

# CAUSES OF CHEST PAIN AND SYMPTOMS SUGGESTIVE OF ACUTE CARDIAC ISCHEMIA IN AFRICAN-AMERICAN PATIENTS PRESENTING TO THE EMERGENCY DEPARTMENT: A MULTICENTER STUDY

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This study examines whether race is a significant determinant of the diagnoses of acute myocardial infarction or angina pectoris in patients with symptoms suggestive of acute cardiac ischemia. The study population was comprised of 3401 (34%) African-American and 6600 (66%) white patients who presented to emergency departments with symptoms suggestive of acute cardiac ischemia. The main outcome measure was a diagnosis of acute myocardial infarction or angina pectoris.

African Americans were younger, predominantly female, and more often had hypertension, diabetes mellitus, or smoked. The diagnosis of acute myocardial infarction was confirmed in 6% of African-American and 12% of white men, and in 4% of African-American and 8% of white women. After adjusting for age, gender, medical history, signs and symptoms, and hospital, African Americans were half as likely to develop acute myocardial infarction and were 60% as likely to have acute cardiac ischemia. Despite having less acute cardiac ischemia, African Americans in this study had high risk levels for coronary artery disease. (*J Natl Med Assoc.* 1997;89:665-671.)

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**Key words:** cardiac ischemia ♦ race ♦ angina  
♦ African Americans

African Americans have high levels of risk factors for coronary artery disease but how this find-

ing influences diagnosis in patients presenting to the emergency department with chest pain is not well understood.<sup>1,2</sup> Investigators from the Multicenter Chest Pain Study found no significant differences in the presentation, natural history, or final diagnosis of acute myocardial infarction between African-American and white individuals who presented to two emergency departments with acute chest pain.<sup>3</sup> Such studies have included only patients with chest pain and not those with left arm pain, upper abdominal pain, shortness of breath, dizziness, or other symptoms consistent with acute cardiac ischemia. The inclusion of these patients may complicate diagnostic and therapeutic decision making.

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Evaluating chest pain and establishing the diagnosis of coronary heart disease in African Americans are often difficult given the presence of excess hypertension and left ventricular hypertrophy and the increased occurrence of out-of-hospital cardiac arrest in African Americans.<sup>4,7</sup> Furthermore, the paradoxical finding of severe chest pain without significant angiographic coronary artery disease complicates diagnosis and treatment of African Americans with symptoms suggestive of acute cardiac ischemia.<sup>1,4</sup>

This study examines whether race is a significant determinant of acute myocardial infarction or angina pectoris in patients with symptoms suggestive of acute cardiac ischemia. There is an important need for further understanding of the evaluation of chest pain and other symptoms of acute cardiac ischemia in African Americans presenting to the emergency department.

## MATERIALS AND METHODS

### Patient Population

Presenting with chest or left arm pain, shortness of breath, or other symptoms suggestive of acute cardiac ischemia, 10,673 individuals  $\geq 30$  years of age were enrolled in the Acute Cardiac Ischemia Time-Insensitive Predictive Instrument (ACI-TIPI) Clinical Trial during 7 consecutive months in 1993. The 10 hospitals in the East and Midwest that participated in the study were: Baystate Medical Center, Boston City Hospital, Medical College of Virginia, Medical College of Wisconsin, New England Medical Center, Newton-Wellesley Hospital, Rhode Island Hospital, University of Cincinnati, Boston University Hospital, and University of North Carolina. The ACI-TIPI Trial, a randomized controlled trial, evaluated a predictive model to aid clinical decision making for emergency department triage.<sup>8</sup> Patients with chest pain or discomfort related to trauma, a surgical emergency, or clear noncardiac cause were excluded as were patients transferred from other institutions.

