

SPECIAL ARTICLE

## Racial Trends in the Use of Major Procedures among the Elderly

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### ABSTRACT

#### BACKGROUND

Differences in the use of major procedures according to patients' race are well known. Whether national and local initiatives to reduce these differences have been successful is unknown.

#### METHODS

We examined data for men and women enrolled in Medicare from 1992 through 2001 on annual age-standardized rates of receipt of nine surgical procedures previously shown to have disparities in the rates at which they were performed in black patients and in white patients. We also examined data according to hospital-referral region for three of the nine procedures: coronary-artery bypass grafting (CABG), carotid endarterectomy, and total hip replacement.

#### RESULTS

Nationally, in 1992, the rates of receipt for all the procedures examined were higher among white patients than among black patients. The difference between the rates among whites and blacks increased significantly between 1992 and 2001 for five of the nine procedures, remained unchanged for three procedures, and narrowed significantly for one procedure. We examined rates of CABG, carotid endarterectomy, and total hip replacement in 158 hospital-referral regions (79 hospital-referral regions for black men and white men and 79 for black women and white women) with an adequate number of persons for each procedure. We found that in the early 1990s, whites had higher rates for these procedures than blacks in every hospital-referral region. By 2001, the difference between whites and blacks (both men and women) in the rates of these procedures narrowed significantly in 22 hospital-referral regions, widened significantly in 42, and were not significantly changed in the remaining hospital-referral regions. At the end of the study period, we found no hospital-referral region in which the difference in rates between whites and blacks was eliminated for men or women with regard to any of these three procedures.

#### CONCLUSIONS

For the decade of the 1990s, we found no evidence, either nationally or locally, that efforts to eliminate racial disparities in the use of high-cost surgical procedures were successful.

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**B**LACK AMERICANS HAVE A MUCH LOWER life expectancy and worse health outcomes than white Americans. Large differences in health outcomes between races have raised obvious questions about differences in health care that might contribute to these patterns. Numerous studies have documented racial disparities in the use of major, high-cost surgical procedures that are not explained by differences in patients' clinical characteristics.<sup>1,2</sup> The racial differences in the use of surgical procedures occur for a broad range of clinical indications and are largely independent of the level of physician discretion involved in a procedure.<sup>3</sup> Although overuse of these procedures in white patients may explain some of the disparity, studies suggest that black patients undergo fewer clinically important, evidence-based procedures than white patients.<sup>4-7</sup>

Studies showing racial disparities in care have received wide attention in the media since the early 1990s, prompting the federal government to develop several initiatives to address this problem. In 1993, the National Institutes of Health started requiring that minority patients be adequately represented in clinical studies, and funds were allocated specifically to improve the health of members of minority groups. In 1996, the Department of Health and Human Services renewed its efforts within the Office of Minority Health to eliminate racial and ethnic disparities in health care with added funding and new initiatives to collaborate with local agencies to improve care for members of minority groups who have diabetes or cardiovascular disease.<sup>8</sup> At least 34 states have established offices of minority health, whose purpose, at least in part, is to reduce disparities in care.<sup>9</sup> Recently, the Institute of Medicine called for the health care system to take on the challenge of eliminating racial disparities.<sup>10</sup>

Despite clinical evidence collected over many years showing important racial disparities and high-profile initiatives to reduce them,<sup>8</sup> we do not know whether the inequities between blacks and whites in the rates of procedures have begun to narrow, and we are not aware of any prior studies that focused on changes in the use of procedures since 1997.<sup>11</sup> In this study, we examined how racial differences in the receipt of nine major surgical procedures among Medicare beneficiaries have changed over the past decade. Analysis of trends in the use of these procedures over time provides evidence of whether initi-

atives to reduce disparities have begun to work. Given substantial regional variation in the patterns of disparities,<sup>12</sup> we also studied local regions, where initiatives might be most effective, in order to detect whether in those regions racial disparities might have been reduced or increased.

