11-2001

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Recommended Citation

Arnold, A. L., Milner, K., & Vaccarino, V. (2001). Sex and race differences in electrocardiogram use (The National hospital ambulatory medical care survey). The American Journal of Cardiology, 88(9), 1037-1040.

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Sex and Race Differences in Electrocardiogram Use (The National Hospital Ambulatory Medical Care Survey)

Amy L. Arnold, MPH, Kerry A. Milner, DNSc, RN, and Viola Vaccarino, MD, PhD

There are sex and race differences in many aspects of health care delivery. For example, blacks and women are less likely to receive aspirin and thrombolytic drugs.[1–3] Blacks and women presenting with chest pain are less likely to be referred for cardiac catheterization.[4] Blacks and women diagnosed with acute myocardial infarction (AMI) are also less likely to undergo cardiac catheterization.[5] The gender differences in diagnostic evaluation after AMI appear more pronounced among younger women.[6] The American College of Cardiology and the American Heart Association joint electrocardiography guidelines state that all patients presenting to the emergency department (ED) with chest pain should undergo electrocardiography (ECG) to rule out acute ischemia or infarction, regardless of sex or age.[7] It is possible that sex and race differences exist in the administration of this important screening tool among patients with chest pain, possibly reflecting a lower suspicion of coronary heart disease in women (especially young women) and blacks. These management differences may result in failure to diagnose coronary heart disease and may explain why these subgroups are referred less often for cardiac catheterization. Therefore, the purpose of this study was to examine whether this basic guideline is being implemented uniformly in a national sample of patients presenting to the ED with chest pain. Specifically, we hypothesized that young women and blacks presenting with chest pain would be significantly less likely to undergo ECG relative to their white male counterparts.

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The National Hospital Ambulatory Medical Care Survey has been conducted by the Centers for Disease Control and Prevention since 1992 to provide nationally representative estimates of the patient care services offered in EDs in the United States. The sampling design and data collection procedures have been described elsewhere.[8] For the present study, data collected during the years 1995 to 1998 were used. The sample consisted of 3,356 patients between the ages of 30 and 89 years who presented to the ED with chest pain as a primary complaint (ICD-9 codes 1050.0–1050.2, 2515.0). Subjects were excluded if their visit was due to injury (n = 226), because injury could have caused chest pain not of cardiac origin, or if they died in the ED (n = 16), because death may have occurred before an electrocardiogram could have been recorded. Race was abstracted from the medical record and included blacks or whites. Persons of other races were excluded due to limited number (n = 73). Patients were stratified into 2 age groups (<55 and ≥ 55 years) based on previous studies that demonstrated that women <55 years are less likely to be hospitalized for acute cardiac ischemia,[9] and the risk of coronary heart disease increases in women aged ≥ 55 years.[10]

Chi-square and *t* tests were used to examine the relation of sex and race to baseline characteristics and to ECG. Adjusted relative risks of ECG by sex, race, and age were estimated from generalized linear models. To determine the individual effects of age, metropolitan and geographic hospital location, insurance status (Medicaid, private, other) and provider (resident/intern, staff physician, other physician, other provider) on ECG by sex, race and age, sequential modeling was used. Because of the complex sample design used in the National Hospital Ambulatory Medical Care Survey, all analyses were weighted to produce results that are representative of the entire U.S. population.

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The sample included 1,664 men (49%) and 1,702 women (51%). Nearly three-fourths of the sample was white (79%). Men were significantly younger, more likely to be white, more likely to be diagnosed with AMI, and less likely to have Medicaid insurance than women (Table 1). Blacks, compared with whites, were significantly younger, were more likely to visit a metropolitan area ED, to have Medicaid insurance, to see a physician in training (resident or intern) rather than a staff physician, and less likely to be diagnosed with AMI.

