Symptom Expression in Coronary Heart Disease and Revascularization Recommendations for Black and White Patients

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Objectives. We examined whether symptoms of coronary heart disease vary between Black and White patients with coronary heart disease, whether presenting symptoms affect physicians' revascularization recommendations, and whether the effect of symptoms upon recommendations differs in Black and White patients.

Methods. We interviewed Black and White patients in Pittsburgh in 1997 to 1999 who were undergoing elective coronary catheterization. We interviewed them regarding their symptoms, and we interviewed their cardiologist decision-makers regarding revascularization recommendations. We obtained coronary catheterization results by chart review.

Results. Black and White patients (N = 1196; 9.7% Black) expressed similar prevalence of chest pain, angina equivalent, fatigue, and other symptoms, but Black patients had more shortness of breath (87% vs 72%, $P = .001$). When we considered only those patients with significant stenosis (n = 737, 7.1% Black) and controlled for race, age, gender, and number of stenotic vessels, those who expressed shortness of breath were less likely to be recommended for revascularization (odds ratio = 0.535; 95% confidence interval = 0.375, 0.762; $P < .001$), but there was no significant interaction with race.

Conclusions. Black patients reported shortness of breath more frequently than did White subjects. Shortness of breath was a negative predictor for revascularization for all patients with significant stenosis, but there was no difference in the recommendations by symptom by race. (*Am J Public Health.* 2007;97:1701–1708. doi:10.2105/AJPH.2005.084103)

Coronary revascularization interventions are used to relieve the symptoms of individuals with coronary heart disease (CHD) and improve quality of life.[1,2] Given that the death rate from CHD is higher in Black individuals,[3] it might be expected that cardiac interventions would be used at least as frequently in Black patients as in White patients. However, numerous studies have documented significantly lower revascularization rates in Black patients,[4–7] even when this procedure appears to be clinically indicated.[8]

The reasons for this disparity include factors at the patient, provider, and system levels.[7] Some studies suggest that Black patients are more likely to express CHD symptoms other than typical chest pain.[9] Symptom presentation may affect referrals for catheterization or revascularization recommendations. However, the link between race and symptom expression is not well delineated nor is the relation between symptoms and revascularization recommendations. We sought to determine whether there was a difference in CHD subjective symptoms expressed by Black and White patients referred for elective cardiac catheterization and whether symptom differences affected revascularization recommendations. Such information may help to elucidate known racial differences in revascularization rates.

METHODS

Participants and Data Collection

We evaluated patients at 1 Veterans Affairs (VA) and 1 non-VA hospital in Pittsburgh. Trained study personnel evaluated all Black and White patients scheduled for cardiac catheterization between November 1997 and June 1999 for eligibility. We excluded patients who were scheduled for elective revascularization after previous catheterization (typically at a referring hospital), had a cardiac transplant, appeared acutely ill, or were undergoing primary emergency angioplasty. A research assistant approached consecutive eligible outpatients in the holding area for same-day procedures, except when multiple simultaneous procedures prevented all outpatients from being approached, in which case patients who appeared to be Black (by physical characteristics as determined by the research assistant) were preferentially approached. Inpatients were approached on the day preceding their scheduled procedure. We did not attempt to enroll individuals who were acutely ill, were continuously attended to by health care providers, or appeared unable to provide informed consent. Each participating hospital's institutional review board approved the study protocol.

After the patients gave informed consent and were enrolled, the trained research assistants (2 Black men, 4 White women, 1 White man) interviewed them while they awaited catheterization. The interview included questions about each person's demographics and health status. Race was assigned according to participant self-report. Participants were coded as Black if they described themselves as Black as a single race or 1 of 2 races and White if they provided a description consistent with European ancestry. For example, Italian was converted to White, but American was considered unknown.

To assess symptoms of heart disease, we asked participants, "Do you currently or have you had in the past any problems related to your heart or symptoms of heart trouble?" Positive responses generated the follow-up question, "What problems or symptoms?"