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## METHODS

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### PATIENTS AND PROCEDURES

We used all data for Medicare beneficiaries enrolled in fee-for-service programs from 1992 through 2001 to calculate the rates of performance of nine procedures. We chose these particular procedures because they are common, relatively expensive, and associated with significant rates of disease and death and because previous studies have found racial differences in their rates of use.<sup>1,3,12-14</sup> The rates of the procedures we evaluated (categorized according to the coding of the *International Classification of Diseases, Ninth Revision* [ICD-9]) were the following: abdominal aortic aneurysm repair (ICD-9 codes 38.44 and 39.25 restricted to the diagnoses of 441.3 to 441.9); back surgery (03.0x, 03.1x, 03.2x, 03.32, 03.39, 03.4, 03.5x, 03.6, 03.93, 03.94, 03.96, 80.5 to 80.59, and 81.0 to 81.09); coronary-artery bypass grafting (CABG) (36.10 to 36.19); percutaneous transluminal coronary angioplasty (36.01, 36.02, and 36.05); cardiac valve replacement (35.20 to 35.24); carotid endarterectomy (38.12); total hip replacement (81.51, 81.59 excluding diagnosis of 820 to 821.39, and 996.0 to 996.99); total knee replacement (81.41 and 81.54); and appendectomy (diagnosis-related groups 164 to 167).

We used the denominator file of all Medicare beneficiaries to identify resident persons 65 years of age or older who were enrolled in Medicare between 1992 and the end of 2001. Any person who was not listed in the denominator file as being enrolled on June 30 of a given year (either because of enrollment in a health maintenance organization or enrollment late in the year) was excluded from the numerator (number of procedures) and denominator (total number of persons eligible for the procedure) for that year. We focused our analysis on comparisons between black persons enrolled and nonblack persons enrolled. However, as others have done,<sup>15</sup> we refer to the nonblack population as white, even though approximately 5.5 percent of such subjects in 2001 were members of other races or ethnic groups.

**VARIABLES**

Race (black or white) according to data collected for Medicare enrollment, age (in categories of 65 to 69 years, 70 to 74 years, 75 to 79 years, 80 to 84 years, and 85 to 99 years), sex, and ZIP Code were determined with the use of the denominator files. ZIP Code was linked with data from the 2000 Census to obtain the median income of people living within a ZIP Code. The outcome was whether a person enrolled in Medicare had a procedure or did not have the procedure. The primary outcome, the difference between whites and blacks (or the white-minus-black gap) according to sex, was the difference in the age-adjusted rate of the procedure between whites and blacks enrolled in a given year.

We defined health care markets as hospital service areas and further aggregated these areas into 306 hospital-referral regions, as previously described for the Dartmouth Atlas of Health Care project.<sup>16</sup> Hospital service areas are defined on the basis of patterns of travel to receive hospital care among those enrolled in Medicare, and hospital-referral regions are defined on the basis of travel for tertiary care among those enrolled in Medicare. We restricted regional analyses to hospital-referral regions in which the expected number of procedures among both black patients and white patients was at least 25.<sup>12</sup>

**ANALYSIS**

We examined the Medicare enrollee census for each year from 1992 through 2001 and calculated the an-

nual age-adjusted rates for each procedure according to race and sex separately. Rates were calculated by dividing the number of procedures (numerator) by the total number of patients eligible for the procedure (denominator) within each category (age, race, and sex) aggregated nationally. We used indirect standardization to create national age-adjusted rates for each group according to race and sex for each year.<sup>17</sup>

Our primary aim was to determine whether the gaps in rates between blacks and whites increased or decreased over time for each procedure. We built linear regression models for men and women separately in which we used age-adjusted differences between whites and blacks in the rates of procedures as the outcome and year (the continuous variable) as the main predictor. We also plotted the rates over time for three procedures (CABG, total hip replacement, and carotid endarterectomy) to understand better the evolution of patterns of care. We chose these three procedures because they are common and represent both cardiovascular and orthopedic conditions.

We also sought to determine whether there were changes in the gaps between whites and blacks in the rates of procedures over time within local regions. We limited the analyses to CABG, total hip replacement, and carotid endarterectomy in hospital-referral regions in which the expected number was at least 25 procedures for each group according to race and sex. We began by pooling data from 1992 through 1994 to achieve an adequate sample size

**Table 1. Characteristics of the Study Population of Fee-for-Service Patients Enrolled in Medicare, According to Year.\***

Characteristic	1992 (N=29,247,133)	1995 (N=29,248,026)	1998 (N=27,041,785)	2001 (N=27,656,346)
	<i>percent</i>			
Age				
65–69 yr	30	29	27	27
70–79 yr	46	46	47	46
≥80 yr	24	25	26	28
Female sex	60	60	60	60
Black race	7	7	7	7
Region				
West	26	25	25	26
Midwest	23	24	25	24
South	26	26	27	28
Northeast	25	25	23	23