Of the 10,673 patients enrolled in the ACI-TIPI Trial, 6600 (62%) were white, 3401 (32%) were African American, 517 (5%) were Hispanic, 75 (0.7%) were Asian, and 46 (0.4%) were of other races; race was unknown for 34 (0.3%) patients. For purposes of this analysis, only white and African-American patients (94% of all patients) were included. To determine the inclusiveness of enrollment, study personnel reviewed all emergency department records. The overall inclusion rate was 92% as was the inclusion rate for African-American and white patients and for women and men.

### Study Variables

Study personnel prospectively collected extensive demographic, medical history, and clinical information for each patient. Demographic variables were age, gender, race or ethnicity, marital status, and health insurance status. The time from symptom onset to arrival to the emergency department as well as the mode of arrival were recorded. Prior medical histories also were noted and included history of ulcer disease, systemic hypertension, angina pectoris, myocardial infarction, stroke, diabetes mellitus, cigarette smoking, and use of cardiac medications. Upon presentation to the emergency department, specific signs and symptoms were recorded prospectively and included:

- chest pain,
- shortness of breath,
- upper abdominal pain,
- nausea,
- vomiting,
- dizziness, and
- fainting.

The first systolic and diastolic blood pressures were indicated as were the presence of rales and S3 gallop on physical examination and congestive heart failure on chest radiograph.

The study site investigator reviewed all records and assigned a final diagnosis according to World Health Organization criteria for acute myocardial infarction. The final diagnosis was based on the admission and discharge electrocardiograms and creatine kinase and creatine kinase muscle brain serum tests done during the first 72 hours. The 30 categories that comprised the final diagnosis were listed under four major headings:

- acute myocardial infarction,
- angina pectoris,
- cardiac nonischemic, and
- noncardiac.

Patients with acute myocardial infarction were classified according to Killip Class,<sup>9</sup> and for patients with angina pectoris, the severity of chest pain was categorized according to the Canadian Cardiovascular Society classification of angina.<sup>10</sup>

### Statistical Analysis

The chi-square and two sample *t*-tests were used to compare baseline characteristics in white and African-American patients. To compare the time from symptom onset to emergency department arrival for white and African-American men and

Table 1. Demographic Characteristics

Variable	Men			Women		
	% White*	% African American†	P	% White‡	% African American§	P
Age (years)	60±15	52±14	<.0001	65±16	55±15	<.0001
Marital status			<.0001			<.0001
Single	15	40		12	30	
Married	66	32		41	23	
Divorced	11	20		13	24	
Widowed	2	6		34	23	
Health insurance			<.0001			<.0001
Self, uninsured	15	33		12	26	
Medicaid	6	23		8	24	
Medicare	44	28		56	33	
Hospital			<.0001			<.0001
1	20	3		17	5	
2	2	12		2	12	
3	3	3		3	4	
4	4	20		4	23	
5	9	23		9	16	
6	5	2		4	2	
7	12	4		14	<1	
8	30	6		31	6	
9	7	22		8	26	
10	7	8		7	8	
Time from symptom onset to ED arrival	2.0 (1.0, 7.4)	3.0 (0.8, 12.0)	.0006	3.0 (1.0, 9.0)	3.3 (1.0, 14.0)	.045

Abbreviations: ED=emergency department.  
 \*n=3655.  
 †n=1491.  
 ‡n=2944.  
 §n=1910.  
 ||Median time in hours. Numbers in parentheses are 25th and 75th percentiles.

women, the Wilcoxon rank sum test was used. The association between race and time from symptom onset to emergency department arrival was examined with multivariable linear regression.

Stepwise logistic regression was used in the following way to assess the association of race with final diagnosis: all variables (sociodemographic, medical histories, signs and symptoms, and hospital) were considered for selection. Race was forced into the model to determine its association with final diagnosis, after the selected variables entered the model ( $P<.05$ ). The dependent variable, final diagnosis, was defined as 1) acute myocardial infarction or 2) acute cardiac ischemia, which included the categories acute myocardial infarction and angina pectoris.

