

Racial and Ethnic Differences in the Use of Invasive Cardiac Procedures among Cardiac Patients in Los Angeles County, 1986 through 1988

ABSTRACT

Objectives. The purpose of the study was to compare use of invasive cardiovascular procedures among Latino, Asian, African-American, and White patients.

Methods. In a cross-sectional study of hospital discharge data, multiple logistic regression was used to model use of coronary artery angiography, bypass graft surgery, and angioplasty among adult Los Angeles County residents discharged from California hospitals between 1986 and 1988 with primary diagnoses consistent with possible ischemic heart disease.

Results. After potential demographic, socioeconomic, and clinical confounders, including hospital procedure volume, were controlled, Latinos were less likely than Whites to undergo angiography (odds ratio [OR] = 0.90) and bypass graft surgery (OR = 0.87). African Americans were less likely to receive bypass graft surgery (OR = 0.62) and angioplasty (OR = 0.80). Asians were as likely as Whites to receive each procedure. The impact of adjustment for hospital procedure volume was greater for Latinos and Asians than for African Americans.

Conclusions. Administrative data suggest that disparities in use of invasive cardiovascular procedures are not limited to African Americans. Hospital procedure volume appears to be an important factor related to such disparities. The causes of racial/ethnic differences in reported procedure rates remain unclear. (*Am J Public Health.* 1995;85:352-356)

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Introduction

Multiple studies have documented differences between African-American and White population or patient groups in the use of cardiac and other procedures in the United States.¹⁻⁹ However, no published reports have examined such use among Latinos or Asians.

Factors thought to be responsible for the lower rates for some procedures among African Americans (poorer access to health services, poorer patient-physician communication, less generous health insurance coverage, lower income, and cultural factors) are also relevant to the ability of members of other ethnic groups to access medical services.¹⁰ We undertook this study to examine the rates at which Asians and Latinos, as well as African Americans, receive invasive cardiac procedures once admitted to a hospital with a diagnosis of possible ischemic heart disease. Los Angeles County was selected for this analysis because of the substantial presence and socioeconomic diversity of its Latino (about 25% of county residents), Asian (5%), and African American (12%) populations.

This study was designed to answer the following research questions: (1) How do the rates of invasive cardiac procedures of African Americans, Latinos, and Asians in Los Angeles County compare with those of Whites? (2) Do any discrepancies persist after adjustment for factors that might affect such use? (3) What is the independent effect of hospital procedure volume on such disparities after factors such as income and health insurance status are controlled?

Methods

Patient-specific discharge data were obtained from the California Hospital

Discharge Data Set for all patients discharged from California hospitals from January 1, 1986, through December 31, 1988. All short-term, acute care hospitals in the state of California are required to submit abstracts of each hospitalization for incorporation into this data set. The submitted data are reviewed for accuracy both by the submitting institution and by the Office of Statewide Health Planning and Development. The data set includes information on each patient's age, zip code of residence, gender, primary payer, ethnicity, date of admission, principal and up to 24 secondary diagnoses, principal and up to 24 secondary procedures, length of stay, source and type of admission, discharge disposition, total hospital charges, admission type (elective, emergent, urgent), diagnosis related group, and a specific hospital identification number.

Sample

All patients discharged with principal discharge diagnoses of acute myocardial infarction (ICD-9-CM¹¹ codes 410, 410.0-410.9), unstable angina (411.1), angina pectoris (413, 413.0-413.1, and 413.9), chronic myocardial ischemia (414, 414.0-414.1, 414.10-414.11, 414.19, 414.8, 414.9), or chest pain (786.50-786.52, 786.59) were identified. All patients whose zip code of residence fell outside Los Angeles County were excluded. To re-

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duce the possibility of redundancy in the sample, all patients admitted from or discharged to other acute care hospitals were excluded. Additional exclusions included patients discharged from federal hospitals and all institutions other than general acute care facilities, patients younger than 30 or older than 89 years, Native American or Eskimo patients, and those with race listed as unknown or other.

Study Variables

The primary procedure and the first 12 secondary procedures were used to determine whether a patient had undergone coronary artery angiography (ICD-9-CM procedure codes 37.21–37.23), coronary artery bypass graft surgery (36.2 and 36.10–36.20), or coronary artery angioplasty (36.01–36.02 and 36.05) while hospitalized.

