247 (2)	256 (6)	520 (3)	13 (0)	8 (2)	22 (1)	244 (3)	154 (6)	408 (4)	6 (1)	5 (3)	11 (0.78)
\$80,000-\$99,999	255 (3)	165 (4)	433 (3)	7 (0)	5 (2)	12 (0)	188 (2)	95 (4)	297 (3)	4 (0)	3 (2)	8 (1)
\$50,000-\$79,999	820 (8)	535 (13)	1400 (9)	42 (3)	16 (5)	59 (3)	652 (8)	309 (12)	1004 (9)	23 (2)	12 (6)	35 (2)
\$40,000-\$49,999	732 (7)	370 (9)	1146 (8)	58 (3)	21 (6)	85 (4)	616 (8)	258 (10)	896 (8)	30 (3)	12 (6)	43 (3)
\$30,000-\$39,999	1053 (10)	475 (12)	1579 (11)	93 (6)	27 (8)	129 (6)	789 (10)	306 (12)	1134 (10)	59 (5)	7 (4)	80 (6)
\$20,000-\$29,999	1641 (16)	584 (14)	2311 (16)	164 (10)	41 (12)	211 (10)	1418 (18)	431 (17)	1905 (17)	128 (12)	24 (12)	159 (11)
\$10,000-\$19,999	2217 (22)	573 (14)	2923 (20)	404 (24)	76 (23)	518 (24)	1766 (22)	337 (13)	2183 (20)	273 (25)	51 (26)	342 (24)
\$5,000-\$9,999	702 (7)	132 (3)	868 (6)	331 (20)	45 (14)	414 (19)	473 (6)	98 (4)	604 (6)	189 (17)	27 (14)	227 (16)
<\$5,000	356 (4)	53 (1)	435 (3)	162 (10)	22 (7)	197 (9)	207 (3)	49 (2)	282 (3)	108 (10)	9 (5)	128 (9)

Missingness:
Hispanic Baseline
 PCS: 192 (8.71%), BMI: 421 (19.10%), Education: 87 (3.95%), Household income: 557 (25.27%)
White Baseline
 PCS: 632 (4.28%), BMI: 3777 (25.56%) Education: 329 (2.23%), Household income: 3160 (21.39%),
White Follow up
 PCS: 502 (4.58%), BMI: 2027 (18.51%), Education: 215 (1.96%), Household income: 2237 (20.43%)
Hispanic Follow up
 PCS: 113 (8.05%), BMI: 246 (17.52%) Education: 61 (4.34%), Household income: 371 (26.42%)
 Full table in appendix

Baseline surveys:

Tables 3 and 4 demonstrated that in crude models, the MCS/PCS difference was -4.00 (95% CI: -4.58, -3.42) and -5.71 (95% CI: -6.24, -5.19), respectively, for Hispanic women compared to NHW. In age/BMI adjusted baseline models, Hispanic women had significantly lower MCS/PCS scores [-3.27 (95% CI: -3.91, -2.63), and -5.29 (95% CI: -5.91, -4.68), respectively]. The SEP domain mediated the majority of the effect (MCS= 90%, and PCS= 57%) with household income having the greatest influence within the

domain (MCS= 67% and PCS= 43%) followed by education (MCS= 50% and PCS= 22%). The comorbidities domain, social support domain, therapy type domain and tumor biology domain all had <25% of a mediation effect. Further, in fully specified models that included all five domains, however, only the MCS Hispanic vs NHW disparity remained significantly elevated [MCS= 0.73 (95% CI: -0.53, 1.98) and PCS= -2.68 (95% CI: -3.91, -1.45)].

Follow up surveys:

Observed PRO trends for all women decreased over the 10-year period, but trends remained lowest for Hispanic women in comparison to NHW (Figure 1). Similar trends to baseline were observed in follow-up surveys (Tables 3-4 and Figures 1-2). In crude models, the MCS/PCS difference was -5.63 (95% CI: -6.54, -4.72) and -3.90 (95% CI: -3.99, -3.82) for Hispanic women compared to NHW. In age/BMI adjusted baseline models, compared to NHW, Hispanic women had significantly lower MCS/PCS scores [-5.23 (95% CI: -6.41, -4.05), and -3.56 (95% CI: -3.89, -3.22), respectively]. For both MCS/PCS scores, the SEP domain mediated the majority of the effect (MCS= 41% and PCS= 63%) with household income having the greatest influence within the domain (MCS= 29% and PCS= 43%) followed by education (MCS= 28% and PCS= 30%). The comorbidities domain, social support domain, therapy type domain and tumor biology domain all had <25% of a mediation effect. In fully specified models with all 5 mediating domains, the MCS/PCS disparity for Hispanic vs NHW women remained lower [-2.69 (95% CI: -3.43, -1.96), and -0.79 (95% CI: -2.22, 0.63), respectively]. Further, as the MCS difference from the latter model is >2% points, this difference is considered to be

more than a minimally important difference; this is however, in contrast to the PCS difference.

