

# Area Socioeconomic Status is Associated with Refusal of Recommended Surgery in Patients with Metastatic Cancer to Bone

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**INTRODUCTION:** Area socioeconomic status (SES) has not been widely studied in patients with metastatic disease to bone. This study sought to identify associations between the Yost Index, a geocoded area SES score, and race/ethnicity with patient refusal of recommended surgery among patients with metastatic cancer to bone.

**METHODS:** This retrospective cohort study utilized data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) database spanning from January 1, 2010, to December 31, 2018. Bone and joint sites were categorized using the International Classification of Diseases for Oncology (ICD-O-3) site recodes. The Yost Index, a geocoded area socioeconomic status (SES) score, was divided into quintiles using census tract-level American Community Service (ACS) 5-year estimates. Multivariate Cox regression models were employed to calculate crude and adjusted hazard ratios (aHRs) of overall survival, with 95% confidence intervals (CIs). The models were adjusted for age, sex, cancer site, and treatment modality.

**RESULTS:** A total of 138,989 patients were included, of which 14,943 (10.8%) had surgery recommended (Table 1). Patients in the lowest SES quintile (poorest) had 57% higher odds of refusing surgical treatment than those in the highest SES quintile (aOR of 1.57, 95% CI: 1.30-1.91, p<0.001, Table 2). Patients in the lowest SES quintile also had a 31.2% higher age-adjusted incidence rate of not being recommended for surgery compared with those in the highest quintile (186.4 vs. 142.1 per 1 million, p<0.001, Table 3). Black patients had 34% higher odds of refusing treatment compared with White patients, independent of SES status (aOR of 1.34, 95% CI: 1.14-1.58, p=0.003). Advanced age, unmarried patients, and patients with aggressive cancer subtypes were also independently associated with higher odds of refusing surgery (p<0.001).

**DISCUSSION AND CONCLUSION:** SES and race/ethnicity are persistent independent predictors of patient refusal of surgery among individuals with metastatic cancer to bone. Effective strategies for addressing these inequalities and improving the access and quality of care of patients of lower SES and minority backgrounds are required.

Table 1. Baseline covariates of patients living with metastatic cancer to the bone and joints, stratified by reason for no cancer-directed surgical resection, 2010-2018

Age at Diagnosis	Reason for no cancer-directed surgical resection					
	Surgery not recommended and/or not performed	Surgery recommended due to comorbidity	Surgery recommended but not performed, unknown reason	Surgery recommended but not performed, patient refusal	Surgery recommended but not performed, patient died	P-value
	(N=11947)	(N=3927)	(N=12014)	(N=1489)	(N=1178)	(N=242)
Mean (SD)	68.0 (12.0)	69.4 (11.7)	64.2 (13.8)	68.4 (12.0)	73.2 (11.3)	67.5 (12.2)
Median (IQR)	68.0 (6.10)	69.0 (20.0, 100)	63.0 (6.10)	69.0 (21.0, 100)	73.0 (20.0, 100)	67.0 (6.10)
Sex						<0.001
Female	4798 (59.8%)	1460 (41.1%)	4006 (50.0%)	540 (59.8%)	601 (59.8%)	140 (59.8%)
Male	7149 (59.8%)	1560 (41.1%)	4006 (50.0%)	921 (63.0%)	577 (44.1%)	142 (50.0%)
Race						<0.001
White	8416 (74.8%)	2121 (58.0%)	9630 (78.0%)	1137 (77.4%)	984 (83.7%)	221 (78.4%)
AIAN	532 (0.4%)	138 (0.5%)	113 (0.9%)	11 (0.8%)	2 (0.2%)	0 (0.0%)
Black	1848 (15.9%)	256 (7.0%)	1488 (12.2%)	217 (14.9%)	190 (16.3%)	47 (16.6%)
APIA	9645 (7.6%)	1670 (4.5%)	814 (6.5%)	97 (6.4%)	79 (6.7%)	16 (5.7%)
Marital Status						<0.001
Married	6434 (53.9%)	1767 (47.0%)	4883 (39.7%)	680 (47.0%)	418 (35.6%)	126 (44.7%)
Nonmarried	5509 (46.1%)	763 (20.9%)	5132 (42.7%)	779 (53.0%)	759 (64.4%)	116 (41.3%)
Urban/Rural						<0.001
Urban	10429	3299 (88.2%)	10477 (87.2%)	1243 (84.8%)	1024 (86.9%)	240 (87.2%)
Rural	15188 (12.7%)	528 (13.8%)	1537 (12.8%)	224 (15.2%)	154 (13.1%)	34 (12.0%)
Yost Index						<0.001
Quintile 1	2090 (17.5%)	777 (20.3%)	304 (24.3%)	249 (17.0%)	224 (19.0%)	72 (25.3%)
Quintile 2	2103 (17.6%)	847 (22.7%)	264 (21.2%)	271 (18.9%)	271 (23.0%)	51 (18.0%)
Quintile 3	2117 (17.8%)	779 (20.9%)	210 (16.8%)	262 (17.9%)	204 (17.3%)	51 (18.1%)
Quintile 4	2103 (17.6%)	675 (18.2%)	211 (16.9%)	268 (18.8%)	240 (20.4%)	48 (17.0%)
Quintile 5	2174 (18.0%)	799 (21.4%)	199 (16.0%)	371 (25.7%)	239 (20.3%)	54 (19.0%)
Primary Site						<0.001
Breast	1731 (11.5%)	432 (11.3%)	430 (3.5%)	232 (15.9%)	364 (31.2%)	71 (25.0%)
Colorectal	2412 (20.2%)	113 (3.0%)	840 (6.7%)	40 (2.8%)	60 (5.1%)	12 (4.2%)
Esophagus	233 (2.0%)	11 (0.3%)	29 (0.2%)	3 (0.2%)	14 (1.2%)	5 (1.8%)
Kidney	440 (3.7%)	22 (0.6%)	173 (1.4%)	10 (0.7%)	49 (4.2%)	2 (0.7%)
Liver	2469 (20.7%)	116 (3.1%)	72 (0.6%)	37 (2.5%)	46 (3.9%)	8 (2.8%)
Lung	4059 (34.2%)	2150 (57.6%)	902 (7.4%)	440 (30.2%)	497 (42.3%)	120 (42.0%)
Pancreas	375 (3.2%)	126 (3.4%)	40 (0.3%)	20 (1.4%)	25 (2.1%)	7 (2.5%)
Prostate	2440 (20.5%)	435 (11.6%)	240 (1.9%)	120 (8.1%)	150 (12.8%)	11 (3.9%)
Stomach	2129 (17.8%)	71 (1.9%)	82 (0.7%)	22 (1.5%)	10 (0.8%)	6 (2.1%)
Urinary Bladder	445 (3.7%)	32 (0.9%)	145 (1.2%)	10 (0.7%)	15 (1.3%)	4 (1.4%)

