7-2000

Differences Between Blacks and Whites With Coronary Heart Disease in Initial Symptoms and in Delay in Seeking Care

Sally B. Richards

Marjorie Funk

Kerry A. Milner
Sacred Heart University, milnerk@sacredheart.edu

DIFFERENCES BETWEEN BLACKS AND WHITES WITH CORONARY HEART DISEASE IN INITIAL SYMPTOMS AND IN DELAY IN SEEKING CARE

Sally B. Richards, MSN, APRN, Marjorie Funk, RN, PhD, Kerry A. Milner, RN, DNSc. From Yale University School of Nursing, New Haven, Conn.

• ***BACKGROUND*** ***Mortality rates for coronary heart disease are higher in blacks than in whites.***
• ***OBJECTIVES*** ***To examine differences between blacks and whites in the manifestation of symptoms of coronary heart disease and in delay in seeking treatment.***
• ***METHODS*** ***Patients were directly observed as they came to an emergency department with symptoms suggestive of coronary heart disease. The sample included 40 blacks and 191 whites with a final diagnosis of angina or acute myocardial infarction.***
• ***RESULTS*** ***After controlling for pertinent demographic and clinical characteristics, logistic regression analysis revealed that blacks were more likely than whites to have shortness of breath (odds ratio = 3.16; 95% CI = 1.49-6.71; P = .003) and left-sided chest pain (odds ratio = 2.55; 95% CI = 1.10-5.91; P = .03). Blacks delayed a mean of 26.8 hours (SD = 30.3; median = 11 hours), whereas whites delayed a mean of 24.4 hours (SD = 41.7; median = 5 hours) in seeking care. Mean delay time was not significantly different for blacks and whites; differences in median delay time were of borderline significance (P = .05).***
• ***CONCLUSIONS*** ***Blacks were more likely than whites to have shortness of breath and left-sided chest pain as the presenting symptoms of coronary heart disease. Differences in delay in seeking treatment were not significant, although blacks tended to delay longer than did whites. The relatively small number of blacks may account for the lack of observed racial differences in both initial symptoms and in delay in seeking treatment. (American Journal of Critical Care. 2000;9:237-244)***

Differences between blacks and whites in mortality due to coronary heart disease (CHD) are well known.[1-7] In 1995, the mortality rates were 7% higher in black males than in white males and 35% higher in black females than in white females.[1]

The higher mortality rates in blacks have several possible explanations. First, blacks are less likely than whites to have common diagnostic and therapeutic procedures for CHD, such as angiography, angioplasty, and bypass surgery.[3,8-28] Second, when experiencing symptoms, blacks may delay longer than whites in seeking treatment. Although some[29-32] have reported that blacks delay longer than whites do, it is not clear if race is an independent predictor of delay or if other factors are involved.[31,33,34] Longer delay in seeking treatment may be due to atypical symptoms, because patients may not recognize the seriousness of their condition and may not associate these symptoms with heart problems.[35-37] According to reports, blacks are more likely than whites to have shortness of breath initially, whereas whites are more likely to have chest pain.[38-40]

Drawing conclusions from existing studies on race and both presenting symptoms and delay in seeking treatment is difficult because previous

Reprint requests: InnoVision Communications, 101 Columbia, Aliso Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050 (ext 515); fax, (949) 362-2049; e-mail, ivcReprint@aol.com.

research is scarce and often black and white comparison groups are not included in the same investigation. The purpose of this study was to explore differences between blacks and whites in both manifestation of symptoms of CHD and delay in seeking treatment for these symptoms. The specific research questions were as follows:

1. Do blacks and whites differ in the manifestation of symptoms of CHD?
2. Among patients with confirmed CHD, do blacks and whites differ in the elapsed time between the onset of symptoms and arrival at the emergency department?

Methods

Design

A prospective, observational design was used. This study was part of a larger investigation of various aspects of CHD presentation.

Sample and Setting

Data were collected in the emergency department of Yale-New Haven Hospital, an 810-bed university teaching hospital that is a regional cardiac referral center. Patients were enrolled in the study if they reported 1 or more typical or atypical symptoms suggestive of CHD and met the following inclusion criteria: (1) age 35 years or more for men and 45 years or more for women or (2) for men 18 to 34 years old and women 18 to 44 years old, diabetes or 2 or more cardiac risk factors or preexisting conditions (history of CHD, hypertension, hyperlipidemia, smoking, obesity, family history of premature CHD, and completion of menopause). Age criteria were based on the different likelihoods of CHD occurring in males and females. The age criteria of 35 years for men and 45 years for women were based on the Framingham Heart Study, which indicates that the prevalence of CHD begins to increase in men at the age of 35 and in women at the age of 45.[41] At any age, men and women with diabetes are at increased risk for CHD.[42] Additional inclusion criteria for younger patients were used to exclude patients at very low risk for CHD.