Figures 3 and 4 demonstrate stratified estimates for mean MCS and PCS t-scores by R/E and household income (high vs low) in fully specified models. Trends demonstrate a decrease over time for all races and income groups, however, NHW high income women had the highest scores for both MCS and PCS while Hispanic low-income women scored the lowest.

Table 3: Estimates of mediated effects for Mental Component Summary (MCS) T-Score R/E disparity in covariate-adjusted models

	Baseline surveys				Follow up surveys			
	RD	CI	p-value	% Mediated	RD	CI	p-value	% Mediated
Crude	-4.00	(-4.58, -3.42)	<0.0001		-5.63	(-6.54, -4.72)	<0.0001	
Baseline*	-3.27	(-3.91, -2.63)	<0.0001		-5.23	(-6.41, -4.05)	<0.0001	
SEP Domain*	-0.31	(-1.11, 0.48)	0.442	90.47%	-3.06	(-4.38, -1.75)	<0.0001	41.40%
Education*	-1.66	(-2.33, 0.98)	<0.0001	49.25%	-3.79	(-5.01, -2.56)	<0.0001	27.57%
Household Income*	-1.09	(-1.92, -0.37)	0.003	66.53%	-3.69	(-5.01, 2.36)	<0.0001	29.48%
Poverty Level*	-2.56	(-3.24, -1.88)	<0.0001	21.71%	-4.72	(-5.98, -3.47)	<0.0001	9.66%
All comorbidities Domain*	-2.61	(-3.26, -1.96)	<0.0001	19.98%	-4.99	(-6.17, -3.81)	<0.0001	4.59%
Clinical/Pathological Domain*	-3.29	(-4.03, -2.55)	<0.0001	-0.76%	-5.37	(-6.40, -4.34)	<0.0001	-2.68%
Social Support/Marital Status Domain*	-2.93	(-3.58, -2.29)	<0.0001	10.14%	-4.97	(-6.15, -3.78)	<0.0001	-5.04%
All domains*	0.73	(-0.53, 1.98)	0.256	100.00%	-2.69	(-3.43, -1.96)	<0.0001	48.47%

Full table in appendix

RD: Risk Difference

SEP: Socioeconomic Position

CI: 95% confidence intervals

HBP: High blood pressure

Risk difference calculated with generalized linear models

*Adjusted for age and body mass index

% mediated calculated by subtracting subgroup/domain risk difference from the baseline adjusted risk difference divided by the baseline adjusted risk difference

Table 4: Estimates of mediated effects for Physical Component Summary (PCS)

T-Score R/E disparity in covariate-adjusted models

	Baseline Surveys				Follow up Surveys			
	RD	CI	p-value	% Mediated	RD	CI	p-value	% Mediated
Crude	-5.71	(-6.24, -5.19)	<0.0001		-3.90	(-3.99, -3.82)	<0.0001	
Baseline*	-5.29	(-5.91, -4.68)	<0.0001		-3.56	(-3.89, -3.22)	<0.0001	
SEP Domain*	-2.29	(-3.05, -1.52)	<0.0001	56.71%	-1.30	(-1.65, -0.95)	<0.0001	63.33%
Education*	-4.01	(-4.66, -3.37)	<0.0001	21.55%	-2.49	(-3.02, -1.96)	<0.0001	29.98%
Household Income*	-3.02	(-3.72, -2.32)	<0.0001	42.99%	-2.02	(-2.33, -1.72)	<0.0001	43.09%
Poverty Level*	-4.53	(-5.18, -3.88)	<0.0001	14.43%	-2.87	(-3.29, -2.44)	<0.0001	19.33%
All comorbidities Domain*	-5.02	(-5.64, -4.40)	<0.0001	5.21%	-3.21	(-3.56, -2.86)	<0.0001	9.74%
Clinical/Pathological Domain*	-5.45	(-6.27, -4.64)	<0.0001	-2.99%	-3.63	(-4.17, -3.08)	<0.0001	-2.04%
Therapy Domain*	-4.52	(-5.26, -3.77)	<0.0001	14.66%	-2.70	(-3.38, -2.02)	<0.0001	24.02%
Social Support/Marital Status Domain*	-4.92	(-5.53, -4.30)	<0.0001	7.15%	-3.28	(-3.75, -2.82)	<0.0001	7.64%
All domains*	-2.68	(-3.91, -1.45)	<0.0001	49.35%	-0.79	(-2.22, 0.63)	0.274	77.66%

Full table in appendix

RD: Risk Difference

SEP: Socioeconomic Position

CI: 95% confidence intervals

HBP: High blood pressure

Risk difference calculated with generalized linear models

*Adjusted for age and body mass index

% mediated calculated by subtracting subgroup/domain risk difference from the baseline adjusted risk difference divided by the baseline adjusted risk difference (e.g. SEP: $[-5.29 - (-2.29)] / -5.29 = 0.5671$)