Independent variables consisted of ethnicity, age, gender, principal diagnosis, number of secondary diagnoses, admission type, primary payer, and income. Data for each category except income were obtained from the Discharge Data Set. Median household income for the zip code of patient residence, obtained from the 1980 US census, was used as a proxy for patient income. Four specific ethnic groups constituted the ethnicity variable: African-American, Asian, White, and Latino. Five specific age categories were used: 30–39, 40–49, 50–64, 65–74, and 75–89 years. Admission type could be elective, urgent, or emergent. Eight primary payer groups were used: Medicare, Medicaid, private indemnity, BlueCross BlueShield, health maintenance organization, uninsured (a category including both “self-pay” and “no charge” patients [i.e., those receiving free care or charity care]), indigent services, and “other” (workers’ compensation, other government, other nongovernment, and unknown primary payer).

Analysis Methods

Multivariate logistic regression was used to investigate the relationship between use of each procedure (i.e., coronary artery angiography, angioplasty, or bypass grafting) and ethnicity, with potential confounders controlled. The unit of analysis for these models was each hospital discharge. Four sets of logistic regression models were estimated to generate odds ratios (ORs) for receiving each of the three procedures for each ethnic group relative to Whites. The first models incorporated only ethnicity as the indepen-

TABLE 1—Number of Patients Receiving Three Invasive Cardiac Procedures, by Race/Ethnicity: Los Angeles County, 1986 through 1988

	Total Discharged from Hospitals with Diagnoses of Heart Disease		Received Invasive Procedures					
			Angiography		Bypass Graft Surgery		Angioplasty	
	No.	%	No.	%	No.	%	No.	%
African Americans	16 509	12.6	2 336	8.2 ^a	587	5.5 ^a	564	6.1 ^a
Latinos	19 218	14.6	2655	9.4 ^a	935	8.8 ^a	655	7.1 ^a
Asians	5 900	4.5	1 199	4.2	538	5.1 ^a	380	4.1
Whites	89 781	68.3	22 166	78.2 ^a	8544	80.6 ^a	7591	82.3 ^a

^aSignificantly different from the proportion of the same ethnic group in the overall study population by two-tailed chi-square test.

dent variable and generated unadjusted odds ratios for receiving each procedure. The second set of models included all independent variables described previously. The possibility exists that differences in use of hospitals where these procedures are not performed may account for ethnicity-related disparities in procedure use. Therefore, the third set of models was estimated from a data set that excluded patients who were discharged from hospitals not performing any of the three procedures at the time of the study. The final set of models used the same data set as the third but included a categorical variable to adjust for the number of procedures performed per year at the hospital to which the patient was admitted. Procedure volumes were categorized as very low (<20), low (20–100), medium (101–200), and high (>200).

Results

More than 3 million Los Angeles County residents were discharged from California hospitals between 1986 and 1988. Our study population consisted of the 131 408 patients from this group who met our eligibility criteria.

The various ethnic groups were well represented within the study population, as shown in Table 1. Whites, the largest group, constituted more than two thirds of the discharges. African Americans and Latinos each represented about one seventh of the study population. Asians were the smallest group in the study population, with 5900 patients (4.3%). Table 1 also presents procedure totals by ethnic group. Although large numbers of each ethnic group received each procedure, African Americans and Latinos received proportionately fewer procedures and Whites proportionately more. The propor-

tions of Asian patients receiving angiography and angioplasty were reflective of their distribution in the sample population.

Some independent variables potentially associated with use of the procedures also varied by ethnicity (Table 2). African-American and Latino patients in the study population were somewhat more likely to be female. African-American, Asian, and Latino patients were younger than White patients. African Americans were less likely than White patients to have Medicare or private insurance as primary payer and were more likely to have Medicaid or to be enrolled in a health maintenance organization. They were also more likely either to be uninsured or to receive indigent services benefits. Asian patients were less likely than Whites to be covered by Medicare and more likely to have Medicaid coverage or to be uninsured. Latino patients were more likely than Whites to receive Medicaid. Income disparities were substantial. Statistically significant inter-ethnic differences were also seen in the number of secondary diagnoses.

The distribution of patients from each ethnic group discharged from hospitals performing varying volumes of each procedure is shown in Table 3. African-American and Latino patients were significantly less likely than Whites to be admitted to hospitals that performed large numbers of each procedure. Asians were more likely than Whites to be admitted to hospitals that did not perform the three procedures but were as likely to be admitted to hospitals with high volumes of bypass graft surgery and angioplasty.