A total of 545 patients were observed. The sample used for this report consisted of 231 patients (42.4%), black and white, in whom CHD was diagnosed during the visit to the emergency department. CHD was defined as either angina or acute myocardial infarction (AMI). Angina was defined as changes on an electrocardiogram associated with ischemia, that is, T-wave inversion and ST depression or elevation in 2 or more consecutive leads, and no elevation of serum levels of cardiac enzymes. Elevated levels of cardiac enzymes (per Yale-New Haven Hospital laboratory criteria) indicated AMI.

Procedure

The study was approved by the Yale University School of Nursing and Yale-New Haven Hospital human subjects research review committee. A data collection form was developed by the investigators of the larger study and was pilot tested during a 4-month period to establish validity and reliability.

Between September of 1995 and August of 1997, during shifts of 2 to 5 hours, across all 24 hours and all 7 days, nurse data collectors unobtrusively observed patients in the emergency department and recorded the patients' descriptions of their symptoms. Data collectors listened to each patient's initial report of symptoms to a clinician. If a patient reported any of the 27 symptoms listed on the data collection form, a check was made by that symptom. If a symptom was not on the list, a check was made by "other," and the patient's description of his or her symptom was written in verbatim. All presenting symptoms were recorded and were not ranked in any way.

After the emergency department staff completed the initial assessment of a patient and the caregiving activities allowed, the data collector asked the patient for oral consent to be included in the study. If the patient was too sick to be asked for oral consent in the emergency department, the data collector obtained consent when the patient was considered in stable condition and within 24 hours of hospital admission. Only 5 patients declined to participate in the study (<1% refusal rate), and data on these patients were subsequently destroyed.

Information on race and time of onset of symptoms was obtained by patients' self-report. Patients were asked to indicate their race, and if they did not understand the question, they were shown a list of racial categories and asked to choose the category to which they belonged. This article is limited to analyses of data on black and white patients because so few patients indicated other racial groups: 3.7% Hispanic, 0% Asian, and 2.4% "other."

Data on preexisting health conditions and cardiac risk factors were gathered from each patient and from his or her medical record. Interrater agreement checks were done bimonthly during the 2 years of data collection and were always greater than 95%.

Data Analysis

Data were analyzed by using the SAS 6.11 statistical package (SAS Institute, Cary, NC). Simple descriptive statistics (percentages and measures of central

tendency and dispersion) were used to describe demographic and clinical characteristics of the sample, presenting symptoms, and delay in seeking treatment. Bivariate analyses with χ^2 and t tests were used to compare baseline characteristics between blacks and whites and to determine initial racial differences in symptom manifestation and delay times. If reported delay exceeded 1 week (n = 1) or information on delay was missing (n = 8), data on the relevant subjects were eliminated from the analysis of delay time.

When symptoms differed significantly ($P < .01$) between blacks and whites, logistic regression analysis was used to control for other factors related to the occurrence of the symptoms. An α level of .01 was chosen because of the multiple χ^2 analyses performed. Race was entered into the models, along with other demographic and clinical variables related to each symptom, by using bivariate analyses ($P < .10$). An α of .10 was selected as the cutoff to ensure that all possible factors were evaluated in the logistic regression analysis. For each symptom, results obtained with stepwise selection were confirmed by forward selection and backward elimination.

Results

The sample of 231 patients with an ultimate diagnosis of angina (66.2%) or AMI (33.8%) included 191 whites (82.7%) and 40 blacks (17.3%). More than half (58.0%) were men. Ages ranged from 31 to 91 years, with a mean of 66.5 years (SD = 14.5).

The most common presenting symptom was shortness of breath (39.8%). Next, in order, were substernal chest pain (34.2%) and arm pain (27.3%). For most presenting symptoms, differences between patients with angina and patients with AMI were not significant. Patients with AMI, however, were more likely than patients with angina to report neck pain and chest pain in a location other than the left side or substernally ($P < .05$). Thirty patients (13.2%) presented with only 1 symptom, 52 (22.8%) presented with 2 symptoms, 54 (23.7%) with 3 symptoms, 40 (17.5%) with 4 symptoms, and the remaining 52 (22.8%) with 5 or more symptoms. Three additional patients were in cardiac arrest when they arrived at the emergency department; for these 3, the existence of symptoms was unknown. The mean number of symptoms reported by patients in the sample was 3.43 (SD = 2.14), with a median of 3.