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0002-9149/01/$–see front matter
PII S0002-9149(01)01987-7

TABLE 1 Sex and Race Differences in Baseline Characteristics and Outcomes Among Patients Presenting With Chest Pain to Emergency Departments Across the United States (USA)

	Men	Women	p Value	White	Black	p Value
Total	1,664 (49)	1,702 (51)		2,705 (81)	651 (19)	
Age (yrs)						
Mean ± SD	56 ± 16	57 ± 17	0.011	58 ± 16	51 ± 15	<0.001
30–54	811 (49)	798 (47)	0.211	1,202 (44)	407 (63)	<0.001
55–89	843 (51)	904 (53)		1,503 (56)	243 (37)	
White	1,377 (83)	1,328 (78)	<0.001			
Metropolitan area	1,258 (76)	1,333 (78)	0.108	2,030 (75)	561 (86)	<0.001
Region of USA						
Northeast	362 (22)	366 (22)	0.442	587 (22)	141 (22)	<0.001
Midwest	452 (27)	429 (25)		723 (27)	158 (24)	
South	551 (33)	605 (36)		853 (32)	303 (47)	
West	290 (18)	301 (18)		543 (20)	48 (7)	
Insurance*						
Private	703 (44)	668 (41)	0.093	1,133 (44)	238 (39)	0.021
Medicaid	150 (9)	272 (17)	<0.001	281 (11)	141 (23)	<0.001
Other†	777 (49)	753 (46)	0.175	1,312 (51)	217 (35)	<0.001
Provider seen*						
Resident/intern	182 (11)	212 (12)	0.200	238 (8)	157 (24)	<0.001
Staff physician	1,498 (91)	1,465 (86)	<0.001	2,409 (89)	553 (85)	0.005
Other physician	254 (15)	276 (16)	0.482	452 (17)	77 (12)	0.003
Other provider‡	1,518 (92)	1,545 (91)	0.337	2,478 (92)	585 (90)	0.177
Emergency department diagnosis of AMI	283 (17)	178 (10)	<0.001	417 (15)	44 (7)	<0.001
Emergency department disposition						
Admitted	820 (50)	730 (43)	<0.001	1,331 (49)	218 (34)	<0.001
Referred	663 (40)	777 (46)		1,090 (40)	349 (54)	
No follow-up	33 (2)	54 (3)		60 (2)	27 (4)	
Other§	131 (8)	140 (8)		218 (8)	54 (8)	
Electrocardiogram use	1,429 (86)	1,389 (82)	<0.001	2,296 (85)	523 (80)	0.005
Age 30–54 yrs	684 (48)	607 (44)	0.025	983 (43)	309 (59)	<0.001
Age 55–89 yrs	744 (52)	782 (56)		1,313 (57)	214 (41)	

*Categories are not mutually exclusive.
†Other insurance includes Medicare, worker's compensation, self-pay, other or unknown.
‡Includes physician assistant, nurse practitioner, registered nurse, licensed practical nurse, medical/nursing assistant, or emergency medical technician.
§Other disposition includes return to emergency department as needed, left before being seen, returned to referring physician, and other.
Values are expressed as number (%).