Logistic regression results are shown in Table 4. The first column in Table 4 (model 1) presents unadjusted odds ratios

TABLE 2—Distribution of Independent Variables Associated with the Use of Cardiac Procedures, by Racial/Ethnic Group

	Whites	African Americans	Latinos	Asians
Categorical variables, % of group within category				
Primary diagnosis				
Unstable angina	24.6	24.0	28.5 ^a	29.4 ^a
Acute myocardial infarction	23.0	18.6 ^a	17.2 ^a	20.0 ^a
Chest pain	20.9	32.2 ^a	28.5 ^a	19.7
Chronic ischemia	16.6	8.0 ^a	9.6 ^a	16.4
Angina	15.0	17.2 ^a	16.2 ^a	14.6
Age, y				
30–39	3.1	8.2 ^a	7.3 ^a	3.9 ^a
40–49	9.8	17.2 ^a	16.4 ^a	12.9 ^a
50–64	32.3	38.8 ^a	36.8 ^a	34.3 ^a
65–74	29.3	21.7 ^a	23.0 ^a	29.9
75–89	25.5	14.2 ^a	16.5 ^a	19.0 ^a
Female gender	43.2	56.2 ^a	54.5 ^a	43.5
Insurance status				
Medicare	51.4	39.9 ^a	34.7 ^a	26.7 ^a
Private	21.7	13.5 ^a	18.7 ^a	19.5 ^a
HMO	13.0	18.2 ^a	11.5 ^a	14.0
Medicaid	4.8	14.6 ^a	19.5 ^a	26.4 ^a
Self-insured/uninsured	3.0	4.4 ^a	5.9 ^a	5.4 ^a
BlueCross/BlueShield	4.2	2.5 ^a	2.4 ^a	4.1
Indigent services	1.1	5.5 ^a	6.4 ^a	3.1 ^a
Other	0.9	1.3 ^a	0.9	0.8
Admission type				
Emergent	36.7	47.3 ^a	38.5 ^a	37.9
Urgent	43.4	40.2 ^a	47.9 ^a	40.1 ^a
Elective	19.9	12.6 ^a	13.6 ^a	22.1 ^a
Continuous variables, mean (SD)				
Income,	24 091 (7692)	15 516 ^a (5497)	17 969 ^a (5218)	20 222 ^a (6918)
No. of comorbidities	2.90 (2.44)	2.98 ^a (2.42)	2.74 ^a (2.50)	2.79 ^a (2.33)

^aWhite–African American, White–Asian, and White–Latino differences are significant ($P < .01$) by two-tailed chi-square test for categorical variables and two-tailed *t* test for continuous variables.

by procedure for each of the three non-White ethnic groups, with Whites as the reference group. Except for the fact that Asians were as likely as Whites to receive bypass graft surgery, African Americans, Asians, and Latinos were significantly less likely to receive each of the three procedures before adjustments were made for clinical, demographic, and socioeconomic variables.

In the multivariate logistic regressions that controlled for all independent variables except hospital volume (model 2), odds ratios for all non-White groups moved closer to 1, although statistically significant differences remained. Odds ratios for coronary angiography, relative to White patients, were 0.80 for African Americans, 0.69 for Latinos, and 0.85 for Asians (all with significant confidence

intervals that did not include 1). For coronary artery bypass graft surgery, odds ratios were 0.58 for African Americans, 0.70 for Latinos, and 0.98 for Asians (the latter was not significantly different from that for Whites). Significant disparities were found for all three ethnic groups relative to Whites for coronary artery angioplasty (ORs = 0.76 for African Americans, 0.65 for Latinos, and 0.88 for Asians).

The next model (model 3) shows the effect of removing from the analysis group those patients discharged from hospitals that did not perform any of the three invasive cardiovascular procedures during the study period. African Americans and Latinos continued to have significantly lower odds of receiving each of the three procedures, compared with Whites. How-

ever, Asians became as likely as Whites to receive angiography (OR = 1.01), bypass graft surgery (OR = 1.11), and angioplasty (OR = 0.99).

Adding an adjustment factor to control for the effect of increasing hospital procedure volume (model 4) diminished almost all interethnic differences in the odds of receiving these three procedures. However, African Americans remained significantly less likely than Whites to undergo either of the revascularization procedures (ORs = 0.62 for coronary artery bypass graft surgery and 0.80 for coronary artery angioplasty). For angiography, adding the procedure volume adjustment essentially eliminated the disparity between African Americans (OR = 0.94) and Whites. Disparities between Latinos and Whites also declined or disappeared with application of the hospital procedure volume adjustment (ORs for Latinos = 0.90 for coronary artery angiography, 0.87 for coronary artery bypass graft surgery, and 0.99 for coronary artery angioplasty). Once again, no disparities in receipt of procedures were found between Asians and Whites.

Discussion

Among studies of inequities in the use of cardiac procedures, these findings are noteworthy in demonstrating that apparent disparities in receipt of cardiovascular procedures between White and African-American patients were paralleled by differences in rates between Whites and Latinos and, to a lesser extent, between Whites and Asians. Although considerable research has documented further evidence of disparities between Whites and African Americans,¹² no previous study has reported disparities in the use of cardiac procedures for other ethnic groups.