Table 1 Differences between blacks and whites in baseline characteristics

	Total sample (N = 231)		Blacks (n = 40)		Whites (n = 191)			
Characteristic	No.	%	No.	%	No.	%	χ^{2}*	P
Female sex	97	42.0	25	62.5	72	37.7	8.35	.004
Hyperlipidemia	92	39.8	9	22.5	83	43.5	6.06	.01
Hypertension	132	57.1	29	72.5	103	53.9	4.66	.03
Smoking	59	25.5	14	35.0	45	23.6	2.28	.13
Diagnosis of acute myocardial infarction	78	33.8	10	25.0	68	35.6	1.66	.20
History of coronary heart disease	163	70.6	25	62.5	138	72.3	1.51	.22
Family history of premature coronary heart disease	63	27.3	12	30.0	51	26.7	0.18	.67
Menopause, not receiving hormone replacement therapy (n = 84 women, 67 white, 17 black)	74	88.1	14	82.4	60	89.6	0.16	.69
Obesity (n = 217, 181 white, 36 black)	114	52.5	20	55.6	94	51.9	0.16	.69
History of myocardial infarction (n = 211, 174 white, 37 black)	105	49.8	19	51.4	86	49.4	0.05	.83
History of heart failure	44	19.0	8	20.0	36	18.8	0.03	.87
History of other cardiac problems (arrhythmias, cardiomyopathy)	60	26.0	10	25.0	50	26.2	0.02	.88
Diabetes	73	31.6	13	32.5	60	31.4	0.02	.89
	Mean	SD	Mean	SD	Mean	SD	t**	P
Age, years	66.5	14.5	56.7	11.8	68.6	14.2	4.94	<.001

*df = 1; **df = 229.

Table 2 Differences between blacks and whites in initial symptoms of coronary heart disease (N = 231)

	Blacks (n = 40)		Whites (n = 191)			
Symptom	No.	%	No.	%	χ^{2}*	*P*
Left-sided chest pain	14	35.0	28	14.7	9.20	.002
Shortness of breath	24	60.0	68	35.6	8.21	.004
Nausea/vomiting	14	35.0	38	19.9	4.33	.04
Midback pain	0	0	18	9.4	2.88	.09
Palpitations	5	12.5	10	5.24	2.87	.09
Jaw pain	15	37.5	0	0	2.19	.14
Diaphoresis	13	32.5	45	23.6	1.41	.24
Burning in chest	4	10.0	9	4.7	0.89	.35
Epigastric discomfort	8	20.0	29	15.2	0.57	.45
Chest pressure	6	15.0	36	18.8	0.33	.57
Dizziness	7	17.5	28	14.7	0.21	.65
Neck pain	2	5.0	16	8.4	0.16	.69
Arm pain	10	25.0	53	27.7	0.13	.72
Substernal chest pain	13	32.5	66	34.6	0.06	.80
Chest heaviness	4	10.0	14	7.3	0.06	.80
Tightness/squeezing in chest	5	12.5	22	11.5	0.03	.86
Shoulder pain	5	12.5	25	13.1	0.01	.92
Fatigue	4	10.0	23	12.0	0.01	.92

*df = 1.

The time from the onset of symptoms to arrival in the emergency department ranged from 15 minutes to 1 week, with a mean of 24.8 hours (SD = 40.1) and a median of 6 hours. Data on delay time could not be determined for 9 subjects.

Baseline characteristics of blacks and whites were compared in an attempt to account for potential differences in presenting symptoms and in delay time (Table 1). Blacks were significantly more likely to be female and to have a history of hypertension. On the other hand, whites were more likely to have hyperlipidemia. Additionally, blacks were significantly younger than whites. Differences between blacks and whites for the other characteristics examined were not significant.

Racial Differences in the Manifestation of Symptoms of CHD

Differences between blacks and whites in initial symptoms are shown in Table 2. Symptoms reported by more than 5% of the sample were included in this analysis. Blacks were significantly more likely than whites to have left-sided chest pain (P = .002) and shortness of breath (P = .004). Differences between blacks and whites in other presenting symptoms, including substernal chest pain, were not significant.

Logistic regression analyses were used to determine if racial differences persisted in the occurrence of left-sided chest pain and shortness of breath after controlling for other factors (Tables 3 and 4). For both left-sided chest pain and shortness of breath, race remained in the final logistic models. After controlling for other relevant factors, blacks were approximately 2 times more likely than whites to have left-sided chest pain and 3 times more likely to have shortness of breath.