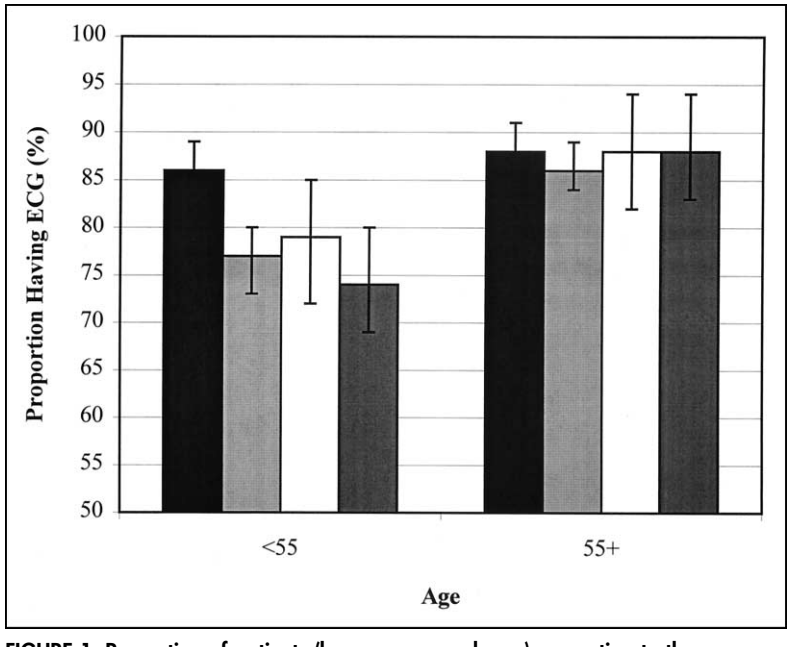

FIGURE 1. Proportion of patients (by age, sex, and race) presenting to the emergency department with chest pain who underwent ECG. *Filled bars,* white men; *stippled bars,* white women; *open bars,* black men; *dark gray bars,* black women.

In all, 2,819 patients (84%) underwent ECG. Overall, men were significantly more likely to undergo ECG than women (86% and 82% respectively, $p = 0.0002$) and whites were significantly more likely to undergo ECG than blacks (85% and 80% respectively, $p = 0.005$). When the likelihood of obtaining an electrocardiogram according to sex and race was examined according to age, differences were noted only among patients aged <55 years (Figure 1). Among patients <55 years of age, women and blacks were less likely to undergo ECG than men, with black women being the least likely. In contrast, among patients ≥55 years of age, no substantial differences in ECG were found according to sex and race, and the rates of ECG were similar to those of men ≤55 years in all groups.

Sequential modeling revealed that the probability of undergoing ECG was not affected by hospital location,

TABLE 2 Adjusted Likelihood of Receiving an Electrocardiogram in the Emergency Department According to Gender, Race, and Age

	Model 1 (unadjusted)		Model 2*		Model 3†		Model 4‡	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Age <55 yrs								
White men	1.00	—	1.00	—	1.00	—	1.00	—
White women	0.90	0.85–0.95	0.90	0.86–0.95	0.90	0.85–0.95	0.90	0.86–0.95
Black men	0.91	0.84–0.99	0.94	0.86–1.03	0.94	0.85–1.03	0.93	0.85–1.01
Black women	0.86	0.80–0.94	0.89	0.82–0.97	0.91	0.84–0.99	0.91	0.84–0.98
Age ≥55 yrs								
White men	1.00	—	1.00	—	1.00	—	1.00	—
White women	0.98	0.94–1.02	0.97	0.93–1.00	0.98	0.94–1.01	0.98	0.92–1.05
Black men	1.00	0.93–1.08	0.99	0.93–1.06	0.99	0.93–1.06	1.01	0.94–1.08
Black women	0.99	0.92–1.06	0.97	0.91–1.04	0.97	0.90–1.03	0.98	0.92–1.05

*Adjusted for age, metro area, region.
†Adjusted for age, metro area, region, insurance.
‡Adjusted for age, metro area, region, insurance, provider.
CI = confidence intervals.

insurance, or provider type (Table 2). Older patients, regardless of race, were equally likely to undergo ECG. However, among patients <55 years, women, either white or black, were significantly less likely to undergo ECG than white men across all levels of adjustment. Black men in this age group also tended to have ECG less often than white men; however, this effect was not statistically significant in multivariable analysis.

Those who underwent ECG were more likely to be admitted to the hospital than those who did not (50% and 28%, respectively), and were less likely to be referred (42% and 48%, respectively) or have no follow-up or other disposition (9% and 24%, respectively). Of those who underwent ECG and were admitted, 67% received a primary diagnosis of unspecified chest pain, whereas 16% were diagnosed with AMI. In contrast, of those who did not undergo ECG and were admitted, 49% were diagnosed with unspecified chest pain and 22% with AMI. However, follow-up information is not available for those referred to other facilities or discharged from the ED, and thus a detailed analysis of patient outcomes is not possible.