Unadjusted odds ratios varied considerably by ethnicity. African Americans and Latinos tended to have significantly lower odds than Whites of receiving any of the three procedures, whereas Asian patients were less likely to receive coronary artery angiography and angioplasty. However, important differences were also found in the presence of several potential confounders among the different ethnic groups studied. African-American, Latino, and Asian patients in the study population were more likely to be women, to have low incomes, and to either be uninsured or have Medicaid as their primary payer. All of these factors have been reported to be associated with lower

use of cardiac procedures and other medical services.¹³⁻¹⁷

Multivariate logistic regression analysis confirmed the existence of ethnicity-related differences in the use of the three invasive cardiovascular procedures. The direction and magnitude of differences between African Americans and Whites demonstrated by this analysis are consistent with those of other reports.⁶ It is particularly noteworthy that similar effects were also found for Latinos and, to a lesser degree, Asians.

This study is unique in that it also examines hospital procedure volume as a possible explanatory factor for the presence of ethnicity-related disparities in the use of invasive cardiovascular procedures. This possibility was investigated in two ways: by eliminating patients discharged from hospitals that did not perform the procedures and by controlling for procedure volume in the analysis. Once patients discharged from hospitals that did not perform the three cardiovascular procedures were eliminated from the analysis population, important effects on ethnicity-related disparities were noted. Asians became as likely as Whites to receive coronary artery angiography and angioplasty. For African Americans, however, no important changes in the relative magnitude of the odds ratios were seen. For Latinos, the odds of receiving each of the three procedures, relative to Whites, increased but remained less than those for Asians. These findings suggest that perhaps all disparities in the use of invasive cardiovascular procedures for Asians and an important component of such disparities for Latinos may be related to disproportionate representation of those populations in hospitals that do not perform such procedures.

Controlling for the volume of each procedure performed at the hospital from which the patient was discharged increases our understanding of interethnic variation in the use of cardiac procedures. That such adjustment improved or eliminated ethnicity-related differentials for African Americans and Latinos suggests that reduced use of hospitals with higher procedure volume may contribute to such differentials. However, the importance of this effect appears to vary considerably among these ethnic groups. Volume adjustment diminished disparities in angiography and bypass graft surgery while eliminating disparities in angioplasty for Latinos, and had little effect on disparities in bypass graft surgery and angioplasty for African Americans while essentially elimi-

TABLE 3—Distribution of Patients by Racial/Ethnic Group and Hospital Procedure Volume

Hospital Procedure Volume ^a	% of Patients			
	White	African American	Latino	Asian
Angiography				
High	56.7	40.5 ^b	39.8 ^b	46.6 ^b
Medium	9.9	8.0 ^b	9.3 ^b	9.9
Low	9.5	17.8 ^b	10.1 ^b	7.7 ^b
Very low	5.7	13.2 ^b	7.1 ^b	7.1 ^b
None	18.2	20.5 ^b	33.8 ^b	28.7 ^b
Bypass graft surgery				
High	21.4	14.8 ^b	8.5 ^b	22.4
Medium	23.2	15.4 ^b	11.0 ^b	12.1 ^b
Low	16.6	18.8 ^b	29.9 ^b	20.8 ^b
Very low	2.8	5.7 ^b	1.8 ^b	1.7 ^b
None	36.0	45.4 ^b	48.8 ^b	43.1 ^b
Angioplasty				
High	21.5	16.0 ^b	7.9 ^b	20.6
Medium	9.8	5.2 ^b	6.5 ^b	4.7 ^b
Low	23.6	16.0 ^b	17.0 ^b	18.5 ^b
Very low	12.3	18.3 ^b	23.0 ^b	13.3
None	32.8	44.6 ^b	45.7 ^b	42.9 ^b

^aVolume was defined as number of procedures performed per year: high = more than 200; medium = 101–200; low = 20–100; very low = fewer than 20.

^bCaucasian–African American, Caucasian–Asian, and Caucasian–Latino differences are significant ($P < .01$) by two-tailed chi-square test.