Racial Differences in Delay in Seeking Treatment

Mean time from the onset of symptoms to arrival in the emergency department was similar in blacks and whites (Table 5). Data on delay time were positively skewed because a number of subjects delayed seeking care for a long time (19 delayed 72 hours or more). Even after a log transformation was carried

Table 3 Predictors of left-sided chest pain in final logistic regression model*

Predictor	Standardized estimate	*P*	Adjusted odds ratio	95% CI
Younger age	.313	.006	NA	NA
Black race	.197	.03	2.55	1.10-5.91

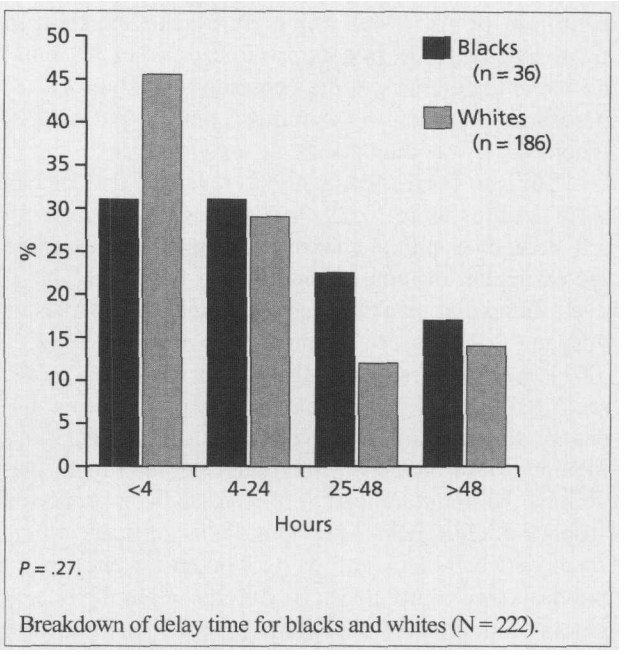
* Model obtained by stepwise selection and confirmed by forward selection and backward elimination. Goodness-of-fit statistic P = .5743. Additional variables entered, but not retained in final model: history of myocardial infarction, history of heart failure, family history of premature (<55 years old) coronary heart disease, and history of coronary heart disease.

NA indicates not applicable.

Table 4 Predictors of shortness of breath in final logistic regression model*

Predictor	Standardized estimate	P	Adjusted odds ratio	95% CI
History of heart failure	.423	.001	7.04	3.16-15.63
Black race	.241	.003	3.16	1.49-6.71
History of arrhythmias or cardiomyopathy	.167	.04	1.99	1.02-3.88

* Model obtained by stepwise selection and confirmed by forward selection and backward elimination. Goodness-of-fit statistic $P = .4339$. Additional variables entered, but not retained in final model: diabetes, sex, hyperlipidemia, and history of coronary heart disease.



Breakdown of delay time for blacks and whites (N = 222).

out, the *t* test still did not show significant racial differences. However, when we examined median delay times, the median time to arrival at the emergency department after the onset of symptoms was 11 hours for blacks and only 5 hours for whites. This difference was of borderline significance ($P = .05$).

Consistent with preceding analyses, a larger percentage of whites delayed less than 4 hours, whereas a larger percentage of blacks delayed more than 24 hours (see Figure). These differences were not significant ($\chi^2 = 3.961$; $df = 3$; $P = .27$).

Discussion

The final sample for this study consisted of 191 whites and 40 blacks. The proportion of blacks (17.3%) is lower than that reported by the hospital for all diagnoses (34%). This underrepresentation of blacks in our sample may be due to a lower prevalence of CHD and higher out-of-hospital mortality due to CHD in blacks.[1,2,5,6]

In our sample, a significantly higher proportion of blacks than whites were female. This finding is consistent with a higher prevalence of CHD in black women than in white women.[1] The mean age was significantly younger in blacks than in whites, a finding that is also consistent with previously reported research.[17,21,33,38,43,44] As others[21,33,36,43-49] have found, blacks were more likely than whites to have a history of hypertension. On the other hand, whites were more likely than blacks to have hyperlipidemia. Previously reported data on racial differences in the occurrence of hyperlipidemia are conflicting.[1,2,21,33,36,43-45,47]

Although racial differences for other cardiac risk factors, such as smoking, obesity, and diabetes, have been reported,[1,33,36,45] we found no statistically significant differences between blacks and whites for any other risk factors. The relatively small number of blacks in our study (n = 40) may account for the lack of observed differences in risk factors and did not permit examination of race-sex groupings.

Table 5 Differences between blacks and whites in delay time (hours) before arrival at emergency department (N = 222)

Race	Mean	SD	P (*t* test)	Median	P (median test)
Black	26.8	30.3	.69	11	.05
White	24.4	41.7		5	

Manifestation of Symptoms of CHD

In our study, blacks were significantly more likely than whites to present with shortness of breath and left-sided chest pain. Logistic regression analysis revealed that blacks were 3 times more likely than whites to present with shortness of breath. Others[38-40] also reported that blacks experience shortness of breath more often than do whites. Perkoff and Strand[40] found that dyspnea was more than twice as likely ($P < .01$) to be the presenting symptom of AMI in blacks (31.2%) than in whites (12.3%). On the other hand, whites more often presented with chest pain (64% vs 40%, $P < .01$). Neill[39] also reported that the prevalence of shortness of breath as the presenting

symptom of AMI was higher in black men than in white men (P=.05). In contrast, Raczynski et al[36] found no racial differences in the occurrence of shortness of breath as a presenting symptom among patients in whom CHD was diagnosed.