Figure 1. Stratified estimates for mean MCS score by R/E in fully specified models (RDs and 95% CIs)

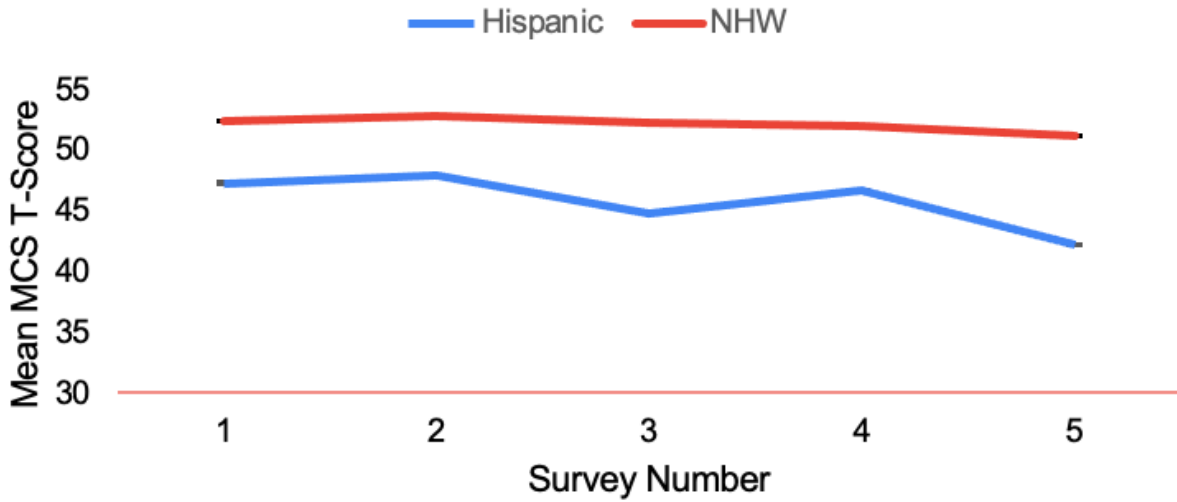


Figure 2. Stratified estimates for mean PCS score by R/E in fully specified models (RDs and 95% CIs)

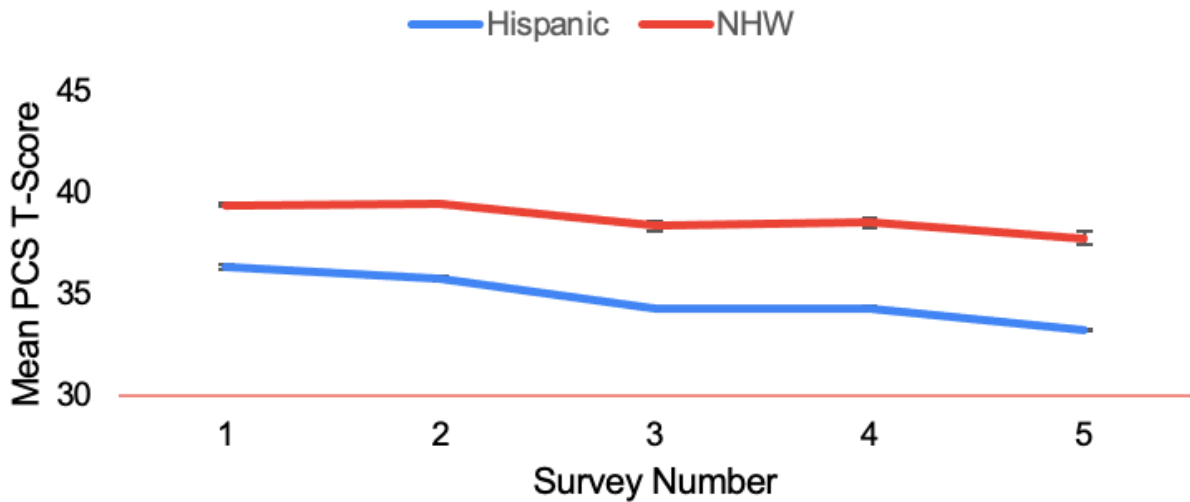


Figure 3. Stratified estimates for mean MCS score by R/E and household income level in fully specified models (RDs and 95% CIs)

