

Disparities in Time to Treatment for Breast Cancer

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Abstract. *Background/Aim:* This study aimed to identify the demographic/socioeconomic factors associated with disparities in time to breast cancer treatment. *Patients and Methods:* We conducted an analysis of breast cancer patients from the National Cancer Database, 2008-2019. Time intervals from diagnosis to surgery, radiation, and chemotherapy were compared based on age, sex, race, and socioeconomic status. *Results:* A total of 715,210 patients with breast cancer were included. Overall, Hispanic patients had the longest times to surgery, radiation, and chemotherapy compared to non-Hispanic patients (surgery 73.3 vs. 53.8 days, radiation 177.2 vs. 136.9 days, chemotherapy 83.0 vs. 66.5 days, all $p < 0.01$). Similarly, black patients, those who were uninsured, and those with lower income (<\$63,000) had the longest times to treatment. *Conclusion:* We identified several racial/socioeconomic disparities in time to treatment. Further investigation into the causes of these disparities is of increasing importance to address inequities in breast cancer care.

According to the National Cancer Institute, breast cancer is the second most common cancer in women after skin cancer. While the mortality rate of breast cancer has decreased in the last few decades (1), disparities in cancer treatment still exist. In the past, factors, such as race, seemed to play a major role in research studies with the results showing that outcomes in patients with breast cancer were worse for black women and

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other ethnic groups such as Hispanic groups when compared to white women (2). Scientific studies have shown that genetics and biological properties may play a significant role in the morbidity and mortality of a patient with breast cancer (3). However, multiple studies indicate that the outcomes of breast cancer treatments are multifactorial, and treatment delays may significantly impact disease staging and treatment outcomes (4). Factors that result in treatment delay include the patient's insurance, financial status, and demographics. Disparities in time to treatment need to be identified and brought to attention in order to decrease the gap in access to breast cancer treatment.

Patients and Methods

We conducted a retrospective study between 2004 and 2019 using the National Cancer Database (NCDB). Institutional Review Board approval was not required for the study.

Patients with breast cancer of stages, as per the American Joint Committee on Cancer (AJCC 6th and 7th edition) guidelines, were included. Variables in the analysis included age, sex, race, Hispanic origin, insurance status, income, treatment facility type, geographic location (rural/urban), grade, cancer stage, and Charlson-Deyo Comorbidity (CDC) score. Times to treatment (surgery, chemotherapy, and/or radiation) were computed and summarized.

Statistical analysis was performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). The clinical and demographic characteristics, disease outcome measures, and treatment variables were summarized. The mean, median, standard deviation, and ranges were provided for continuous variables and analyzed using the Kruskal-Wallis test. The frequencies and relative frequencies were provided for categorical variables and analyzed using chi-square tests.

Results

Time to first treatment. The time to first treatment for breast cancer is an important interval when determining how delay of treatment impacts patient outcome. Many studies have reported that delay in receiving breast cancer diagnosis and treatment



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resulted in worse overall survival rates, especially when the treatment delays were longer than 90 days post diagnosis. Delaying adjuvant therapy resulted in worse survival rates in patients who underwent surgery in less than 90 days post diagnosis (5, 6). When comparing factors that contributed to the time of first treatment for breast cancer, Hispanic patients and uninsured patients had the longest time interval until their first treatment (Table I). Those patients treated at academic facilities also had the longest time interval to first treatment when compared to other facility types. For all outcomes, time to treatment had no association with overall survival (OS).