## RESULTS

### Sociodemographic

Of the 10,001 white and African-American patients enrolled in the ACI-TIPI Trial, 3401 (34%) were African American; 56% of African Americans were women, compared with 45% of white patients. On average, African-American men were 8 years younger than their white counterparts, and African-American women were 10 years younger than white women (Table 1). In addition to being younger, African Americans were more likely to be single or divorced, and this was true for both women and men. A significantly higher proportion of African Americans were without health insurance and were not eligible for Medicare due to their relative youth.

Hospitals that participated in the trial were locat-

**Table 2. Medical History and Clinical Characteristics**

Variable	Men			Women		
	% White*	% African American†	P	% White‡	% African American§	P
<b>Medical history</b>						
Ulcer	16	16	.74	14	14	.73
Hypertension	44	57	<.0001	51	64	<.0001
Angina	42	29	<.0001	39	32	<.0001
Myocardial infarction	35	20	<.0001	26	18	<.0001
Stroke	8	9	.47	9	9	.85
Diabetes	20	20	.88	23	32	<.0001
Current smoker	30	56	<.0001	24	34	<.0001
Cardiac medications	59	47	<.0001	64	60	.01
<b>Signs and symptoms</b>						
Chest pain	75	77	.20	72	79	<.0001
Chest pain as primary symptom	70	69	.49	64	69	.0002
Shortness of breath	51	62	<.0001	55	61	<.0001
Abdominal pain	12	20	<.0001	13	17	<.0001
Nausea	24	28	.01	29	35	<.0001
Vomiting	7	13	<.0001	10	14	<.0001
Dizziness	26	35	<.0001	26	33	<.0001
Fainting	7	6	.32	7	5	.001
Rales	20	19	.14	25	19	<.0001
S3 sound	3	4	.013	3	3	.74
Congestive heart failure	16	16	.65	18	15	.019
Systolic blood pressure >160	23	21	.29	28	28	.45
Diastolic blood pressure >90	28	36	<.0001	23	34	<.0001

\*n=3655.  
 †n=1491.  
 ‡n=2944.  
 §n=1910.

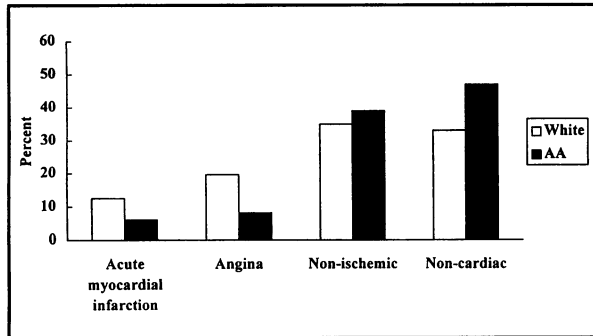
ed in major metropolitan areas and smaller cities in the eastern and midwestern regions of the United States. The proportion of patients who were African Americans ranged from 2% at a suburban hospital to 74% at a large municipal hospital. Several hospitals were located in urban areas where the majority of residents were African Americans.

The median time from symptom onset to hospital arrival or delay time was 1 hour longer for African-American men and 18 minutes longer for African American women (Table 1). In general, women had longer delay times than men although delay times for African Americans and white women were similar. White men had the shortest median delay and the least variability in delay as indicated by values for the

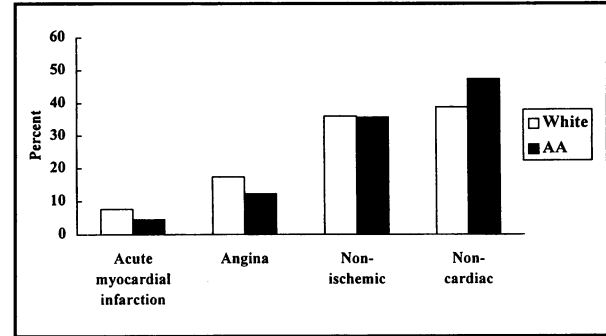
25th and 75th percentiles. After adjustment for variables in Tables 1 and 2 by linear regression, there was no longer a statistically significant association between race and delay time for men ( $P=.23$ ). However, among the women, African-American women continued to have longer delay times even after adjustment for covariates ( $P=.001$ ).