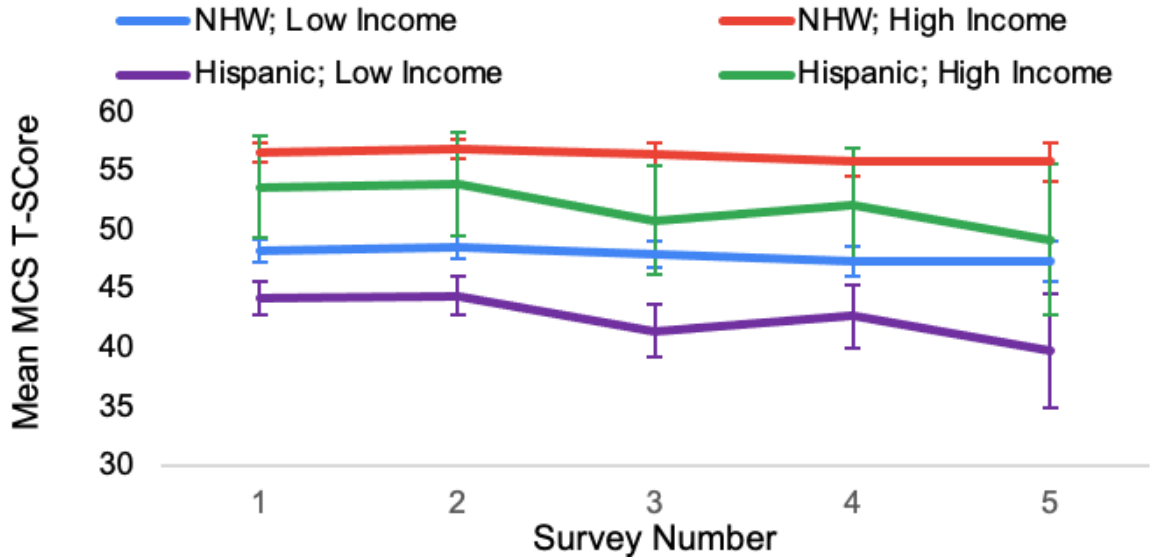
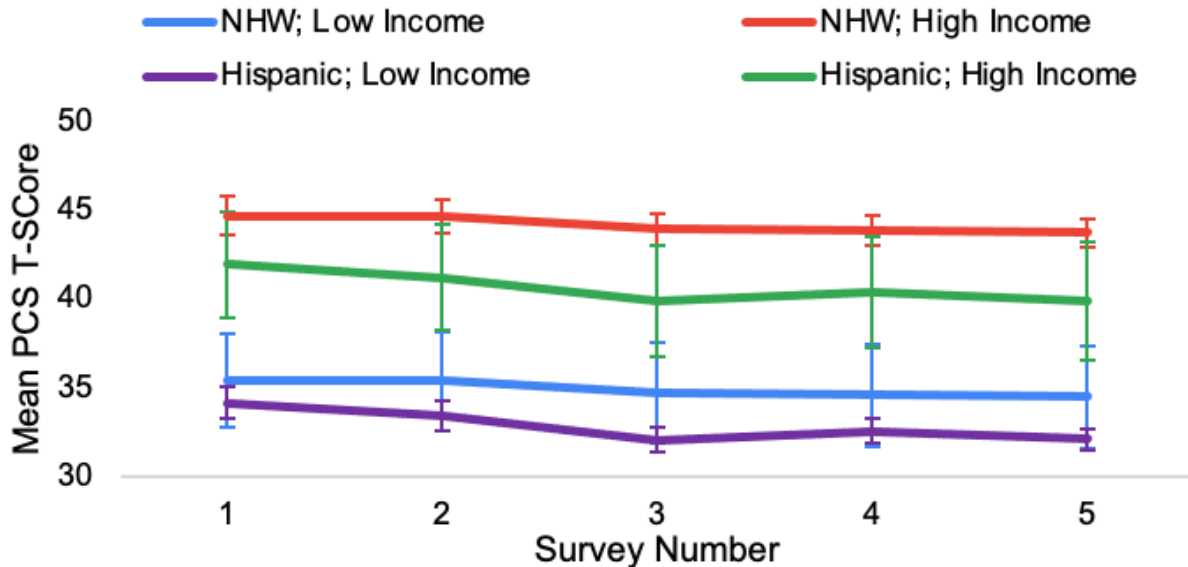


Figure 4. Stratified estimates for mean PCS score by R/E and household income level in fully specified models (RDs and 95% CIs)



Discussion

Main Study Findings:

In this population-based sample of breast cancer patients and in both physician and mental component scores, over time, we saw R/E PRO disparities between elderly Hispanic and NHW women where Hispanic women did worse. This was largely mediated by SEP and specifically by household income followed by level of education in both outcomes. For poverty level, the percent mediated increased with follow up surveys compared to baseline surveys with PCS as an outcome. The opposite was true for MCS as an outcome. Further, when stratified by R/E and household income, trends decreased overtime for all women, but NHW high-income women did best in both mean PCS and MCS t-scores while Hispanic low-income women did the worst. Further, mean MCS T-scores demonstrated a greater widening gap in the R/E over time in comparison to mean PCS T-scores highlighting the dire need for support in that realm.