\* Percentages may not total 100 because of rounding.

and adequate stability of the rates of procedures for each group within each hospital-referral region. The rates of procedures among blacks and whites were then indirectly standardized according to age, and these standardized rates were compared with the use of a log transformation and the usual formula for the standard error.<sup>18</sup> We report both the number of hospital-referral regions in which the procedure rate among whites exceeded that among blacks and the number of hospital-referral regions for which the difference in rate is significant at the level of  $P < 0.05$ .

Other outcomes included whether the difference in the rate of procedures between whites and blacks changed over time in each hospital-referral region. We performed a linear regression analysis for each hospital-referral region with the yearly difference between whites and blacks in the standardized rates of procedures as the dependent variable and the year

(from 1992 to 2001) as the independent predictor. We report the number of hospital-referral regions in which the gaps between whites and blacks in the use of a procedure widened over time and the number in which the gaps narrowed over time as well as the number in which these changes were statistically significant at the level of  $P < 0.05$ .

Finally, we pooled data from the last three years of the study (1999 through 2001) to determine the number of hospital-referral regions in which the gaps still favor white patients and in how many regions these gaps remain statistically significant. To illustrate the changes in rates over time (on the basis of the data for 1992 through 1994 and those for 1999 through 2001) and for comparisons between white patients and black patients, we plotted the rates for 1992 through 1994 against those for 1999 through 2001 for each hospital-referral region and race according to sex and procedure.

**Table 2. Rates and Changes in Rates of Procedures among Men and Women Enrolled in Medicare, 1992 and 2001.\***

Procedure	1992			2001			Change in Gap per Year†
	Whites	Blacks	Difference	Whites	Blacks	Difference	
<b>Men</b>							
Repair of abdominal aortic aneurysm	2.10	0.57	1.53	1.59	0.51	1.08	-0.45‡
Angioplasty	21.34	11.86	9.48	28.19	19.67	8.52	-0.96
Back surgery	3.05	1.59	1.46	4.70	2.51	2.19	0.73
CABG	9.01	2.72	6.29	9.80	4.11	5.69	-0.60
Carotid endarterectomy	3.13	0.82	2.31	4.42	1.44	2.98	0.67
Total hip replacement	1.96	0.86	1.10	2.60	1.08	1.52	0.42‡
Knee replacement	3.47	1.19	2.28	5.05	1.85	3.20	0.92‡
Valve replacement	1.43	0.48	0.95	1.91	0.73	1.18	0.23‡
Appendectomy	0.46	0.32	0.14	0.55	0.31	0.24	0.10‡
<b>Women</b>							
Repair of abdominal aortic aneurysm	0.39	0.23	0.16	0.37	0.25	0.12	-0.04
Angioplasty	11.68	10.07	1.61	16.83	17.35	-0.52	-2.13‡
Back surgery	2.62	1.48	1.14	4.33	2.37	1.96	0.82‡
CABG	3.14	1.80	1.34	3.70	2.82	0.88	-0.46
Carotid endarterectomy	1.59	0.64	0.95	2.42	1.15	1.27	0.32
Total hip replacement	2.36	1.24	1.12	3.33	1.86	1.47	0.35‡
Total knee replacement	4.32	3.47	0.85	6.61	5.10	1.51	0.66‡
Valve replacement	0.89	0.39	0.50	1.17	0.64	0.53	0.03‡

\* CABG denotes coronary-artery bypass grafting.

† The gap was calculated as the procedure rate among whites minus that among blacks; a minus sign signifies a narrowing of the difference between whites and blacks in the rates of a procedure.

‡ P for trend  $< 0.05$  in the multivariable linear regression models.