TABLE 4—Summary of Logistic Regression Analyses of Invasive Cardiac Procedures: Odds Ratios (Relative to White Patients), by Racial/Ethnic Group

	Model 1 ^a	Model 2 ^b	Model 3 ^c	Model 4 ^d
	Unadjusted OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Angiography				
African American	.50 (.48, .53)	.80 (.76, .84)	.78 (.74, .82)	.94 (.89, 1.00)
Asian	.78 (.73, .83)	.85 (.80, .92)	1.01 (.94, 1.09)	1.03 (.95, 1.11)
Latino	.49 (.47, .51)	.69 (.65, .72)	.81 (.77, .85)	.90 (.85, .95)
Bypass graft				
African American	.35 (.32, .38)	.58 (.52, .64)	.57 (.52, .63)	.62 (.56, .69)
Asian	.95 (.87, 1.05)	.98 (.88, 1.09)	1.11 (1.00, 1.24)	1.03 (.92, 1.15)
Latino	.49 (.45, .52)	.70 (.64, .76)	.77 (.71, .83)	.87 (.79, .94)
Angioplasty				
African American	.38 (.35, .42)	.76 (.69, .84)	.76 (.69, .83)	.80 (.72, .88)
Asian	.75 (.67, .83)	.88 (.79, .99)	.99 (.88, 1.10)	.89 (.79, 1.01)
Latino	.38 (.35, .41)	.65 (.60, .71)	.75 (.69, .82)	.99 (.90, 1.09)

Note. OR = odds ratio; CI = confidence interval.

^aNo additional independent variables are used.

^bControlling for primary diagnosis, age, gender, primary insurance type, admission type, income, and number of comorbidities.

^cIdentical to model 2 except that discharges from hospitals not performing procedures are deleted.

^dIdentical to model 3 with categorical hospital procedure volume variable added.

inating disparities in this group for angiography. The persistence of the relative magnitude of discrepancies in the odds of receiving either of the revascularization procedures (bypass graft surgery or angio-

plasty) for African Americans even after controlling for volume is troubling. Clearly, use of these revascularization procedures by African Americans is especially susceptible to other factors, such as patient

preference and physician practice style, that were not measured in this analysis.¹²

This study has several methodological and sampling limitations. First, one of its central presumptions is that ethnicity is reported accurately in administrative data. Reports of ethnicity can be subjective and are infrequently validated. This important consideration is not unique to this analysis.¹⁸ Nonetheless, it is unlikely that systematic under- or overreporting of a particular ethnicity is correlated with the propensity to perform invasive cardiac procedures. Second, although the number of secondary diagnoses was used, as in previous studies,^{1,6} as a proxy for comorbidity, actual clinical measures of atherosclerotic coronary artery disease severity, such as the degree of coronary artery stenosis, are not available in administrative data sets. Third, the appropriateness of the various procedures cannot be assessed from administrative data sets. As a result, it remains uncertain whether lower rates among ethnic minorities indicate appropriate or inappropriate underuse. Fourth, zip-code median family income was used as a proxy for patient income and socioeconomic status. Zip code of residence is sometimes not reported accurately by patients, and even when it is, zip-code median income may not be representative of that portion of the zip-code population admitted to hospitals. Finally, assessment of individual patient preference with regard to such procedures is not possible in this type of analysis. More information is needed about how different population groups react in the presence of cardiac disease or when offered an invasive cardiovascular procedure.

Three additional potential shortcomings of this study are also common to most previous analyses of this type. One is the absence of record linkage numbers from the California Hospital Discharge Data Set during the study period, introducing the possibility that multiple admissions of specific individuals may be responsible for interethnic disparities. We attempted to minimize this possibility by eliminating observations where patients were transferred from one institution to another, but it is still possible that ethnic groups vary in rates of multiple or split hospitalizations. Another potential shortcoming is possible

bias in the attribution of important variables, such as the primary diagnosis, assigned to patients during discharge abstract coding. Finally, our data are from 1986 through 1988. It is possible that relative ethnic rates for these procedures have changed since that time.

The finding that disparities in the use of invasive cardiovascular procedures—previously reported only for African Americans relative to Whites—also apply to Latinos and, to a lesser degree, Asians, requires validation in studies using other methodologies. If confirmed, these findings have implications for ongoing efforts to combat cardiovascular disease as well as for health reform, most notably efforts to ensure access to high-quality care for all members of our society. It is far from certain that simply removing insurance-related barriers to care will eliminate the disparities noted in this analysis. This analysis does suggest that some as yet unidentified factors, which may include access barriers, health status, patient preference, and other issues, and which may vary among ethnic groups, affect the use of invasive cardiovascular procedures.

Because of the importance of these findings, we recommend an expansion of research efforts that incorporate primary data collection strategies.¹⁹ These could include studies to validate administrative data reports of ethnicity, studies that abstract medical records for diagnosis at admission and for procedure use, studies that survey patients about their preferences for treatment and their understanding of the procedures, and studies that survey physicians about indications for procedure use. □

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