Time to surgery. Racial disparities in accessing health care have been shown to have a significant impact on patient outcomes (7). Black women are more likely to die from breast cancer when compared to white women (8). Results published by Best *et al.* demonstrated racial disparity in getting major surgical procedures in the US whereby a lower rate of black patients received major surgery when compared to their white counterparts (9). In our study, 86.2% of our study population received surgery. As shown in Table II, our study showed that compared to other races, black women had a significantly longer time to definitive surgery of 71.70 days (standard deviation of 74.73 days). In addition, patients of Hispanic origin had the longest time interval between diagnosis and first surgery, 73.26 days. Demographically, patients who live in metropolitan areas had longer time intervals to definitive surgery, 54.92 days, when compared to those in urban, 49.37 days, or rural areas, 50.07 days. Patients who were uninsured also had significantly longer time intervals to surgery treatment, 79.75 days, when compared to their insured counterparts, private insurance, 57.21 days, or government insurance of 50.38 days. Patients who underwent definitive breast surgery at an academic facility took a longer time to receive surgery, 61.64 days, when compared to other facilities such as community of 49.30 days, or comprehensive facility of 50.53 days (Table II).

Time to radiation. Radiation therapy is an important treatment to comprehensively treat patients with breast cancer. In our study, 42.0% of our study population required radiation therapy as an adjuvant therapy. Compared to the data from the other cancer types, interestingly, patients with breast cancer had the longest time interval to radiotherapy, with a mean of 138.23 days (standard deviation of 89.81 days). When compared to other races, black women had significantly longer time interval to radiation therapy of 172.07 days (standard deviation of 101.78 days). In addition, patients of Hispanic origin had the longest time interval to radiation treatment of 177.20 days (standard deviation of 107.32 days). Patients who were uninsured also had significantly longer time intervals, 185.55 days, to radiation treatment when compared to patients who were insured. In addition, patients with an income of less than \$63,000 yearly

also took longer to receive their radiation treatment with a mean of 141.05 days. Patients who received radiation therapy at an academic facility also had a time interval of 185.55 days, when compared to other facility types (Table III).

Time to chemotherapy. According to the American Cancer Society chemotherapy has recently been used as an adjuvant or neoadjuvant therapy (10). It has been shown in previous studies that black breast cancer patients experience increased delays in the initiation of adjuvant chemotherapy when compared to other ethnic groups which may be due to biological factors, increased risk for infection, or socioeconomic background (11). However, as shown in Table IV, our study showed that Native Americans take the longest time when compared to other ethnic groups with a mean of 73.45 days (standard deviation of 59.95 days) to receive chemotherapy treatment. Like other breast cancer treatments, patients of Hispanic origin take longer to receive their chemotherapy treatment, 82.95 days (standard deviation of 67.41 days).

Discussion

In our analysis, multiple socioeconomic factors and demographics played a significant role in time to breast cancer treatment (12-14). According to American Cancer Society, Hispanic patients often have lower levels of education, are more likely to live in poverty, face many barriers to healthcare, and are less likely to have health insurance when compared to other ethnic groups (15). Our study showed that Hispanic women experienced delay in receiving all aspects of breast cancer treatment when compared to women who are not of Hispanic origin. In addition to factors such as socioeconomic disadvantages among the Hispanic population, cultural factors may also play a significant role in the ability of Hispanic patients to access breast cancer care (16). Furthermore, previous studies also showed that Hispanic women are less likely to be diagnosed with breast cancer at an early stage and are more likely to be diagnosed with hormone receptor negative breast cancer both of which result in more complex treatment (17, 18). Taken together, this disparity identified among Hispanic women on receiving breast cancer care may be quite pervasive.

In addition to Hispanic origin, our study found that black women also experienced a longer time to receive breast cancer treatments when compared to other races. Many previous studies have raised concern about the mortality rate in black women with breast cancer. Studies have shown that African Americans have less access to breast cancer screening, prevention, and treatments when compared to other populations (19). The American Cancer Society also suggests that in areas highly populated by African Americans, women have difficulty receiving essential healthcare which results in late diagnosis, higher motility