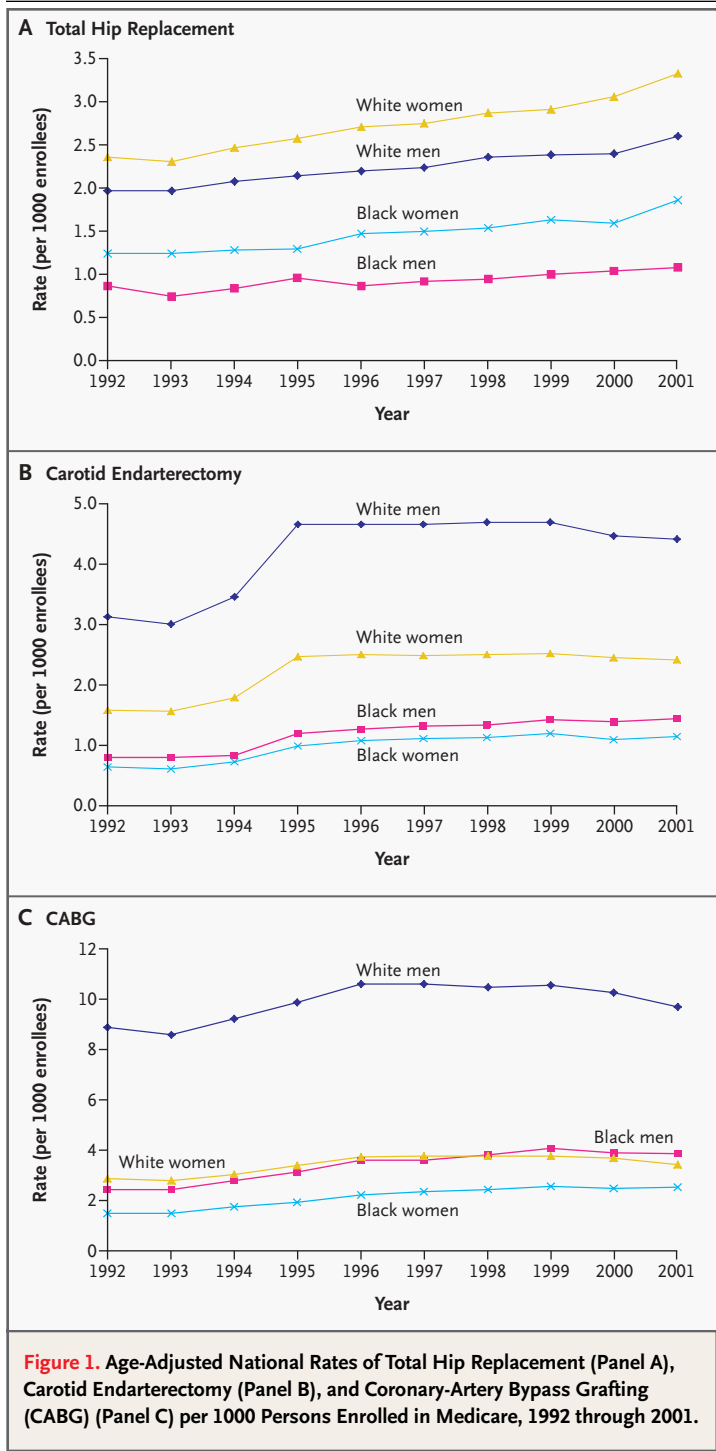
RESULTS

There were approximately 29 million enrollees in our denominator files for each year from 1992 through 2001. During the 1990s, the percentage of those enrolled in Medicare in the oldest age groups (80 to 99 years of age) rose from 24 to 28 percent, whereas the percentage in the youngest age group declined (Table 1). The percentages of enrollees who were female or white remained relatively constant.

NATIONAL RATES OF PROCEDURES

National rates of the use of the procedures among Medicare enrollees increased during the study period from 1992 through 2001 for eight of the nine procedures studied (i.e., all except repair of an abdominal aortic aneurysm), and the increases were generally present for each group according to sex and race (Table 2). Among men, the rates for all nine procedures were higher among whites than among blacks in 1992. The difference in rates between whites and blacks (the rate for whites minus the rate for blacks) widened significantly for five procedures, narrowed significantly for one procedure, and did not change significantly for three procedures (Table 2). For example, the gap in the rate of repair of an abdominal aortic aneurysm narrowed significantly (gap among men, 1.53 procedures per 1000 enrollees vs. 1.08 procedures in 1992 vs. 2001; change,  $-0.45$  procedure per 1000 enrollees;  $P=0.03$ ). The findings among women were similar.