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The American College of Cardiology and American Heart Association strongly recommend recording an electrocardiogram in all patients presenting with chest pain[7] regardless of sex and age, because it is safe, simple, inexpensive, and has been shown to diagnose AMI in 47% to 81% of suspected cases of AMI, later confirmed by clinical diagnosis at discharge.[11–15] Our data suggest that this important first-line diagnostic tool is not being used uniformly in a national sample of patients presenting to the ED with chest pain. In the present study, 16% of patients presenting with chest pain did not undergo ECG. Patients ≥55 years old, regardless of sex or race, were as likely to undergo ECG as white men <55 years. However, young women, either black or white, were significantly less likely than young white men to undergo ECG, even after adjustment for hospital location, insurance status, and provider. Younger black men also tended to have an electrocardiogram recorded less often than white men; however the difference was attenuated in multivariable analysis.

Our results are consistent with previous studies that found that women presenting with chest pain have fewer electrocardiograms than men,[16] and wait longer for them.[17] There is currently no published data examining racial differences in electrocardiographic use. Haywood et al[18] found that members of low socioeconomic status, who were more likely to be black or Latino, were less likely to have had a prior electrocardiogram than their white counterparts.[18]

As expected, older patients were most likely to undergo ECG regardless of race and sex. This most likely reflects the clinician's increased suspicion of cardiovascular disease in older patients compared with younger patients. Despite the knowledge that blacks generally develop cardiovascular disease at an earlier age than do whites,[19,20] we found race and age differences in those undergoing ECG: younger women tended to have an electrocardiogram recorded less often than men of similar age, with black women being the least likely to undergo ECG.

This study has a number of limitations. First, data were collected retrospectively through medical record review. This method is susceptible to errors, including a possible misclassification in the assignment of race. However, steps were taken to ensure data accuracy. For example, the quality control protocol allowed only a 5% error rate in the reason for visit category, which was used to determine whether a patient had a primary complaint of chest pain. Second, we did not have information on patient medical history and thus we were unable to control for a patient's pretest probability of acute coronary ischemia. Third, we only had data on whether patients presented with chest pain. We did not have data on other symptoms that may have provided further clues to the examining clinician on whether the chest pain was due to angina. However, we excluded patients whose visit was due to injury, and this should have minimized the number of patients in whom an alternate reason for the chest pain was obvious. Despite the limitations, these

data are based on a nationally representative sample of patients presenting to the ED with chest pain, originated by the largest systematic sampling of ED encounters in the United States.

In conclusion, younger women, either white or black, presenting to the ED with chest pain, are significantly less likely to undergo ECG than younger white men. These management differences may delay diagnosis of acute coronary ischemia and potentially explain, at least in part, sex and race referral differences in cardiovascular therapies.

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Effect of Inotropic Stimulation on Motion and Thickening of the Ventricular Septum Following Either Coronary Artery Bypass Grafting or Mitral Valve Replacement for Mitral Stenosis

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Paradoxic septal motion (PSM) is a common finding after open heart surgery, and has been observed after valve replacement as well as coronary bypass artery grafting (CABG).[1–3] It can potentially result from impaired regional myocardial function representing true dyskinesia or from enhanced anterior cardiac motion after pericardiotomy. Because the transducer position on the chest wall is fixed, augmented anterior cardiac motion during systole interacting with the fixed echocardiographic reference system may result in apparent septal dyskinesia, despite normal myocardial function. Because inotropic stimulation can improve myocardial function and at the same time augment cardiac motion, assessment of septal wall thickening and motion during dobutamine stress echocardiography should allow identification of

TABLE 1 Patient Characteristics

Variable	CABG (n=30)	MVR (n=10)	Controls (n=30)
Age (yrs)	63 ± 13	61 ± 12	62 ± 12
Mean time from surgery (yrs)	2.2 ± 1.6	6.2 ± 3.8	–
Men	23	2	20
Diabetes mellitus	12	1	6
Systemic hypertension	15	1	6
Hypercholesterolemia (>200 mg/dl)	15	2	10
Cigarette smoking	24	1	6
Myocardial infarction	0	0	0
Rheumatic heart disease	0	10	0

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This study was supported by a grant from the Israel Science Foundation, Jerusalem, Israel.

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Manuscript received January 19, 2001; revised manuscript received and accepted June 14, 2001.

0002-9149/01/$–see front matter
PII S0002-9149(01)01988-9