Previous findings

As stated previously, Ashing-Giwa et al. (2007) found that Latina breast cancer survivors had reported the lowest levels of HRQOL compared to other racial/ethnic groups. Though our findings at baseline were similar, the Ashing-Giwa et al. findings were only cross-sectional meaning that our analysis being longitudinal further demonstrated the long-term effects of racial/ethnic specific differences. Further, Ashing-Giwa et al. conducted multivariate regression analyses as opposed to a Baron and Kenny mediation analysis that we did. Ashing-Giwa found that years since diagnosis, number of comorbidities, role limitation, emotional wellbeing, quality of doctor-patient relationship, social support, and life stress were significant HRQOL determinants while

we found SEP to be especially important. Further, though we assess for different variables, there was so overlap in assessment such as social support though our findings demonstrated that it did not mediate as large as an effect as SEP did.

Jackson et al. (2021) conducted a cross-sectional similar analysis to Ashing-Giwa et al. (2007) where they had examined race/ethnicity differences in HRQOL among breast cancer survivors. Jackson et al. found that compared to NHW women, Hispanics had statistically significantly lower mental component scores while there was no significant association found for physical component scores when adjusting for age, marital status, level of education, insurance status smoking status, comorbidities and year of data collection which is a little similar to what we did when we conducted the analysis including all domains. However, we found opposite findings at baseline including all domains, where PCS demonstrated statistically differences while MCS was not statistically significant. Reasons explaining this difference could be explored as future direction.

Because the focus of this analysis was to examine race/ethnicity differences including Hispanics, an important cultural component to examine would be language. Balazy et al. (2019) found that in general, non-English speaking patients had greater odds of later stage disease than did English speaking patients again suggesting a potential cultural difference that can be explained by nativity and hence language. This was further exacerbated when looking at women over the age of 50 where non-English speaking patients presented with a more advanced stage than did those that were English speakers. This would be an insightful additional factor to examine, however, the

sample size of Hispanic women and the data available was too limited in our dataset, therefore, we were unable to compare.

In general, our findings followed what was noted in previous literature which is that Hispanic women do worse in terms of either mental or physical PROs or HRQOL (Jackson et al., 2021; Lee et al. 2023; Rincon et al. 2020); however, studies conducting mediation analyses and specifically assessing SEP as a mediator were limited. The same is true for studies examining long term (follow up surveys) as opposed to immediate effects (baseline surveys) making our findings distinctive. We did fail to examine some factors such as patient-doctor relationship which could have fallen under social support, though this data was missing from our dataset. Moving forward, gathering this data could serve to better our analysis and perhaps provide even more insight into what is driving these disparities.

Strengths

Strengths to this analysis include the use of the SEER-MHOS dataset for this analysis as it is population based; that it looked at longitudinal effects looking over several surveys (though sampling was random, in other words, not everyone was chosen for inclusion of each follow up); use of self-reported race/ethnicity and SEP which minimizes misclassification; and use of mediation analysis that assessed for different domains. Within each domain, we were also able to test how each factor in the domain would influence on its own which allows us to take a closer look at what is driving these differences.

Limitations

Because some prior studies suggest that acculturation, such as language spoken, may influence individuals' behaviors and thus influence their medical decision making, it would be insightful to see if this makes a difference between primarily Spanish or English-speaking breast cancer survivors. This dataset lacked enough data to be able to assess for these differences, but future research could gather this data and country of origin (if born outside of the United States) to see if that also makes a difference. Other limitations include a much smaller Hispanic sample compared to NHW and potential self-reporting bias for how PROs were quantified. Possible multicollinearity in the domain with subtype and grade is also a limitation as they may have been correlated. Finally, because random samples for every follow up captured some longitudinal data, the age of diagnosis to age at time of survey (equating to years since diagnosis), differed women to women. Therefore, we were unable to fully understand if a subgroup like household changed over time and whether this value was more important at diagnosis or years after diagnosis making this another limitation.

Recommendations:

Based on these findings we would recommend policy changes to further support Hispanic breast cancer survivors as their low SEP appears to be contributing to low mental and physical health. This could potentially support the idea that Hispanic women could potentially benefit from disability support if their medical condition led to an overall decline in health, though much more research assessing that would be required. There may also be a need for easier access to healthcare like free or reduced fee services for screenings or treatments. Further, because there was little evidence to support that therapy type or clinical factors influenced the difference in PROs, there is no evidence

to suggest that these are biological factors but rather sociological factors driving the inequity. Though it being sociological rather than biological suggests that the upstream factors may have been driving this disparity, it suggests that potential support may influence positive change and narrow or eliminate the gap.

Conclusion

Our findings suggest that compared to NHW, Hispanic BC survivors had worse HRQOL outcomes over time and the observed PRO disparities are largely mediated by SEP, and likely mostly by household income and to a lesser extent education. In addition, Hispanic BC survivors appear to have an almost 2.7% lower MCS score which remains unexplained and requires further study. Finally, the R/E disparities worsen over time particularly for those with low SEP; this suggests that there is a need to provide sustainable support for this vulnerable group.