Table I. *Time to first treatment.*

	n	Mean (SD)	p-Value
Age			
40-50	103,521	32.46 (35.73)	<0.001
50-60	157,174	32.21 (34.34)	
60-70	174,383	32.07 (33.31)	
70+	222,940	30.82 (31.95)	
Sex			
Male	6,958	26.23 (34.77)	<0.001
Female	651,060	31.80 (33.49)	
Race			
White	547,028	30.87 (32.01)	<0.001
Black	79,022	36.92 (41.15)	
Native American	1,891	33.73 (35.52)	
Asian	14,404	34.19 (36.06)	
Other	9,322	34.31 (35.74)	
Hispanic origin			
Non-Hispanic	9,352	41.42 (43.92)	<0.001
Hispanic	590,804	31.51 (33.01)	
Insurance status			
Not insured	12,481	36.13 (44.83)	<0.001
Private	306,761	31.13 (31.98)	
Government	328,532	31.99 (33.92)	
Unknown	10,244	36.69 (45.53)	
Income			
<63,000	379,206	31.67 (34.26)	0.1
>63,000	245,213	31.52 (32.56)	
Facility type			
Community	71,310	29.54 (35.68)	<0.001
Comprehensive	304,640	30.00 (30.76)	
Academic	180,034	34.89 (37.54)	
Other	102,034	32.92 (31.73)	
Rural/Urban			
Metro	560,548	32.24 (34.03)	<0.001
Urban	72,372	28.31 (28.74)	
Rural	9,293	27.91 (32.05)	
Grade			
Well	124,420	31.66 (31.63)	<0.001
Moderate	253,811	32.74 (32.37)	
Poor	199,786	31.64 (32.62)	
Undifferentiated	3,942	32.17 (34.22)	
Stage			
0	112,101	33.85 (36.61)	<0.001
I	235,474	33.40 (29.71)	
II	131,077	32.94 (32.13)	
III	39,813	29.71 (35.61)	
IV	41,705	25.85 (39.18)	
CDC			
0	535,241	31.63 (33.77)	<0.001
1	93,306	31.92 (31.76)	
2	21,251	32.94 (33.66)	
≥3	8,220	34.17 (35.08)	

CDC: Charlson-Deyo comorbidity score.

Table II. *Time to surgery.*

	n	Mean (SD)	p-Value
Age			
40-50	98,161	67.74 (74.73)	<0.001
50-60	146,471	61.74 (70.14)	
60-70	161,952	53.35 (60.86)	
70+	201,289	42.93 (50.43)	
Sex			
Male	6,238	43.26 (58.93)	<0.001
Female	601,635	54.36 (63.29)	
Race			
White	507,863	51.54 (60.10)	<0.001
Black	70,076	71.70 (78.64)	
Native American	1,755	59.51 (82.50)	
Asian	13,701	59.11 (65.61)	
Other	8,629	61.43 (68.06)	
Hispanic origin			
Non-Hispanic	545,344	53.80 (62.69)	
Hispanic	8,656	73.26 (79.05)	<0.001
Insurance status			
Not insured	10,142	79.75 (87.35)	<0.001
Private	291,144	57.21 (64.61)	
Government	297,632	50.38 (60.31)	
Unknown	8,955	57.35 (70.05)	
Income			
<63,000	347,218	54.49 (64.65)	<0.001
>63,000	228,605	53.03 (60.62)	
Facility type			
Community	66,126	49.30 (62.02)	<0.001
Comprehensive	284,135	50.53 (59.47)	
Academic	163,010	61.64 (69.62)	
Other	94,602	56.12 (62.40)	
Rural/Urban			
Metro	517,974	54.92 (63.62)	<0.001
Urban	66,733	49.37 (59.20)	
Rural	8,592	50.07 (64.82)	
Grade			
Well-differentiated	119,959	42.76 (48.62)	<0.001
Moderately differentiated	237,645	52.34 (59.35)	
Poorly differentiated	184,318	65.43 (73.00)	
Undifferentiated	3,718	53.01 (55.79)	
Stage			
0	111,227	43.80 (46.06)	<0.001
I	231,875	42.34 (42.91)	
II	124,179	71.67 (76.15)	
III	34,356	124.56 (95.16)	
IV	11,264	113.46 (119.45)	
CDC			
Score 0	495,774	54.82 (64.18)	<0.001
Score 1	86,140	51.72 (58.93)	
Score 2	19,016	51.46 (59.03)	
Score 3 and higher	6,943	52.00 (59.36)	

CDC: Charlson-Deyo comorbidity score.

rates, and poorer outcomes (20). With an increased time interval for receiving breast cancer treatment when compared to other races, our data supports the inequity for black women to receive breast cancer treatment.