When we examined the rates for CABG, total hip replacement, and carotid endarterectomy in greater detail (Fig. 1), we found that the patterns of use over time varied according to procedure. There were steady increases in the rates of total hip replacement among white women, white men, and black women, but those among black men remained relatively stable (Fig. 1A). In contrast, there was a sharp rise in rates of carotid endarterectomy from 1993 through 1995 for all groups, although the increase was much more pronounced among whites than among blacks (Fig. 1B). These changes followed the publication of the results of two clinical trials that expanded the indications for carotid endarterectomy.<sup>19,20</sup> The rates for CABG remained relatively stable from 1992 through 2001, with small increases early in this period for all groups and small decreases late in the period (Fig. 1C).



**PROCEDURES WITHIN HOSPITAL-REFERRAL REGIONS**

When we examined hospital-referral regions that had an adequate number of persons for the analysis of the frequency of CABG, total hip replacement, and carotid endarterectomy, we noted several findings (Table 3). First, whites underwent a greater number of these three procedures than blacks in every hospital-referral region from 1992 through 1994. For example, among men, in all 20 hospital-referral regions that had an adequate sample size, whites had more total hip replacements than blacks, although the racial difference was statistically significant in only 17 of these hospital-referral regions (Table 3). Next, we found that during the study period, the gap between whites and blacks for total hip replacement widened in 17 of these 20 hospital-referral regions (in 5, the changes were statistically significant) and narrowed in 3 (none were statistically significant) (Table 3). The majority of the hospital-referral regions also showed a widening gap between whites and blacks for carotid endarterectomy, although for CABG, a majority of the hospital-referral regions showed a narrowing of the gap. Finally, from 1999 through 2001, more of each of the three procedures were performed among white

men than among black men in every hospital-referral region, and most of the differences in the rates of use were statistically significant. In our analyses of hospital-referral regions according to procedures performed among black women and white women, the trends in racial differences in rates of use of these procedures were qualitatively similar.

We also examined the stability of the rates at the start of the study (between 1992 and 1994) and at the end of the study (between 1999 and 2001). Hospital-referral regions that had high rates of procedures among white patients also had relatively high rates among black patients (Spearman correlations ranging from 0.20 to 0.60 according to sex and procedure in the early period, and from 0.50 to 0.86 in the later period). Similarly, the rates at the start of the study period closely predicted the rates at the end of the study period (Fig. 2); this was true among both whites and blacks. Whereas the rates of the use of the procedures were higher among whites than among blacks in each hospital-referral region, blacks in a few regions had higher rates than did whites in other regions, a phenomenon that was true for both periods examined (Fig. 2). The variation in the rates of procedures among hospital-referral regions was also substantial for each race.

**DISCUSSION**

We examined trends in the rates of use of nine major procedures among black persons and white persons enrolled in Medicare between 1992 and 2001 and found that racial differences in these rates did not narrow meaningfully during this decade. The

**Table 3. Increase, Decrease, or Elimination of Racial Difference in the Largest Hospital-Referral Regions.\***

Procedure	Gap between Whites and Blacks in HRRs†			
	Gap >0, 1992–1994	Gap Widened	Gap Narrowed	Gap >0, 1999–2001
	no. of HRRs (no. with significant result)‡			
<b>Men</b>				
Total hip replacement (20 HRRs)	20 (17)	17 (5)	3 (0)	20 (18)
Carotid endarterectomy (19 HRRs)	19 (19)	15 (8)	4 (0)	19 (19)
CABG (40 HRRs)	40 (40)	17 (8)	23 (7)	40 (40)
<b>Women</b>				
Total hip replacement (20 HRRs)	20 (18)	17 (13)	3 (1)	20 (19)
Carotid endarterectomy (19 HRRs)	19 (19)	14 (6)	5 (2)	19 (19)
CABG (40 HRRs)	40 (39)	9 (2)	31 (12)	40 (39)

\* HRRs denotes hospital-referral regions, and CABG coronary-artery bypass grafting.