Particpants were asked to specifically respond yes or no to the symptom categories chest pain, shortness of breath, heart attack, need to limit activities, ability to work affected, or "other." Subjects were free to mention as many symptoms or problems as they wished. Responses of "other" were recorded verbatim by the research interviewers. The first 50 verbatim responses were read by 2 physician investigators who developed new categories based on these responses and then independently assigned each of the "other" verbatim responses to 1 of these new categories or to 1 of the original categories. Discrepancies between the investigators were resolved by consensus or recourse to a third investigator. This process continued for the remaining responses. The investigators were blinded to the participants' race throughout. Examples of the full range of the verbatim responses that were eventually recoded are provided in Table 1.

To examine the impact of physical symptoms on care provider recommendations, we focused only on subjective physical symptoms that patients attributed to their heart disease—chest pain, angina equivalent, shortness of breath, fatigue, and "other symptoms" (numbness, muscle cramps)—and chose not to include and analyze responses that named diagnostic terms (heart attack, arrhythmia, coronary artery disease, congestive heart failure), interventions or tests, or functional limitations that did not specify a physical symptom.

Following the catheterization, we surveyed the physician who would or did make a revascularization recommendation (or gave a referral to a surgeon to consider coronary artery bypass grafting). To improve participation, we did not ask the cardiology attending faculty at the non-VA hospital to complete the questionnaire when a percutaneous intervention was completed during the index catheterization; we assumed that they had recommended the procedure and coded a yes response. However, they were asked to complete the questionnaire when the intervention was not completed as a part of the catheterization procedure. At the VA facility, where the respondent was typically a cardiology fellow, the questionnaire was used in all cases regardless of whether an intervention was completed as part of the catheterization. Almost all physician interviews took place after initial discussion of the catheterization results with the patient. We asked, "Did you recommend that this patient undergo revascularization or have a cardiothoracic surgery consult for potential revascularization at this time?" Response options were yes or no.

Trained research assistants, under physician supervision, reviewed each participating physician's written catheterization report to collect data regarding coronary anatomy and stenosis. Significant stenosis was defined as 70% or greater stenosis of any single epicardial vessel or greater than 50% stenosis of the left main coronary artery. We categorized coronary disease severity as (1) severe (significant stenosis of left main artery or 3 vessels), (2) moderate (significant stenosis of 1–2 vessels and involving the proximal left anterior descending artery), (3) mild (significant stenosis of 1–2 vessels and no involvement of the proximal left anterior descending artery), or (4) no significant disease (no significant stenosis in any artery). This system for categorizing coronary disease severity has been widely used in studies evaluating the appropriateness and necessity of catheterization and revascularization.[10–13] Left ventricular ejection fraction (LVEF), determined by left ventriculogram (dye contrast evaluation of percentage of left ventricular end diastolic volume ejected per beat), was recorded when available.

TABLE 1—Coding Scheme for Verbatim Responses From Patients Who Answered "Other" to Symptom Question: Pittsburgh, Pa, November 1997 to June 1999

Sample Verbatim Responses	Final Codes
Recoded to existing category by investigator	
Angina	Chest pain
Shocks in the chest	
Dyspnea of exertion (by a physician patient)	Shortness of breath
Silent heart attack	Heart attack
Myocardial infarction	
New category created by investigator	
Chest pressure/tightness	Anginal equivalents
Heaviness/discomfort	
Burning sensation in chest	
Numbness	Other symptoms
Muscle cramps	
Palpitation	Arrhythmia
Fibrillation	
Fatigue/tiredness/weakness/loss of energy	Fatigue
Weakness in legs/limbs	
Blockages	Coronary artery disease
Atherosclerosis	
Smoking-related problems	Other diseases/disorders/risk factors
Blood pressure fluctuation	
Hypercholesterolemia	
Poor circulation	Other vascular problems
Carotid endarterectomy	
Pacemakers	Intervention/tests
Heart surgery	
Fluid in lungs	Congestive heart failure
Enlarged heart	
Heart murmur	Other heart problems
Blood clots	