Socioeconomic status has been shown to play a significant factor for women to receive breast cancer treatment (21). Insurance status at time of breast cancer impacts the mortality rate of patients with breast cancer, whereby women

Table III. Time to radiation.

	n	Mean (SD)	p-Value
Age			
40-50	48,515	170.48 (93.06)	<0.001
50-60	79,098	154.27 (93.45)	
60-70	89,936	133.64 (87.87)	
70+	79,387	107.74 (74.74)	
Sex			
Male	2,073	151.57 (91.95)	<0.001
Female	294,863	138.13 (89.79)	
Race			
White	247,286	132.71 (86.70)	<0.001
Black	35,403	172.07 (101.78)	
Native American	840	159.98 (97.68)	
Asian	6,361	149.06 (89.69)	
Other	4,239	153.47 (90.49)	
Hispanic origin			
Non-Hispanic	267,655	136.88 (88.79)	
Hispanic	4,588	177.20 (107.32)	<0.001
Insurance status			
Not insured	5,309	185.55 (105.71)	<0.001
Private	153,304	144.99 (88.19)	
Government	134,230	128.52 (89.25)	
Unknown	4,093	141.77 (102.06)	
Income			
<63,000	167,641	141.05 (92.72)	<0.001
>63,000	111,442	133.86 (85.60)	
Facility type			
Community	32,882	134.90 (90.65)	<0.001
Comprehensive	138,561	133.24 (87.48)	
Academic	76,993	149.50 (94.91)	
Other	48,500	136.82 (85.86)	
Rural/Urban			
Metro	253,249	138.41 (89.96)	<0.001
Urban	32,568	137.01 (89.19)	
Rural	4,072	137.53 (86.04)	
Grade			
Well-differentiated	60,591	101.54 (69.04)	<0.001
Moderately differentiated	118,986	132.87 (86.81)	
Poorly differentiated	93,416	171.76 (93.50)	
Undifferentiated	1,650	120.38 (77.95)	
Stage			
0	42,503	86.95 (51.92)	<0.001
I	123,871	113.22 (71.97)	
II	62,329	191.01 (90.76)	
III	22,550	233.24 (81.62)	
IV	5,484	154.73 (126.31)	
CDC			
Score 0	248,771	138.04 (89.48)	0.07
Score 1	38,235	139.22 (90.74)	
Score 2	7,484	138.91 (94.66)	
Score 3 and higher	2,446	139.21 (94.08)	

CDC: Charlson-Deyo comorbidity score.

Table IV. Time to chemotherapy.