**Medical Histories and Signs and Symptoms**

There were considerable racial differences with respect to medical histories (Table 2). A higher proportion of both male and female African Americans had hypertension and were current smokers. Among the women, a higher proportion of African Americans had diabetes. However, white patients



**Figure 1.** Final diagnosis for white and African-American (AA) men. There was a statistically significant association between race and final diagnosis ( $P < .0001$ ).



**Figure 2.** Final diagnosis for white and African-American (AA) women. There was a statistically significant association between race and final diagnosis ( $P < .0001$ ).

more often had histories of angina, myocardial infarction, and use of cardiac medications.

Concerning symptoms on admission, an equal proportion of African-American and white men had chest pain in the emergency department and chest pain as the primary symptom (Table 2). However, this was not the case for women in that a higher proportion of African-American women had chest pain in the emergency department and chest pain as the primary symptom. In addition, a higher proportion of African-American men and women had additional symptoms including shortness of breath, abdominal pain, nausea, vomiting, and dizziness. Finally, the result that African Americans more often had diastolic blood pressure  $>90$  mm Hg on admission is consistent with the finding of more previous systemic hypertension.

### Diagnosis

For both women and men, there were marked racial differences with respect to final diagnosis (Figures 1 and 2). The diagnosis of acute myocardial infarction was established in 6% of African-American and 12% of white men and the diagnosis of angina pectoris in 8% and 20% of African-American and white men, respectively. Consequently, only 14% of African-American men had chest pain or other symptoms due to acute cardiac ischemia, while 32% of white men did. Noncardiac diagnoses were established in almost half of African American and one third of white men. Cardiac nonischemic diagnoses were established in 39% and 35% of African-American and white men, respectively.

Similarly, only 4% of African-American women

had a final diagnosis of acute myocardial infarction, whereas 8% of white women did. The diagnosis of angina pectoris was established in 12% and 17% of African American and white women, respectively. Chest pain and other symptoms were attributed to acute cardiac ischemia in 16% of African-American and 25% of white women. As with their male counterparts, almost half of African-American women had noncardiac diagnoses, while 39% of white women did. Cardiac nonischemic diagnoses were established in 36% of both groups.

While there were distinct racial differences in final diagnosis, among those men and women who developed acute myocardial infarction, there were no racial differences in severity as measured by Killip Class. Similarly, among men and women with angina, there were no racial differences with respect to severity as measured by the Canadian Cardiovascular Society classification.

To more fully examine the association between race and final diagnosis, logistic regression was used in 7366 patients (74%) with complete information. After variables in Tables 1 and 2 were allowed to enter the logistic model, both African-American men and women were still less likely to develop acute myocardial infarction or acute cardiac ischemia. After adjustment for sociodemographic characteristics, medical history variables, signs and symptoms, and hospital, African Americans were half as likely as white patients to develop acute myocardial infarction (odds ratio=0.54, 95% confidence interval=0.41, 0.68). In a similar manner, African Americans were 60% as likely to have acute cardiac ischemia (odds ratio=0.59, 95% confidence interval=0.50, 0.71).

## DISCUSSION

In this study of patients presenting to emergency departments with symptoms suggestive of acute cardiac ischemia, African-American men and women were less likely to prove to have acute myocardial infarction or acute cardiac ischemia (ie, acute infarction or angina pectoris). This finding was true in both univariate and multivariate analyses. Even after adjusting for sociodemographics, medical histories, and signs and symptoms, African Americans were about half as likely to develop acute myocardial infarction and nearly 60% as likely to have symptoms due to acute ischemia compared with their white counterparts. However, among patients who truly had acute myocardial infarction or angina, there were no racial differences with respect to severity of illness as measured by Killip or the Canadian Cardiovascular Society classifications.