Analysis

Demographic and clinical characteristics of Black and White patients were compared using the χ^2 and Student *t*-test statistics. We used the χ^2 or Student *t* test to assess associations between patient symptoms and patient characteristics. We used binary logistic regression (SPSS version 12.0, SPSS Inc, Chicago, Ill) to identify univariate predictors of a revascularization recommendation (yes or no) only in patients who had significant stenosis. We also developed a blocked sequential multivariate model for symptoms predicting a revascularization recommendation only in patients with significant stenosis, with control for race, age, gender, and coronary disease severity and further examined interactions between symptoms and race. This sequential approach was taken to control for covariates and then to examine the change in the model statistics with the addition of the predictors of interest, as well as the higher-order effects such as interaction terms. We examined the functional form of our sole continuous covariate—age—and found it to be linear. The Hosmer–Lemeshow χ^2 test (χ^2_{HL}) was used to test goodness of fit of the model to the data. Significant findings for the model χ^2 (χ^2_{Model}) suggest that at least 1 of the predictors in the model was significant. We considered associations to be statistically significant when $P \leq .05$.

RESULTS

Baseline Characteristics and Symptom Expression

Of 1300 eligible patients participating, 1196 were coded as being Black or White and reporting at least 1 symptom and were included in the analysis. Baseline characteristics of Black (n=116, 9.7%) and White (n=1080, 90.3%) participants are summarized in Table 2. Black participants were significantly younger than were White participants, more often women, and less often married. Fewer than one third of patients in both groups currently worked, but there was no difference between groups (*P*=.878). Black patients were less satisfied with their income, with 58% feeling they had "not enough" or "just enough" income, compared with 54% of White patients (*P*=.044). Nearly two thirds of the Black patients rated themselves to be in fair-to-poor health, compared with only half of the White patients (*P*=.028). On catheterization, Black and White participants were similar with respect to LVEF (*P*=.438), but White participants had greater coronary disease severity (*P*<.001), attributable to more instances of multiple-vessel or left main artery disease.

Considering the entire study population, patients were most likely to complain of shortness of breath (73.8%), followed by chest pain (71.8%), angina equivalent (26%), "other" symptoms (11.4%), and fatigue (5.9%). Comparisons for race, gender, age, and disease severity for patients with and without each symptom are displayed on the left side of Table 3. Participants reporting shortness of breath were more likely to be Black (*P*=.001) and women (*P*=.029) and to have greater disease severity (*P*=.029). Patients reporting chest pain were older than those without that symptom (*P*=.001). Patients who reported "other" symptoms were older (*P*=.007) and had greater disease severity (*P*<.001). No differences were noted between patients with and without fatigue.

When we examined only the 837 patients with at least 1 significant stenosis (Table 3, right side), patients reporting shortness of breath were more likely to be Black (*P*=.048). Patients with stenosis reporting chest pain were younger (*P*=.024), and those reporting an angina equivalent were more likely to be women (*P*=.023). No patient characteristic was associated with fatigue or "other" symptoms.

Revascularization Recommendations

For all patients who provided a symptom complaint and whose managing physician provided a revascularization recommendation (n=1088; Blacks, n=104, 9.6%; Whites, n=984, 90.4%), significantly fewer Black (25%) than White (39%) patients were recommended to be revascularized (*P*=.003).

TABLE 2—Demographic Characteristics and Catheterization Results for All Patients Reporting Symptoms (N=1196) and for Blacks (n=116) and Whites (n=1080): Pittsburgh, Pa, November 1997 to June 1999