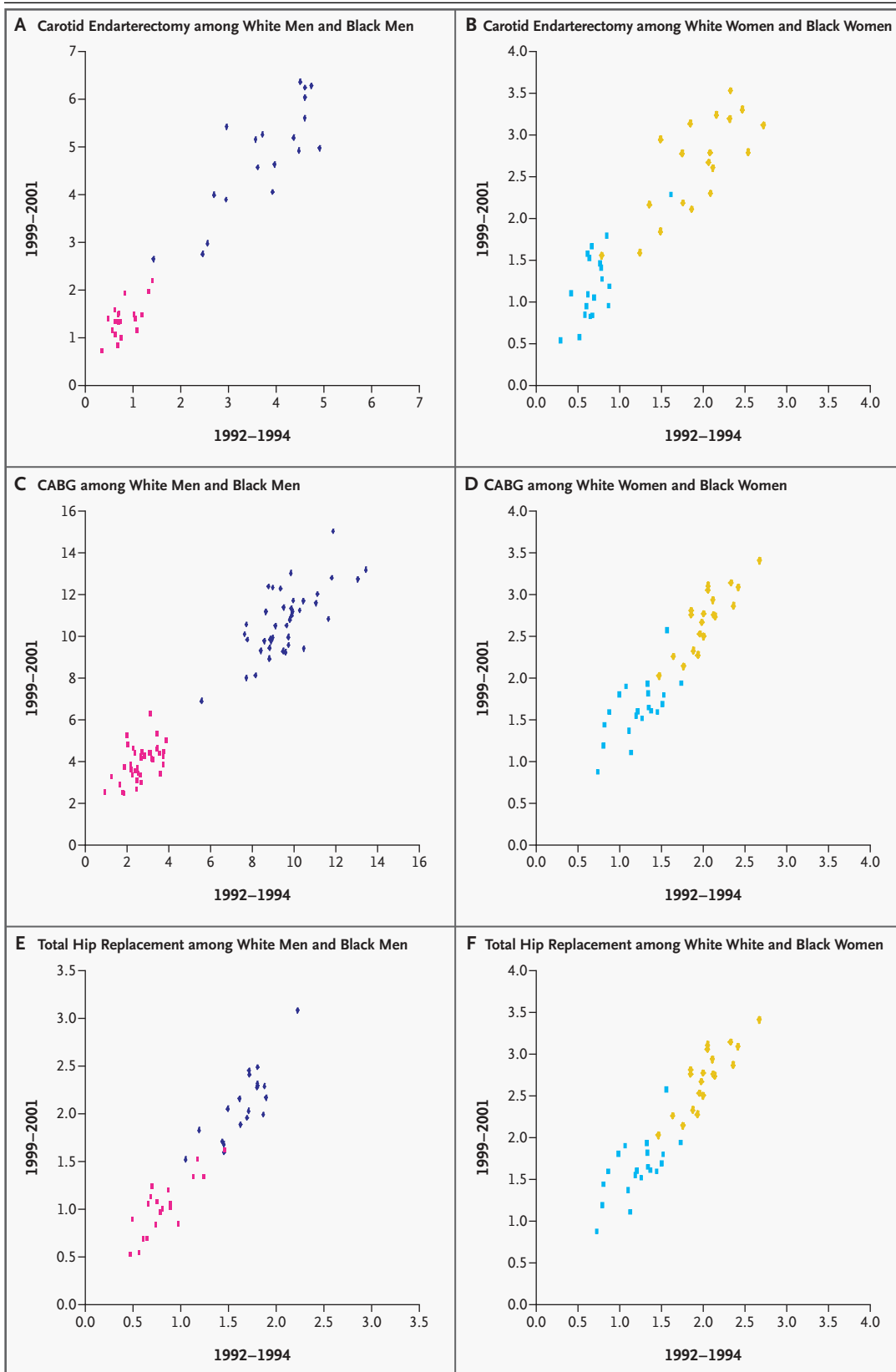
† The gap was calculated as the procedure rate among whites minus that among blacks.

‡ P<0.05 was considered to indicate a statistically significant result.

**Figure 2 (facing page). Comparisons of the Rates of Three Major Surgical Procedures Performed in Two Periods (1992 through 1994 and 1999 through 2001) among Black Men and White Men and among Black Women and White Women per 1000 Persons Enrolled in Medicare.**

Panel A shows the rates in selected hospital-referral regions of carotid endarterectomy among black men (red squares) and white men (dark blue diamonds), and Panel B shows the rates of this procedure among black women (blue squares) and white women (yellow diamonds). Panel C shows the rates in selected hospital-referral regions of CABG among black men and white men, and Panel D shows the rates of this procedure among black women and white women. Panel E shows the rates in selected hospital-referral regions of total hip replacement surgery among black men and white men, and Panel F shows the rates for this procedure among black women and white women.