Appendix

**A1: Mental Component Scores (MCS) by Race/Ethnicity and Baseline vs Follow
up**

Variable	Baseline						Follow up					
	White			Hispanic			White			Hispanic		
	<50	50-100	Total	<50	50-100	Total	<50	50-100	Total	<50	50-100	Total
Age at diagnosis (continuous)												
N (%)	76 (10)	78 (8)	74 (10)	70 (11)	73 (10)	72 (11)	76 (10)	78 (8)	77 (8)	73 (10)	76 (8)	74 (9)
BMI (Continuous)												
N (%)	29.10 (7)	28 (6)	29 (6)	30 (6)	29 (6)	30 (6)	29 (7)	28 (6)	28 (6)	30 (6)	29 (6)	30 (6)
Education N (%)												
> HS Diploma	1852 (40)	4750 (50)	6856 (46)	182 (17)	249 (27)	468 (21)	1295 (39)	3535 (50)	5031 (46)	126 (18)	159 (26)	306 (22)
HS Diploma	1695 (37)	3529 (37)	5463 (37)	276 (25)	270 (30)	577 (26)	1320 (40)	2662 (37)	4180 (38)	146 (21)	198 (33)	25 (22)
<HS Diploma	929 (20)	1086 (11)	2127 (14)	595 (54)	368 (40)	1072 (49)	622 (19)	818 (11)	1524 (14)	384 (56)	228 (38)	668 (48)
Household Income N (%)												
\$100,000+	83 (2)	420 (4)	520 (4)	6 (1)	15 (2)	22 (1)	68 (2)	330 (5)	408 (4)	5 (1)	6 (1)	11 (1)
\$80,000-\$99,999	79 (2)	341 (4)	433 (3)	3 (0)	9 (1)	12 (1)	51 (2)	232 (3)	297 (3)	3 (0)	4 (1)	8 (1)
\$50,000-\$79,999	276 (6)	1079 (11)	1400 (9)	20 (2)	38 (4)	59 (3)	199 (6)	762 (11)	1004 (9)	7 (1)	28 (5)	35 (3)
\$40,000-\$49,999	293 (6)	809 (8)	1146 (8)	36 (3)	43 (5)	85 (4)	244 (7)	630 (9)	896 (8)	16 (2)	26 (4)	43 (3)
\$30,000-\$39,999	459 (10)	1069 (11)	1579 (11)	56 (5)	64 (7)	129 (6)	323 (10)	772 (11)	1134 (10)	21 (3)	45 (8)	80 (6)
\$20,000-\$29,999	750 (16)	1474 (15)	2311 (16)	98 (9)	107 (12)	211 (10)	614 (18)	1235 (17)	1905 (17)	70 (10)	82 (14)	159 (11)
\$10,000-\$19,999	1207 (26)	1583 (17)	2923 (20)	251 (23)	229 (25)	518 (24)	851 (26)	1252 (18)	2183 (20)	193 (28)	131 (22)	342 (24)
\$5,000-\$9,999	402 (9)	431 (5)	868 (6)	247 (22)	129 (14)	414 (19)	282 (8)	289 (4)	604 (6)	131 (19)	85 (14)	227 (16)
<\$5,000	210 (5)	199 (2)	435 (3)	125 (11)	59 (6)	197 (9)	119 (4)	137 (2)	282 (3)	81 (12)	36 (6)	128 (9)
Poverty Level			1079	1879	521	310	97	528		1479	324	
High		706 (15.36)	(11.30)	(12.72)	(47.36)	(33.99)	(50.52)	(15.87)	889 (12.48)	(13.51)	(46.96)	234 (38.94)
Ever a Smoker			1300	2167	123		207	389			56	
Yes		791 (17.21)	(13.62)	(14.67)	(11.18)	74 (8.11)	(9.39)	(11.70)	599 (8.41)		(8.12)	49 (8.15)
Ever had HBP			5673	9075	770	577	1470	2332	4500	7159	517	
Yes		3007 (65.43)	(59.43)	(61.42)	(70.00)	(63.27)	(66.70)	(70.11)	(63.18)	(65.38)	(74.93)	409 (68.05)
Ever had Diabetes			1611	2840	466	244	790	873	1235	2215	273	
Yes		1094 (23.80)	(16.88)	(19.22)	(42.36)	(26.75)	(35.84)	(26.25)	(17.34)	(20.23)	(39.57)	181 (30.12)
Stage												
	Local	2444 (53.18)	(53.88)	(53.49)	(49.91)	(47.92)	1080	1973	4326	6600	395	329 (54.74)
	Regional	771 (16.78)	(15.74)	(16.16)	(20.91)	(19.74)	450	601	1139	1835	135	121 (20.13)
	Distal	230 (5.00)	(4.37)	(4.62)	(4.36)	(4.71)	103	157 (4.72)	292 (4.10)	465	13	21 (3.49)