	Total Sample	Blacks	Whites	*P*
Baseline characteristics				
Age, y, mean (SD)	62.0 (11.07)	58.7 (11.99)	62.4 (10.91)	.001
Male gender, %	77.1	65.8	78.8	.002
Education completed, %				.146
Less than high school	19.7	14.8	20.5	
Higher than high school	79.3	85.2	79.5	
Marital status, %				<.001
Single	8.0	19.8	6.7	
Married	64.2	39.7	66.9	
Divorced	14.8	26.7	13.5	
Widowed	13.0	13.8	12.9	
Currently working, %	28.6	30.2	28.4	.878
Income satisfaction, %				.044
Not enough	14.8	18.5	14.4	
Just enough	41.4	50	40.5	
Only comfortable	26.5	16.7	27.6	
Meets desires	17.3	14.8	17.5	
Previous revascularization, %	37.0	24.1	38.5	.002
Health care system, %				.158
VA	45.9	39.7	46.5	
Non-VA	54.1	60.3	53.5	
General health, %				.028
Poor	14.6	14.7	14.6	
Fair	35.5	48.3	34.1	
Good	40.3	31.9	41.3	
Very good	6.9	3.4	7.2	
Excellent	2.7	1.7	2.8	
Catheterization result				
LV ejection fraction, %, mean (SD)	60.59 (19.99)	62.7 (23.7)	60.4 (19.6)	.438
Severity of disease, %				<.001
No disease	30.0	46.5	28.2	
Mild (1–2 vessels without PLAD[a])	25.7	26.7	25.6	
Moderate (1–2 vessels with PLAD[a])	8.7	7.8	8.8	
Severe (3 vessels[a] or left main[b])	35.6	19.0	37.4	
Any significant stenosis, %	70.0	53.4	71.8	<.001

Note. VA = Veterans Affairs; LV = left ventricular; PLAD = proximal left anterior descending artery.
[a]Stenosis ≥ 70%.
[b]Stenosis > 50%.

TABLE 3—Symptom Prevalence for All Patients Expressing a Symptom (N = 1196), and for Only Those With Significant Stenosis on Cardiac Catheterization (n = 837): Pittsburgh, Pa, November 1997 to June 1999

	Total Sample				With Stenosis Only			
Symptom	No.	Symptom Yes	Symptom No	*P*	No.	Symptom Yes	Symptom No	*P*
Shortness of breath								
Race, %				.001				.048
Black	116	87.1	13.0		62	82.3	11.7	
White	1080	72.4	27.6		775	70.5	29.5	
Age, y, mean (SD)		62.1 (10.8)	62.1 (11.2)	.904		64.0 (10.4)	63.4 (10.3)	.450
Gender, %				.029	830			.174
Men	922	72.3	27.7		677	70.3	29.7	
Women	267	79.0	21		153	75.8	24.2	
Disease severity, no. (%)				.029				.999
No disease		286 (32.4)	73 (23.3)			. . .	. . .	
Mild		219 (24.8)	88(28.1)			219 (36.7)	88 (36.7)	
Moderate		74 (8.4)	30(9.6)			74 (12.4)	30 (12.5)	
Severe		304 (34.4)	122(28.6)			304 (50.9)	122 (50.8)	
Chest pain								
Race, %				.725				.412
Black	116	73.3	26.7		62	77.4	22.6	
White	1079	71.7	28.3		774	72.6	27.4	
Age, y, mean (SD)	1195	61.4 (11.2)	63.8 (10.6)	.001	836	63.4 (10.5)	65.1 (9.8)	.024
Gender, %				.167				.787
Men	921	72.9	27.1		676	72.8	27.2	
Women	267	68.5	31.5		153	73.9	26.1	
Disease severity, no. (%)	1195			.414	836			
No disease		249 (29.0)	110 (32.7)			. . .	. . .	.529
Mild		218 (25.4)	89 (25.5)			218 (35.7)	89 (39.4)	
Moderate		74 (8.6)	29 (8.6)			74 (12.1)	29 (12.8)	
Severe		318 (37)	108 (37.0)			31 (52.1)8	108 (47.8)	
Angina equivalent								
Race, %				.054				.153
Black	116	18.1	81.9		62	19.4	80.6	
White	1080	26.9	73.1		775	27.7	72.3	
Age, y, mean (SD)	1196	62.4 (11.1)	61.0 (11.0)	.059	837	62.9 (10.5)	64.2 (10.3)	.127
Gender, %				.137				.023
Men	922	25.1	74.9		677	25.6	74.4	
Women	267	25.5	70.4		153	34.6	65.4	
Disease severity, no. (%)	1196			.260	837			
No disease		84 27.0	275 (31.1)			. . .	. . .	.341
Mild		84 27.0	223 (25.2)			84 (37)	223 (37)	
Moderate		34 11	70 (7.9)			34 (15)	70 (11)	
Severe		109 35	317 (35.8)			109 (48)	317 (52)	
Other symptoms								
Race, %				.953				.135
Black	116	11.2	88.8		62	3.2	96.8	
White	1080	11.4	88.6		775	8.7	91.3	
Age, y, mean (SD)	1196	59.6 (11.3)	62.3 (11.1)	.007	837	63.9 (9.6)	63.8 (10.4)	.945