Logistic regression analysis revealed that blacks were 2 times more likely than whites to present with left-sided chest pain. Other researchers did not examine the particular location of chest pain. Clark et al,[38] however, found that blacks were more likely than whites or Hispanics (22.7%, 9.1%, and 4.9%, respectively; $P <$ .001) to present without chest pain. Griffiths et al[47] reviewed medical record data on 46 women with a discharge diagnosis of AMI. Unlike our study, their study included only patients with AMI, excluded men, and defined the initial indication of AMI as the presence or absence of chest pain. They found no significant differences between black and white women for chest pain. Similarly, we found no racial differences in the occurrences of all types of chest pain, except left-sided chest pain. In both their study and ours, the lack of observed racial differences for chest pain may be due to the relatively small sample sizes.

Racial differences in coronary anatomy and the presence and extent of certain risk factors[50] may explain the differences that we observed between blacks and whites in manifestation of symptoms of CHD. For example, blacks are less likely than whites to have obstructive coronary disease and, instead, have diffuse multivessel disease.[43,44,48,49,51,52] Additionally, blacks are more likely than whites to have hypertension, with subsequent left ventricular hypertrophy.[43,44,47,49] In patients with left ventricular hypertrophy, symptoms of heart failure, such as shortness of breath, may develop in response to only minor impedance of oxygen supply from the coronary vasculature. Therefore, hypertension and left ventricular hypertrophy may be responsible for the shortness of breath that blacks are likely to experience during an ischemic event. Although information on left ventricular hypertrophy was not available on the subjects in our sample, the association between hypertension and shortness of breath was not significant (P = .35). The etiology of the increased prevalence of left-sided chest pain in blacks in our study is unclear.

Although we found differences between blacks and whites in the occurrence of shortness of breath and left-sided chest pain, these symptoms did not necessarily occur in the absence of other symptoms. In fact, a majority of patients (146 of 228 or 64.0%) had 3 or more symptoms when they arrived at the emergency department. This finding suggests that blacks and whites may be more similar than different in the initial manifestations of CHD.

Delay in Seeking Treatment

A number of investigators[17,29-32] have evaluated race and delay in seeking treatment for symptoms suggestive of CHD (Table 6). In our study, the mean time from onset of symptoms to arrival at the emergency department was 26.8 hours (SD = 30.3 hours) for blacks and 24.4 hours (SD = 41.7 hours) for whites. This difference was not significant, even after a log transformation of the data was done. However, the median delay time was 11 hours for blacks and 5 hours for whites (P = .05). Most studies that examined differences in delay time reported median times because of the number of outliers who delay seeking care for extended times.[17,29-32]

Studies[29-32] that examined delay in seeking treatment in blacks with symptoms of cardiac disease reported shorter delay times than those we found. Most of these studies did not evaluate racial differences in delay time, but rather compared their results with those of investigations examining delay in whites. In addition, some[29] included only patients with AMI, and others[30,32] reported separate results for patients with AMI and those in whom myocardial infarction was ruled out. Methodological differences make comparisons across studies difficult. Longer delay times in our investigation may be a reflection of grouping together subjects with AMI and subjects with angina. For example, mean and median delay times for patients with chest pain but no AMI reported by Ghali et al[32] are similar to the delay times we found in blacks with angina or AMI. Additionally, a majority of subjects (70.6%) had a history of CHD. Although previous experience with symptoms of cardiac disease is often thought to decrease delay time, studies[53-55] have shown that such experience has no effect.

In an Australian-based study of 317 patients, predominantly whites, who had AMI,[56] delay time was significantly increased when patients presented with heartburn, breathlessness, and intermittent symptoms. In our sample, experiencing shortness of breath was not related to delay in seeking treatment (P = .22). Dracup et al[56] further reported that patients delayed longer when the patients attributed their symptoms to a cause other than cardiac disease. Although Raczynski et al[36] did not find racial differences in manifestation of symptoms of CHD, they did report that blacks were significantly less likely than whites to attribute pain to a cardiac origin.

Strengths and Limitations

Several strengths and limitations influence interpretation of our findings. First, our prospective design is a strength. Unlike other studies in which data were collected by chart review or by questioning patients

Table 6 Findings of studies evaluating delay (hours) in seeking treatment for symptoms suggestive of coronary heart disease

Authors (year)	Sample	Blacks		Whites	
		Mean	Median	Mean	Median
Current study	191 whites and 40 blacks with angina or acute myocardial infarction	26.8	11*	24.4	5*
Clark et al[29] (1992)	236 blacks and 30 whites with suspected myocardial infarction	13.1*	3	3.3*	2
Cooper et al[30] (1986)	111 blacks with myocardial infarction	22.7	6	NA	NA
	87 blacks with myocardial infarction ruled out	21.0	6.9	NA	NA
Ell et al[31] (1994)	448 blacks with acute chest pain	14.9	2.7	NA	NA
Ghali et al[32] (1993) (81% of total sample were black)	24 minority and disadvantaged patients with myocardial infarction	11.3	4.6	NR	NR
	50 minority and disadvantaged patients with myocardial infarction ruled out	20.5	10.4	NR	NR
Johnson et al[17] (1993)	77 blacks and 206 whites with myocardial infarction	NR	6	NR	3

*$P \leq .05$.