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rates of the procedures performed were greater among whites than among blacks for every procedure examined. Racial differences in these rates widened for five procedures, narrowed for one, and remained statistically unchanged for three. We found no local regions in which racial differences in care were eliminated altogether by 2001.

More than 600 studies have documented racial and ethnic differences in health care dating back at least to the 1980s.<sup>1</sup> These studies suggested that racial and ethnic differences reflect, in part, underuse by black patients, who fail to receive these procedures when their use is clinically appropriate. In response to this evidence, numerous national and local initiatives have been developed to reduce racial differences in health care. Our findings show that, despite these efforts, differences between white Medicare enrollees and black Medicare enrollees in the rates of major procedures did not change meaningfully in the 1990s. Moreover, we did not find a single hospital-referral region (in the 158 sex-specific and procedure-specific analyses performed) in which the difference in rates (the white-minus-black gap) of the use of CABG, total hip replacement, or carotid endarterectomy was eliminated.

Previous studies<sup>5,13,21-25</sup> have suggested that racial gaps in the use of the procedures we evaluated are unlikely to represent only differences in disease incidence or in patients' preferences. Numerous studies have shown that differences in rates of cardiovascular procedures represent a mix of overuse among whites and underuse among blacks.<sup>5,13,21-23</sup> Likewise, racial differences in rates of total knee replacement and total hip replacement are unlikely to be due to differences in disease incidence, given that the incidence of osteoarthritis among blacks is similar to if not greater than that among whites.<sup>24,25</sup>

Appendectomy is traditionally considered a procedure that involves little physician discretion, although two prior studies have found results consistent with ours.<sup>3,26</sup> Whether the incidence of appendicitis differs between whites and blacks is unknown. Blacks are more likely than whites to have a ruptured appendix at the time of appendectomy,<sup>27</sup> indicating either delayed presentation or a greater reluctance among surgeons to perform the procedure. Whites are more likely than blacks to have false negative appendectomies,<sup>28</sup> indicating either differences in clinical presentation or a lower threshold to perform surgery. The combination of these findings suggests that there are likely clinically

important racial differences in the care of patients with appendicitis.

Although procedure rates among blacks increased for all procedures in the 1990s, this increase did not reduce the racial gaps, because rates among white patients increased even faster than those among black patients for all procedures except repair of an abdominal aortic aneurysm. For example, the rates of carotid endarterectomy substantially increased in 1995, soon after the publication of major trials showing benefits of this procedure in patients with carotid-artery stenosis.<sup>19,20</sup> However, most of this increase in rates of carotid endarterectomy occurred among the white population, perhaps because white patients were more aggressive in seeking surgical remedies after the data were released or, alternatively, because the doctors who cared for white patients were early adopters of a more aggressive surgical approach. Surgical repair of an abdominal aortic aneurysm was the one procedure in which the gap between whites and blacks for the use of a procedure decreased. The narrowing of this gap occurred in the late 1990s and was associated with the disproportionate receipt among whites of procedures involving new endovascular techniques instead of the traditional surgery for repair of an abdominal aortic aneurysm.<sup>29</sup>

Our study has important limitations. First, we could not differentiate between overuse among white patients, underuse among black patients, or some combination of the two. We can only show that whites and blacks continue to receive very different care. Further, it is possible that the clinical indications or patients' preferences for the procedures examined have changed in ways that explain the persistence of gaps between their use in white patients and black patients. However, there are no data on how clinical indications or patients' preferences have changed over time. Finally, because we could examine individually only those hospital-referral regions with an adequate number of persons that would allow for statistically precise estimates of rates of procedures, changes in gaps in their use between blacks and whites in other regions are possible.

In conclusion, we studied racial differences in the receipt of nine major surgical procedures among persons enrolled in Medicare and found that there have been no meaningful, consistent reductions in the gaps in care between black enrollees and white enrollees. Although substantial local and national

attention has been paid to the issue of racial disparities, we found no evidence that the disparities in the rates of use of the procedures examined have been reduced. Numerous other studies have shown that the gaps in care represent, in part, both underuse among black persons and overuse among white

persons. New efforts toward a better understanding of and closing of these gaps in care between black persons and white persons are needed.

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