Continued

We then considered a subsample of only patients with significant stenosis on catheterization, report of a symptom, and a revascularization recommendation (n=737; Blacks, n=52, 7.1%; Whites, n=685, 92.9%). This subsample was similar to the general study population in demographic characteristics, with no between-race differences in education (*P*=.621), current employment (*P*=.962), income satisfaction (*P*=.508), and rating of general health (*P*=.056), but these participants were still different in age (*P*=.036) and marital status (*P*=.006); gender was similar between the races (*P*=.065). When only patients with significant stenosis were considered, there were no significant differences between Black (50%) and White (56.9%) patients being recommended for revascularization (*P*=.331).

We then used logistic regression to analyze predictors for revascularization recommendations in this subsample of patients. The left column in Table 4 displays the univariate regression analysis for prediction of a recommendation favoring revascularization for race, gender, age, disease severity, and each symptom. Being a woman was a significant predictor (odds ratio [OR]=2.037; confidence interval [CI]=1.33, 3.12; *P*=.001) and may represent institutional bias and the older age of the women in this segment of the analysis (women aged 67 years vs men aged 63 years, *P*=.002). Other significant univariate predictors were severe disease (*P*=.002), shortness of breath (*P*=.003), and "other" symptoms (*P*=.034).

The right column of Table 4 displays the results for the multivariate regression analysis. The model was fit in a blockwise sequential fashion. The block of covariates was entered first (race, gender, age, and disease severity). The first block analyses indicated that at least 1 of the covariate variables was significant (χ^2_{Model}=24.75; *df*=5; *P*=.001) and that the model fit the data well (χ^2_{HL}=4.19; *df*=8; *P*=.839). In the second block, the symptoms were entered, and this model was also significant (χ^2_{Model}=45.38; *df*=10; *P*<.001) and had a good fit to the data (χ^2_{HL}=4.417; *df*=8; *P*=.818). Even after the we controlled for the covariates, shortness of breath remained a negative predictor for a recommendation to revascularize (OR=0.535; 95% CI=0.375,

TABLE 3—*Continued*

Gender, %				.322				.126
Men	922	11.9	88.1		677	9.0	91.0	
Women		9.7	90.3		153	5.2	94.8	
Disease severity, no. (%)				<.001				.768
No disease		67 (49.3)	292 (27.5)			…	…	
Mild		23 (16.9)	284 (26.8)			23 (33.3)	284 (37.0)	
Moderate		8 (5.9)	96 (9.1)			8 (11.6)	96 (12.5)	
Severe		38 (27.9)	388 (36.6)			38 (55.1)	388 (50.5)	
Fatigue								
Race, %				.962				.396
Black	119	6.0	94.0		62	3.2	96.8	
White	1080	5.9	94.1		758	5.9	94.1	
Age, y, mean (SD)	1196	61.7 (10.5)	62.1 (11.1)	.806	837	63.8 (10.3)	63.9 (10.4)	.957
Gender, %				.076				.093
Men	922	5.3	94.7		47	5.0	8.5	
Women	267	8.2	91.8		783	95.0	91.5	
Disease severity, no. (%)				.543				.424
No disease		24 (33.8)	335 (29.8)			…	…	
Mild		19 (26.8)	288 (25.6)			19 (40.4)	288 (36.5)	
Moderate		8 (11.3)	96 (8.5)			8 (17.0)	96 (12.2)	
Severe		20 (28.2)	406 (36.1)			20 (42.6)	406 (51.4)	

Note. Ellipses indicate not applicable.