NA indicates not applicable; NR, not reported.

after the patients had been admitted to the coronary care unit, we collected data by directly observing patients in the emergency department. This method of collecting data should maximize the accuracy of the reporting of symptoms and minimize the potential effect of recall bias on reporting of symptoms and delay time. Additionally, patients who died or were not admitted to the coronary care unit could be included. Unlike some other studies, our study included both blacks and whites, so direct comparisons could be made. Also, race was determined by patients' self-report rather than by simple observation of skin color, thus enhancing accuracy. Last, we considered all types of symptoms suggestive of CHD, not just chest pain.

Our study is limited by several factors. Because so few subjects categorized themselves as members of other racial or ethnic groups, we had to confine our analyses to blacks and whites. Therefore, our findings are not generalizable to more ethnically diverse populations. The relatively small percentage of blacks (only 17.3%) may account for the lack of observed racial differences for most of the symptoms, as well as delay time. Also, our relatively small sample size precluded us from evaluating sex and race groupings and from examining angina and AMI separately. Other factors have been implicated in delay time. We did not have access to such potentially important data as socioeconomic status.

In summary, our data indicate that blacks were more likely than whites to present with left-sided chest pain and shortness of breath as initial symptoms of CHD. Racial differences in the elapsed time between onset of symptoms and arrival at the emergency department were not statistically significant, although blacks tended to delay seeking treatment longer than whites did. Educating clinicians and the public about shortness of breath as a presenting symptom of CHD, especially in blacks, is warranted.

ACKNOWLEDGMENTS

We thank the following people for their assistance with this work: Rebekah Mull Wilmes, MSN, APRN; Joanne Sullivan, MSN, APRN; Rebecca Henry, RN, MSN; Veronica Carlevale, MSN, APRN; Joseph Filakovsky, RN, MSN; Christy Bebon, MSN, APRN; Janice Naum, MSN, APRN; Deborah Chyun, RN, PhD; Nancy Lorenze, RN, MSN; the staff of the Yale-New Haven Hospital Emergency Department; and the patients who were so willing to be part of this study.

REFERENCES

1. American Heart Association. *1998 Heart and Stroke Facts: Statistical Supplement.* Dallas, Tex: American Heart Association; 1998.
2. Gillum RF. Coronary heart disease in black populations, I: mortality and morbidity. *Am Heart J.* 1982;104:839-851.
3. Gillum RF. Coronary artery bypass surgery and coronary angiography in the United States, 1979-1983. *Am Heart J.* 1987;113:1255-1260.
4. Gillum RF. Trends in acute myocardial infarction and coronary heart disease death in the United States. *J Am Coll Cardiol.* 1993:23:1273-1277.
5. Keil JE, Loadholt CB, Weinrich MC, Sandifer SH, Boyle E Jr. Incidence