It was evident that African Americans in this study were quite different from their white counterparts. They were younger, predominantly female, and more often single and without health insurance. Despite their younger age, African Americans had high levels of risk factors for developing coronary artery disease. Chest pain was the primary symptom for the vast majority of patients, although African Americans more often had additional symptoms including shortness of breath, abdominal pain, nausea, vomiting, and dizziness. Both African-American men and women had more previous systemic hypertension and were more often current smokers than white patients, and African-American women were more often diabetics. Although deserving of attention, these coronary risk factors are less reflective of current cardiac ischemia than specific cardiac historical and presenting features.<sup>11</sup> Indeed, white patients were more likely to have existing coronary artery disease, as indicated by their more frequent histories of angina, myocardial infarction, and use of cardiac medications.

The findings of this study are somewhat different from those of the Multicenter Chest Pain Study, which reported no racial differences in the occurrence of acute myocardial infarction after adjustment for presenting signs and symptoms.<sup>3</sup> However, as in the current study, African Americans were less likely to have a confirmed diagnosis of acute ischemic heart disease. It is possible that the difference for acute myocardial infarction is due to the fact that the two studies were conducted 10 years apart and in different places, although one medical center participated in both studies. However, the centers in both studies have many

similarities, and it is hard to envision a dramatic change of this sort related to time. A more likely explanation is that the inclusion of patients with symptoms other than chest pain may account for the difference, as African Americans were more likely to have complaints other than or in addition to chest pain.

African Americans in this study delayed longer in presenting to the emergency department than their white counterparts, although after accounting for other presenting features, there was no racial difference for men. In other studies in which African Americans comprised the majority of patients, long delay times have been noted; in one institution, a median delay of 6 hours, twice that for African-American men in the current study, was reported.<sup>12,13</sup> On the other hand, in metropolitan Seattle, an area with a small proportion of African-American residents, the median time from symptom onset to arrival at the emergency department was 2 hours for both African-American and white patients who developed acute myocardial infarction.<sup>14</sup> Socioeconomic status also may be an important predictor of delay and may account for differences both within and between racial groups.<sup>15</sup>

Of note, women with symptoms suggesting acute ischemia comprised the majority (56%) of African Americans presenting to emergency departments. Moreover, of those African-American patients with acute cardiac ischemia, 60% were women; in comparison, only 38% of white patients with acute cardiac ischemia were women. While coronary artery disease is thought to be predominantly a disease of men, this was clearly not the case for African-American women in the current study. Other investigators also have noted high proportions of African-American women with suspected or proven coronary artery disease.<sup>16</sup> This high proportion of African-American women in the current study may be the result of selection bias, but it also might be related to excess hypertension and diabetes in African-American women.<sup>17</sup>

A major strength of the study was that its wide inclusion criteria resulted in the enrollment of a broad spectrum of patients with variable symptoms at presentation. Furthermore, the population contained a large number of African-American patients and was racially balanced. Some studies of coronary artery disease in African Americans have been based on populations with either very low or very high proportions of African-American patients.<sup>1,18</sup> Also, this study collected extensive patient

data that could not explain the racial difference in the diagnosis of acute myocardial infarction or acute cardiac ischemia.

However, it is possible that these racial differences were due to factors beyond the control of this study. For example, it is possible that a higher proportion of African Americans died of cardiac arrest before reaching the emergency department.<sup>6,7</sup> It is also possible that higher proportions of African Americans with acute cardiac ischemia and particularly those of lower socioeconomic status did not seek medical attention for their symptoms.<sup>19</sup> This may be due in part to the fact that African Americans with chest pain were more likely to attribute their symptoms to noncardiac causes,<sup>20</sup> yet it also may be due to a lack of access to care.

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