TABLE 4—Univariate and Sequential Multivariate Logistic Regression Analysis for Likelihood of a Symptom Predicting a Recommendation Favoring Revascularization for Only Those Patients With Significant Stenosis Identified by Cardiac Catheterization: Pittsburgh, Pa, November 1997 to June 1999

Predictor	Univariate Analysis, OR (95% CI)	*P*	Multivariate Analysis,[a] OR (95% CI)	*P*
Black race	0.756 (0.430, 1.330)	.332	0.864 (0.474, 1.537)	.632
Female gender	2.037 (1.332, 3.117)	.001	2.064 (1.328, 3.208)	.001
Age	1.012 (0.998, 1.027)	.096	1.005 (0.990, 1.021)	.522
Moderate disease[b]	1.749 (1.074, 2.848)	.025	1.653 (0.998, 2.738)	.051
Severe disease[b]	1.642 (1.193, 2.259)	.002	1.75 (1.246, 2.458)	.001
Shortness of breath	0.598 (0.428, 0.835)	.003	0.535 (0.375, 0.762)	<.001
Chest pain	1.013 (0.730, 1.404)	.904	1.33 (0.799, 1.608)	.484
Anginal equivalent	1.385 (0.991, 1.936)	.056	1.344 (0.946, 1.909)	.099
Other symptoms	0.563 (0.330, 0.959)	.034	0.532 (0.306, 0.924)	.025
Fatigue	1.402 (0.717, 2.743)	.324	1.576 (0.786, 3.158)	.200

Note. OR = odds ratio; CI = confidence interval. Total sample, n = 737; Blacks, n = 52, 7.1%; Whites, n = 685, 92.9%.
[a]The results of sequential logistic regression with race, gender, age, and coronary disease severity entered in first block as covariates and the symptoms entered in the second block as predicators of interest. No significant interaction with race was found in the third block; thus results from the second block only are reported.
[b]Mild disease is the reference.

0.762; *P*<.001). The category of "other" symptoms (OR=0.532; 95% CI=0.306, 0.924; *P*=.025) was also significant, but the number of patients reporting other symptoms was small (n=60). Finally, there was no 2-way interaction for shortness of breath by race (OR=0.799; 95% CI=0.161, 3.951; *P*=.783) or for race and any other symptom (chest pain, *P*=.389; angina equivalent, *P*=.894; "other," *P*=1.000; fatigue, *P*=1.000). The multivariate regression analysis was repeated to test for gender and symptom interactions, but there were no significant interactions.

DISCUSSION

In a cohort of Black and White patients awaiting catheterization, Black patients reported a significantly higher prevalence of shortness of breath. Complaining of shortness of breath was a negative predictor for having a revascularization procedure recommended, even when only patients with significant stenosis were considered. However, the lesser likelihood for patients with shortness of breath being recommended for revascularization did not vary by race.

Baseline Characteristics and Symptom Expression

The baseline characteristics of our sample, in which Black patients were younger and more likely to be women, were similar to other studies reporting on race and CHD.[14,15] Nearly half of the Black patients in our study had no significant stenosis, compared with a quarter of the White patients. This finding of less stenosis of large epicardial arteries in Black patients has been described by others,[16,17] although the reasons have yet to be established. This same phenomenon of less stenosis of large arterial vessels in Black patients also has been observed in studies of cerebrovascular disease.[18]

Our findings of racial differences in the symptoms expressed by patients with CHD have also been described by others, although not consistently and never in a population in which the coronary anatomy was as well defined as in ours. Richards et al. examined 40 Black and 191 White patients with a final diagnosis of angina (66.2%) or acute myocardial infarction (33.8%).[14] As in our study, Black patients were more likely to have shortness of breath than were White patients (60% vs 36%; *P*=.004), but no between-group differences existed in chest pain, chest heaviness, or tightness or squeezing in the chest. Black patients in their study were still

more likely to have shortness of breath after demographic and clinical characteristics were controlled (OR=3.16; 1.49, 6.71; *P*=.003).