\*Incidence = SEER Research Plus Data (Specialized with Cancer First Recurrence). 18 Registries (excluding AK). Nov 2020 Data (2016-2018) used.

Table 2. Adjusted hazard ratios of refusing surgical treatment in patients with metastases to the bone and joints stratified by clinical covariates

	Adjusted Hazard Ratio	P-value
Age at Diagnosis (Per additional year)	1.07 (1.06-1.07)	<0.0001
Sex		<0.0001
Female	1.00	
Male	1.03 (0.88-1.21)	
Race		<0.0001
White	1.00	
AIAN	0.73 (0.17-3.01)	0.72
Black	1.34 (1.14-1.58)	0.73
APIA	1.21 (0.96-1.51)	<0.0001
Marital Status		<0.0001
Married	1.00	
Nonmarried	2.10 (1.87-2.36)	
Urban/Rural Status		<0.0001
Urban	1.00	
Rural	1.13 (0.95-1.34)	0.026
Surgery		<0.0001
No	1.00	
Yes	0.59 (0.57-0.60)	
Yost Index		<0.0001
Quintile 5 (Highest)	1.00	
Quintile 4	1.35 (1.14-1.60)	
Quintile 3	1.26 (1.05-1.51)	
Quintile 2	1.59 (1.32-1.90)	
Quintile 1 (Lowest)	1.57 (1.30-1.91)	
Primary Cancer		<0.0001
Breast	1.00	
Colorectal	0.71 (0.55-0.90)	<0.0001
Esophagus	6.99 (3.80-12.5)	<0.0001
Kidney	0.69 (0.55-0.87)	<0.0001
Liver	2.67 (1.59-4.29)	<0.0001
Lung	4.29 (3.65-5.05)	<0.0001
Pancreas	6.15 (3.74-10.0)	<0.0001
Prostate	0.45 (0.36-0.57)	<0.0001
Stomach	1.31 (0.70-2.31)	<0.0001
Urinary Bladder	0.07 (0.05-0.11)	0.33

Table 3. Age-adjusted incidence rates of patients living with metastatic cancer to the bone and joints, stratified by Yost Index Quintile and Reason for no cancer-directed surgical resection, 2010-2018

Surgery Status	Yost Index Quintile				
	Quintile 1 [95% CI]	Quintile 2 [95% CI]	Quintile 3 [95% CI]	Quintile 4 [95% CI]	Quintile 5 [95% CI]
Not Recommended, not performed	186.4 (143.3-188.7)	172.1 (162.3-174.5)	164.3 (162.4-166.5)	159.2 (157.4-161.1)	142.1 (140.4-143.7)
Not Recommended, recommended	SE 1.2	SE 1.1	SE 1.0	SE 1.0	SE 0.9
Recommended, not performed	8.9 (8.4-10)	9.1 (8.5-9)	9.2 (8.6-9)	9.0 (8.5-9)	9.1 (8.5-9)
Recommended, not performed, unknown	SE 0.2	SE 0.2	SE 0.2	SE 0.2	SE 0.1
Recommended, not performed, patient refused	19.1 (19.1-20.1)	20.1 (20.2-20)	19.2 (19.5-19)	19.1 (19.5-19)	18.7 (19.4-18)
Recommended, not performed, patient died	SE 0.4	SE 0.4	SE 0.4	SE 0.2	SE 0.2
Recommended, not performed, unknown	SE 0.2	SE 0.2	SE 0.1	SE 0.1	SE 0.07
Recommended, not performed, patient refused	SE 0.1	SE 0.1	SE 0.1	SE 0.1	SE 0.07
Recommended, not performed, patient died	SE 0.1	SE 0.1	SE 0.1	SE 0.04	SE 0.04