of coronary heart disease in blacks in Charleston, South Carolina. *Am Heart J.* 1984;108:779-786.
6. Keil JE, Saunders DE Jr, Lackland DT, et al. Acute myocardial infarction: period prevalence, case fatality, and comparison of black and white cases in urban and rural areas of South Carolina. *Am Heart J.* 1985;109:776-784.
7. Tofler GH, Stone PH, Muller JE, et al. Effects of gender and race on prognosis after myocardial infarction: adverse prognosis for women, particularly black women. *J Am Coll Cardiol.* 1987;9:473-482.
8. Ayanian JZ, Udvarhelyi S, Gatsonis CA, Pashos CL, Epstein AM. Racial differences in the use of revascularization procedures after coronary angiography. *JAMA.* 1993;269:2642-2646.
9. Carlisle DM, Leake BD, Shapiro MF. Racial and ethnic disparities in the use of cardiovascular procedures: associations with type of health insurance. *Am J Public Health.* 1997;87:263-267.
10. Ferguson JA, Tierney WM, Westmoreland GR, et al. Examination of racial differences in management of cardiovascular disease. *J Am Coll Cardiol.* 1997;30:1707-1713.
11. Ford E, Cooper R, Castaner A, Simmons B, Mar M. Coronary arteriography and coronary bypass surgery among whites and other racial groups relative to hospital-based incidence rates for coronary artery disease: findings from NHDS. *Am J Public Health.* 1989;79:437-440.
12. Funk M, Ostfeld AM, Chang V, Lee FA. Racial differences in the use of coronary angiography and coronary revascularization procedures in patients with acute myocardial infarction [abstract]. *Circulation.* 1992;86(suppl):I-99.
13. Giles WH, Anda RF, Casper ML, Escobedo LG, Taylor HA. Race and sex differences in rates of invasive cardiac procedures in US hospitals: data from the National Hospital Discharge Survey. *Arch Intern Med.* 1995;155:318-324.
14. Goldberg KC, Hartz AJ, Jacobsen SJ, Krakauer H, Rimm AA. Racial and community factors influencing coronary artery bypass graft surgery rates for all 1986 Medicare patients. *JAMA.* 1992;267:1473-1477.
15. Gornick ME, Eggers PW, Reilly TW, et al. Effects of race and income on mortality and use of services among Medicare beneficiaries. *N Engl J Med.* 1996;335:791-799.
16. Hannan EL, Kilburn H Jr, O'Donnell JF, Lukacik G, Shields EP. Interracial access to selected cardiac procedures for patients hospitalized with coronary artery disease in New York State. *Med Care.* 1991;29:430-441.
17. Johnson PA, Lee TH, Cook EF, Rouan GW, Goldman L. Effect of race on the presentation and management of patients with acute chest pain. *Ann Intern Med.* 1993;118:593-601.
18. Maynard C, Fisher LD, Passamani ER, Pullum T. Blacks in the Coronary Artery Surgery Study (CASS): race and clinical decision making. *Am J Public Health.* 1986;76:1446-1448.
19. Maynard C, Litwin PE, Martin JS, et al. Characteristics of black patients admitted to coronary care units in metropolitan Seattle: results from the Myocardial Infarction Triage and Intervention Registry (MITI). *Am J Cardiol.* 1991;67:18-23.
20. Mitchell JB, Khandker RK. Black-white treatment differences in acute myocardial infarction. *Health Care Financ Rev.* Winter 1995;17:61-70.
21. Oberman A, Cutter G. Issues in the natural history and treatment of coronary heart disease in black populations: surgical treatment. *Am Heart J.* 1984;108:688-694.
22. Peterson ED, Wright SM, Daley J, Thibault GE. Racial variation in cardiac procedure use and survival following acute myocardial infarction in the Department of Veterans Affairs. *JAMA.* 1994;271:1175-1180.
23. Peterson ED, Shaw LK, DeLong ER, Pryor DB, Califf RM, Mark DB. Racial variation in the use of coronary-revascularization procedures: are the differences real? do they matter? *N Engl J Med.* 1997;336:480-486.
24. Schulman KA, Berlin JA, Harless W, et al. The effect of race and sex on physicians' recommendations for cardiac catheterization. *N Engl J Med.* 1999;340:618-626.
25. Stone PH, Thompson B, Anderson HV, et al. Influence of race, sex, and age on management of unstable angina and non-Q-wave myocardial infarction: the TIMI III Registry. *JAMA.* 1996;275:1104-1112.
26. Udvarhelyi IS, Gatsonis C, Epstein AM, Pashos CL, Newhouse JP, McNeil BJ. Acute myocardial infarction in the Medicare population: process of care and clinical outcomes. *JAMA.* 1992;268:2530-2536.
27. Wenneker MB, Epstein AM. Racial inequalities in the use of procedures for patients with ischemic heart disease in Massachusetts. *JAMA.* 1989;261:253-257.
28. Whittle J, Conigliaro J, Good CB, Lofgren RP. Racial differences in the use of invasive cardiovascular procedures in the Department of Veterans Affairs medical system. *N Engl J Med.* 1993;329:621-627.
29. Clark LT, Bellam SV, Shah AH, Feldman JG. Analysis of prehospital delay among inner-city patients with symptoms of myocardial infarction: implications for therapeutic intervention. *J Natl Med Assoc.* 1992;84:931-937.