Raczynski et al.[15] did not report a higher prevalence of shortness of breath per se in Black patients with CHD, but when symptoms were clustered into painful or not painful, Black patients were less likely to report painful symptoms and were less likely to attribute their symptoms to a cardiac origin even after control for factors other than race. Klingler et al. also found Black patients more likely to attribute symptoms to a noncardiac cause.[19] However, Crawford et al. found no racial differences in shortness of breath or chest pain or in the rates of help seeking for chest pain or shortness of breath.[20] Differences in study findings may relate to different methods used to assess symptoms (open-ended questionnaires, symptom categorization by researchers, symptom scales). Although gender (women[21,22]) and comorbidities (diabetes[23] and hypertension[24]) have been shown to affect clinical presentation, our small sample size did not permit examination of subsets based on these characteristics.

Although it seems from previous research and our results that Black and White patients with CHD have some differences in symptom complaints, it is not clear why. Cultural, educational, and socioeconomic differences may exist in the perception or reporting of pain or in patients' explanatory models of disease[15,25,26] It is also possible that racial differences in the type of arterial dysfunction and, in turn, the degree and location of the arterial occlusion produced, account for some of the variance. It has been reported that Black patients have a greater prevalence of arterial fatty streaks, whereas White patients have more arterial fibrous plaques.[27] Several authors report that White patients have a greater prevalence of atherosclerotic calcification,[28–30] whereas Black patients have more pronounced arterial intimal thickness.[31] These differential manifestations may produce large and discrete proximal arterial occlusions in White patients but more diffuse narrowing of distal arteries and arterioles in Black patients, in turn causing differences in expressed symptoms. It remains unknown whether these physiologic differences are attributable to a genetic cause, are linked to ethnic variation in CHD risk factors that are in turn mediated by socioeconomic and environmental conditions, or are caused by interactions among all of these variables.

Symptoms and Revascularization Recommendations

Other investigators have shown that physicians are less likely to recommend revascularization for patients with symptoms other than chest pain, regardless of race, in emergency situations where definitive diagnostic data are lacking. Canto et al. found that although patients without chest pain (regardless of race) represented one third of the study population diagnosed with acute myocardial infarction, they were less likely to receive emergent interventions (thrombolysis, angioplasty, aspirin, beta blockers, or heparin) and had a higher likelihood of in-hospital mortality (OR=2.21; 95% CI=2.17, 2.26).[32] Manhapra et al. found that absence of chest pain at emergent presentation was a strong negative predictor for immediate reperfusion therapy for eligible Black patients with myocardial ischemia (OR=0.31; 95% CI=0.26, 0.37) and concluded that atypical symptoms are likely to influence the clinician's diagnostic opinions.[33] Our findings seem to demonstrate that this tendency to recommend less intervention when shortness of breath is a symptom still persists even in the nonemergent setting—where treatments can be more thoughtfully considered and data documenting stenosis are available. We were able to identify only 1 other study that found similar results in a nonemergent patient population. Sheffield et al. found that patients with positive exercise stress tests who complained of angina were more likely to be referred for catheterization or nuclear study than were those not complaining of angina, even though the time to and duration of ST segment depression indicative of myocardial ischemia on the simultaneous electrocardiogram was equivalent between groups.[34] It is therefore unclear why shortness of breath seems to move the decision away from revascularization even when supportive diagnostic evidence exists.