Grade												
	Well	948 (20.63)	2118 (22.19)	3192 (21.60)	226 (20.55)	177 (19.41)	441 (20.01)	677 (20.35)	1615 (22.68)	2397 (21.89)	173 (25.07)	116 (19.30)
	Moderate	1804 (39.25)	3805 (39.86)	5884 (39.82)	406 (36.91)	380 (41.67)	875 (39.70)	1339 (40.26)	3024 (42.46)	4569 (41.73)	273 ((39.57)	248 (41.26)
	Poor	1057 (23.00)	2162 (22.65)	3345 (22.64)	267 (24.27)	223 (24.45)	532 (24.14)	835 (25.11)	1561 (21.92)	2498 (22.81)	161 (23.33)	167 (27.79)
Subtype												
	Luminal A	2266 (49.30)	4789 (50.17)	7364 (49.84)	548 (49.82)	431 (47.26)	1076 (48.82)	1868 (56.16)	4162 (58.44)	6324 (57.75)	383 (55.51)	326 (54.24)
	Luminal B	205 (4.46)	440 (4.61)	671 (4.54)	71 (6.45)	56 (6.14)	137 (6.22)	177 (5.32)	353 (4.96)	550 (5.02)	48 (6.96)	34 (5.66)
	Her2+	84 (1.83)	194 (2.03)	289 (1.96)	19 (1.73)	25 (2.74)	48 (2.18)	76 (2.29)	154 (2.16)	240 (2.19)	12 (1.74)	16 (2.66)
	Triple Negative	257 (5.59)	471 (4.93)	750 (5.08)	68 (6.18)	57 (6.25)	140 (6.35)	210 (6.31)	421 (5.91)	661 (6.04)	49 (7.10)	46 (7.65)
Therapy												
	None/Unknown	426 (9.27)	823 (8.62)	1312 (8.88)	101 (9.18)	80 (8.77)	194 (8.80)	304 (9.14)	457 (6.42)	806 (7.36)	42 (6.09)	38 (6.32)
	Localized treatment	1210 (26.33)	2465 (25.83)	3865 (26.16)	320 (29.09)	304 (33.33)	669 (30.35)	862 (25.92)	1751 (24.59)	2746 (25.08)	216 (31.30)	218 (36.27)
	Systemic Therapy	1394 (30.33)	2772 (29.04)	4330 (29.31)	343 (31.18)	302 (33.11)	702 (31.85)	1030 (30.97)	2222 (31.20)	3398 (31.03)	219 (31.74)	218 (36.27)
Marital Status												
	Married	1893 (41.19)	4989 (52.27)	7131 (48.26)	560 (31.28)	601 (39.72)	1246 (34.53)	1304 (39.21)	3307 (46.43)	4813 (43.95)	195 (28.26)	230 (38.27)
MCS White Baseline MCS: 634 (4.29%), BMI: 3777 (25.56%), Education: 329 (2.23%), Household income: 3160 (21.39%) MCT Hispanic Baseline MCT: 192 (8.71%) BMI: 421 (19.10%), Education: 87 (3.95%), Household income: 557 (25.27%) MCT White F/U MCT: 502 (4.58%), BMI: 2027 (18.51%), Education: 215 (1.96%), Household income: 2237 (20.43%) MCT Hispanic F/U MCT: 113 (8.05%), BMI: 246 (17.52%) Education: 61 (4.34%), Household income: 371 (26.42%) Full table in appendix												

A2: Estimates of mediated effects for Mental Component Summary (MCS) T-Score R/E disparity in covariate-adjusted models

	Baseline surveys				Follow up surveys			
	RD	CI	p-value	% Mediated	RD	CI	p-value	% Mediated
Crude	-4.00	(-4.58, -3.42)	<0.0001		-5.63	(-6.54, -4.72)	<0.0001	
Baseline *	-3.27	(-3.91, -2.63)	<0.0001		-5.23	(-6.41, -4.05)	<0.0001	
SEP Domain*	-0.31	(-1.11, 0.48)	0.442	90.47%	-3.06	(-4.38, -1.75)	<0.0001	41.40%
Education*	-1.66	(-2.33, 0.98)	<0.0001	49.25%	-3.79	(-5.01, -2.56)	<0.0001	27.57%
Household Income*	-1.09	(-1.92, -0.37)	0.003	66.53%	-3.69	(-5.01, 2.36)	<0.0001	29.48%
Poverty Level*	-2.56	(-3.24, -1.88)	<0.0001	21.71%	-4.72	(-5.98, -3.47)	<0.0001	9.66%
All comorbidities Domain*	-2.61	(-3.26, -1.96)	<0.0001	19.98%	-4.99	(-6.17, -3.81)	<0.0001	4.59%
Ever a Smoker*	-3.36	(-4.01, -2.71)	<0.0001	-2.95%	-5.38	(-6.67, -4.08)	<0.0001	-2.82%
Ever had HBP*	-3.05	(-3.69, -2.41)	<0.0001	6.64%	-5.09	(-6.23, -3.95)	<0.0001	2.65%
Ever had Diabetes*	-2.67	(-3.31, 2.02)	<0.0001	18.31%	-4.93	(-6.05, -3.81)	<0.0001	5.76%
Stage*	-3.22	(-4.06, -2.37)	<0.0001	1.44%	-5.36	(-6.42, -4.31)	<0.0001	-2.58%
Clinical/Pathological Domain*	-3.29	(-4.03, -2.55)	<0.0001	-0.76%	-5.37	(-6.40, -4.34)	<0.0001	-2.68%
Grade*	-3.27	(-3.96, -2.57)	<0.0001	0.00%	-5.24	(-6.63, -3.85)	<0.0001	-0.24%
Subtype*	-3.46	(-4.27, -2.66)	<0.0001	-6.07%	-5.37	(-6.45, -4.29)	<0.0001	-2.69%
Therapy*	-1.77	(-2.54, -1.00)	<0.0001	45.75%	-3.97	(-4.81, -3.14)	<0.0001	23.99%
Social Support/Marital Status*	-2.93	(-3.58, -2.29)	<0.0001	10.14%	-4.97	(-6.15, -3.78)	<0.0001	-5.04%
All domains*	0.73	(-0.53, 1.98)	0.256	122.26%	-2.69	(-3.43, -1.96)	<0.0001	48.47%