	n	Mean (SD)	p-Value
Age			
40-50	50,012	64.40 (48.64)	<0.001
50-60	68,278	66.46 (56.23)	
60-70	59,073	68.69 (54.72)	
70+	32,516	69.05 (61.63)	
Sex			
Male	2,272	67.10 (52.20)	0.74
Female	207,607	67.00 (55.04)	
Race			
White	165,525	66.11 (54.55)	<0.001
Black	33,738	70.96 (57.76)	
Native American	756	73.45 (59.95)	
Asian	4,583	68.94 (54.00)	
Other	3,344	66.40 (49.63)	
Hispanic origin			
Hispanic	3,788	82.95 (67.41)	<0.001
Non-Hispanic	186,938	66.47 (54.88)	
Insurance status			
Not insured	6,437	66.15 (53.14)	<0.001
Private	119,973	65.17 (52.20)	
Government	79,841	69.82 (58.61)	
Unknown	3,628	66.95 (63.88)	
Income			
<63,000	126,246	67.28 (55.63)	0.032
>63,000	72,054	66.17 (54.53)	
Facility type			
Community	22,335	66.74 (61.45)	<0.001
Comprehensive	95,456	64.86 (51.19)	
Academic	60,013	69.79 (59.03)	
Other	32,075	68.32 (53.17)	
Rural/Urban			
Metro	176,894	67.46 (55.24)	<0.001
Urban	24,730	63.98 (51.13)	
Rural	3,249	62.30 (39.70)	
Grade			
Well-differentiated	15,650	75.34 (64.78)	<0.001
Moderately differentiated	70,860	71.33 (57.05)	
Poorly differentiated	105,039	64.37 (49.64)	
Undifferentiated	965	60.46 (48.63)	
Stage			
0	3,388	88.08 (81.33)	<0.001
I	54,660	79.85 (52.38)	
II	71,209	67.26 (47.74)	
III	29,647	50.19 (47.68)	
IV	23,517	45.41 (65.21)	
CDC			
Score 0	175,364	66.27 (55.69)	<0.001
Score 1	27,329	70.19 (50.05)	
Score 2	5,324	72.46 (56.00)	
Score 3 and higher	1,862	73.28 (55.07)	

CDC: Charlson-Deyo comorbidity score.

without insurance are more likely to be diagnosed in later cancer stage when compared with those who have insurance. This in turn results in delayed treatment and higher mortality in women with lower socioeconomic status (22). In our

study, patients with an income of less than \$63,000 per year and women without insurance were significantly more likely to have delays in receiving breast cancer treatment. A previous study by Kwabeng *et al.* found a strong correlation

between insurance coverage and patient survival (23). While we found no association between the time to treatment disparities and OS rate, we believe that socioeconomic disadvantage and lack of insurance coverage when combined with other factors that were not available within the NCDB may potentially have impact on breast cancer outcomes.

In addition to race/ethnicity and socioeconomic status, another factor that contributes to treatment disparities is demographic location. Previous studies have focused on the correlation of zip code with breast cancer treatment adherence and outcome (24). Interestingly, our data suggested that women with breast cancer who live in a metropolitan area take a significantly longer time to receive their breast cancer treatment. Specifically, one of the factors that affect the time to receive breast cancer treatment is hospital type. Our data indicated that there was a significantly longer time to treatment for patients who received care at academic hospitals when compared to other hospital types. According to a study by Shariff-Marco *et al.*, most African American women with breast cancer received their cancer care in an academic setting following referral from another hospital (25). Referral time likely plays a significant role in the timely treatment of patients with breast cancer in an academic hospital setting. In addition to slower referral time, a higher volume of cases and less flexibility in scheduling also contribute to the delay in receiving treatment. However, due to limited data within the NCDB to investigate these factors, more granular analysis is needed.

As our study is retrospective and derived from a large database analysis, we acknowledge several limitations. Recall bias and missing data limit the reliability and generalizability of our conclusions. In addition, although there was no association between disparity in time to breast cancer treatment and OS, the NCDB does not include other treatment outcomes (*e.g.*, quality of life, recurrence-free survival, or progression-free survival) that may be impacted by these disparities.

In conclusion, our findings suggest that social determinants of health have a significant impact on the disparity in time to breast cancer treatment. Physicians and healthcare providers should be aware of these factors and advocate for breast cancer patients to receive the care and treatment they need and narrow this gap in breast cancer treatment.

Conflicts of Interest

The Authors have no conflicts of interest to declare in relation to this study.

Authors' Contributions

Writing and revision of paper: KS, EG. Analysis and interpretation of data: KA, AG, KS, EG. Other: A.A.K, MA, KP. All Authors read and approved the final manuscript.

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