There are several possible reasons for these findings. Perhaps shortness of breath is a distracter for the provider, suggesting other diagnoses or comorbid conditions with increased procedural risk. Because the revascularization involves a dialogue with the patient, providers may be less likely to recommend the procedure for patients who are more willing to attribute their symptoms to a noncardiac cause.[15] Improving understanding of the impact of symptom expression on treatment decisions is important. Although the lesser likelihood that Black patients will undergo CHD treatment is well described in the literature,[5,8,17,35–37] the degree to which treatment decisions are affected by how patients express symptoms or by how patients, and in turn providers, attribute expressed symptoms to causation warrants further study.

Limitations

Our study had several limitations. First, we examined only patients whose symptoms resulted in elective catheterization. Some patients with atypical CHD sumptoms may not have been referred for catheterization, thus impacting the categories and prevalence of less common symptoms in our sample.

Second, our symptom categorizations may be too simplistic. Possibly patients with fast or irregular breathing described their symptom as shortness of breath, whereas the cardiac symptom of interest is really difficult breathing or dyspnea. We also asked patients to relate "problems related to your heart or symptoms of heart trouble." Some patients may not have recognized that symptoms other than chest pain can be cardiac related and thus did not volunteer nonpainful symptoms. We also recorded more than 1 symptom. Asking the participant to choose 1 predominant symptom might help clarify how a symptomatic chief complaint affects recommendations.

A third limitation is that more comprehensive data regarding past medical history and comorbidities might have identified contraindications to revascularization that would explain the associations we found. However, because all patients in the study were undergoing elective catheterization, it is likely that both the referring physicians and the physicians performing the procedure believed the patient to be free of a comorbid contraindication to performing at least percutaneous revascularization if warranted. We also doubt that severe underlying heart failure precluding revascularization was the reason that shortness of breath was a negative predictor for revascularization, because the mean LVEF for patients with and without shortness of breath was similar

(shortness of breath yes, LVEF 58.1% vs shortness of breath no, LVEF 57.8%; P=.878).

A fourth potential limitation is that participants were under the clinical care of the study cardiologists making the recommendations, so there was no blinding. Possibly, the physicians rated the clinical significance of the catheterization results differently by race. In addition, other patient factors, such as socioeconomic status, level of education, previous compliance with appointments and regimens, insurance, and communication style known to the physicians might have affected their recommendations through conscious or unconscious bias.

Finally, our analysis examining prediction of revascularization recommendations by symptoms by race for patients with significant stenosis may have been underpowered. We enrolled only 52 Black patients with significant stenosis into this segment of the analysis, with even smaller numbers in some of the model cells for symptoms, which may have contributed to our inability to detect interactions between symptoms and race.

Conclusions

Many factors play a role in decisions regarding treatment recommendations for both patients and providers, and the contribution of patient race has been difficult to evaluate. Nonbiological factors, such as the patient's socioeconomic status, access to specialists, and acceptance of recommendations and the physician's expertise or perception of the patient's need for procedures cannot be completely isolated from biological factors.[38] Our findings indicate that symptoms expressed by patients with CHD may vary by race, with Black patients expressing more shortness of breath. Our findings also indicate that shortness of breath is associated with a lower likelihood that physicians will recommend coronary revascularization, even with documented significant stenosis on catheterization, regardless of race. Why this symptom tends to lead a decision away from revascularization and whether the reasons are biological or nonbiological, remain unexplained. Further study more finely tuned to symptom description and control of the noted limitations is needed to determine how the report of this symptom affects the decisionmaking process. Nevertheless, it is possible that the tendency to be less aggressive with revascularization when patients complain of shortness of breath may contribute to lower revascularization rates among Black patients, who are more likely to have this symptom. ■

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Contributors

M. Hravnak originated the study, conducted the data analysis, and drafted the article. M.E. Kelley and S. Sereika assisted with data analysis and interpretation. J. Whittle and C.B. Good assisted in originating the study and drafting the article. S.A. Ibrahim assisted with drafting the article. J. Conigliaro assisted in originating the study, contributed to the data interpretation, assisted in drafting the article, and served as the research mentor.

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Human Participant Protection

This research was approved by the institutional review boards of the University of Pittsburgh and the Veterans Affairs Pittsburgh Healthcare System, and all patients consented to study participation.

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