Abbreviations:

RD: Risk Difference

SEP: Socioeconomic Position

CI: 95% confidence intervals

HBP: High blood pressure

Risk difference calculated with generalized linear models

*Adjusted for age and body mass index

% mediated calculated by subtracting subgroup/domain risk difference from the baseline adjusted risk difference divided by the baseline adjusted risk difference (e.g. SEP: $[-5.29 - (-2.29)] / -5.29 = 0.5671$)

A3 Estimates of mediated effects for Physical Component Summary (PCS) T-Score R/E disparity in covariate-adjusted models

	Baseline Surveys				Follow up Surveys			
	RD	CI	p-value	% Mediated	RD	CI	p-value	% Mediated
Crude	-5.71	(-6.24, -5.19)	<0.0001	-	3.90	(-3.99, -3.82)	<0.0001	-
Baseline*	-5.29	(-5.91, -4.68)	<0.0001	-	3.56	(-3.89, -3.22)	<0.0001	-
SEP Domain*	-2.29	(-3.05, -1.52)	<0.0001	56.71%	1.30	(-1.65, -0.95)	<0.0001	63.33%
Education*	-4.01	(-4.66, -3.37)	<0.0001	21.55%	2.49	(-3.02, -1.96)	<0.0001	29.98%
Household Income*	-3.02	(-3.72, -2.32)	<0.0001	42.99%	2.02	(-2.33, -1.72)	<0.0001	43.09%
Poverty Level*	-4.53	(-5.18, -3.88)	<0.0001	14.43%	2.87	(-3.29, -2.44)	<0.0001	19.33%
All comorbidities Domain*	-5.02	(-5.64, -4.40)	<0.0001	5.21%	3.21	(-3.56, -2.86)	<0.0001	9.74%
Ever a Smoker*	-5.30	(-5.92, -4.69)	<0.0001	-0.02%	3.69	(-4.06, -3.33)	<0.0001	-3.90%
Ever had HBP*	-5.23	(-5.85, -4.62)	<0.0001	1.15%	3.44	(-3.69, -3.20)	<0.0001	3.15%
Ever had Diabetes*	-5.00	(-5.62, -4.38)	<0.0001	5.62%	3.12	(-3.49, -2.75)	<0.0001	12.24%
Clinical/Pathological Domain*	-5.45	(-6.27, -4.64)	<0.0001	-2.99%	3.63	(-4.17, -3.08)	<0.0001	-2.04%
Stage*	-5.48	(-6.20, -4.77)	<0.0001	-3.54%	3.54	(-3.90, -3.19)	<0.0001	0.34%
Grade*	-5.08	(-5.75, -4.42)	<0.0001	3.98%	3.42	(-3.79, -3.04)	<0.0001	3.91%
Subtype*	-5.59	(-6.36, -4.81)	<0.0001	-5.50%	3.89	(-4.32, -3.47)	<0.0001	-9.53%
Therapy*	-4.52	(-5.26, -3.77)	<0.0001	14.66%	2.70	(-3.38, -2.02)	<0.0001	24.02%
Social Support/Marital Status*	-4.92	(-5.53, -4.30)	<0.0001	7.15%	3.28	(-3.75, -2.82)	<0.0001	7.64%
All domains*	-2.68	(-3.91, -1.45)	<0.0001	49.35%	0.79	(-2.22, 0.63)	0.274	77.66%

Abbreviations:

RD: Risk Difference

SEP: Socioeconomic Position

CI: 95% confidence intervals

HBP: High blood pressure

Risk difference calculated with generalized linear models

*Adjusted for age and body mass index

% mediated calculated by subtracting subgroup/domain risk difference from the baseline adjusted risk difference divided by the baseline adjusted risk difference (e.g. SEP: $[-5.29 - (-2.29)] / -5.29 = 0.5671$)

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