30. Cooper RS, Simmons B, Castaner A, Prasad R, Franklin C, Ferlinz J. Survival rates and prehospital delay during myocardial infarction among black persons. *Am J Cardiol.* 1986;57:208-211.
31. Ell K, Haywood LJ, Sobel E, deGuzman M, Blumfield D, Ning JP. Acute chest pain in African-Americans: factors in the delay in seeking emergency care. *Am J Public Health.* 1994;84:965-970.
32. Ghali JK, Cooper RS, Kowatly I, Liao Y. Delay between onset of chest pain and arrival to the coronary care unit among minority and disadvantaged patients. *J Natl Med Assoc.* 1993;85:180-184.
33. Crawford SL, McGraw SA, Smith KW, McKinlay JB, Pierson JE. Do blacks and whites differ in their use of health care for symptoms of coronary heart disease? *Am J Public Health.* 1994;84:957-964.
34. Dracup K, Moser DK, Eisenberg M, Meischke H, Alonzo AA, Braslow A. Causes of delay in seeking treatment for heart attack symptoms. *Soc Sci Med.* 1995;40:379-392.
35. Johnson JA, King KB. Influence of expectations about symptoms on delay in seeking treatment during a myocardial infarction. *Am J Crit Care.* 1995;4:29-35.
36. Raczynski JM, Taylor H, Cutter G, Hardin M, Rappaport N, Oberman A. Diagnoses, symptoms, and attribution of symptoms among black and white inpatients admitted for coronary heart disease. *Am J Public Health.* 1994;84:951-956.
37. Uretsky BF, Farquhar DS, Berezin AF, Hood WB. Symptomatic myocardial infarction without chest pain: prevalence and clinical course. *Am J Cardiol.* 1977;40:498-503.
38. Clark LT, Adams-Campbell LL, Maw M, Bridges D, Kline G. Effects of race on the presenting symptoms of myocardial infarction [abstract]. *Circulation.* 1989;80(suppl):II-300.
39. Neill KM. Ethnic pain styles in acute myocardial infarction. *West J Nurs Res.* 1993;15:531-547.
40. Perkoff GT, Strand M. Race and presenting complaints in myocardial infarction [letter to the editor]. *Am Heart J.* 1973;85:716-717.
41. Lerner DJ, Kannel WB. Pattern of coronary heart disease morbidity and mortality in the sexes: a 26-year follow-up of the Framingham population. *Am Heart J.* 1986;111:383-390.
42. Barrett-Connor EL, Cohn BA, Wingard DL, Edelstein SL. Why is diabetes mellitus a stronger risk factor for fatal ischemic heart disease in women than in men? The Rancho Bernardo Study. *JAMA.* 1991;265:627-631.
43. Maynard C, Fisher LD, Passamani ER, Pullum T. Blacks in the Coronary Artery Surgery Study: risk factors and coronary artery disease. *Circulation.* 1986;74:64-71.
44. Scott NA, Kelsey SF, Detre K, Cowley M, King SB III, the NHLBI PTCA Registry Investigators. Percutaneous transluminal coronary angiography in African-American patients (The National Heart, Lung, and Blood Institute 1985-1986 Percutaneous Transluminal Coronary Angioplasty Registry). *Am J Cardiol.* 1994;73:1141-1146.
45. Maynard C, Fisher LD, Passamani ER. Survival of black persons compared with white persons in the Coronary Artery Surgery Study (CASS). *Am J Cardiol.* 1987;60:513-518.
46. Cannistra LB, O'Malley CJ, Balady GJ. Comparison of outcome of cardiac rehabilitation in black women and white women. *Am J Cardiol.* 1995;75:890-893.
47. Griffiths DH, Pokorny ME, Bowman JM. Differences in African American and white women with myocardial infarction: history, presentation, diagnostic methods, and infarction type. *Am J Crit Care.* 1999;8:101-104.
48. Haywood LJ. Coronary heart disease mortality/morbidity and risk in blacks, I: clinical manifestations and diagnostic criteria: the experience with the Beta Blocker Heart Attack Trial. *Am Heart J.* 1984;108:787-793.
49. Simmons BE, Castner A, Campo A, Ferlinz J, Mar M, Cooper R. Coronary artery disease in blacks of lower socioeconomic status: angiographic findings from the Cook County Hospital Heart Disease Registry. *Am Heart J.* 1988;116:90-97.
50. Lee HO. Typical and atypical clinical signs and symptoms of myocardial infarction and delayed seeking of professional care among blacks. *Am J Crit Care.* 1997;6:7-13.
51. Cooper RS, Ghali JK. Coronary heart disease: black-white differences. In: Saunders E, ed. *Cardiovascular Diseases in Blacks.* Philadelphia, Pa: FA Davis; 1991:205-225.
52. Simmons BE, Castaner A, Mar M, Islam N, Cooper R. Survival determinants in black patients with angiographically defined coronary artery disease. *Am Heart J.* 1990;119:513-519.
53. Weilgosz ATJ, Nolan RP, Earp JA, Biro E. Reasons for patients' delay in response to symptoms of acute myocardial infarction. *Can Med Assoc J.* 1988;139:853-857.
54. Turi ZG, Stone PH, Muller JE, et al. Implications for acute intervention related to time of hospital arrival in acute myocardial infarction. *Am J Cardiol.* 1986;58:203-209.
55. Dracup K, Moser DK. Treatment-seeking behavior among those with signs and symptoms of acute myocardial infarction. *Heart Lung.* 1991;20:570-575.
56. Dracup K, McKinley SM, Moser DK. Australian patients' delay in response to heart attack symptoms. *Med J Aust.* 1997;166:233-236.