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Data for the Texas Health Care Information Council was analyzed to identify the difference in the rates of invasive cardiovascular procedures performed on men and women among 411 Texas hospitals with the diagnosis of coronary heart disease in 1999. In all, 150,361 cases were compared for differences between gender, race, age and type of invasive cardiovascular procedure using chi-square test. Frequencies were tabulated for age, race and gender. Invasive cardiac procedures were differentiated by type: coronary angiography and coronary revascularization. Between the ages of 45 and 79 women were more likely to have angiography performed than men in the same age group. However, young (30-44) and elderly (80+) men were more likely to receive angiographic procedures when presenting with the same symptoms as women. Also, men of all ages and races were more likely to receive revascularization procedures (PTCA, CABG) than women when presenting with coronary heart disease symptomatology. Additionally, men between the ages of 35 and 49 received twice the number of revascularization procedures than women. These findings identified patterns of treatment with defined differences between gender which may be attributed to external factors versus a true gender bias.

DIFFERENCES IN THE RATES OF CARDIOVASCULAR SURGICAL PROCEDURES IN MEN AND WOMEN WITH CORONARY HEART DISESASE IN THE STATE OF TEXAS

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INTRODUCTION

Heart disease continues to be the major cause of morbidity, mortality and health care cost in the nation. In 1995, heart disease was still the leading cause of death among people, including women, over the age of 65. Among that population, over 58 billion dollars was spent per year in health care costs.[1] Although heart disease continues to lead all causes of death, there has been a steady decline in overall mortality over the past 30 years in men and women.[2] Many advances in treatment and diagnosis have been made for the benefit of both genders, but a difference in the use of cardiovascular diagnostic and therapeutic procedures among men and women has been noted.

Differences in the delivery of health care in regards to race, socioeconomic status, age, type of insurance and gender have been observed.[3] Over the past 15 years, research has shown that there is a difference in the use of surgical procedures for men and women when both genders are hospitalized for coronary heart disease.[3,6] Findings in previous studies have shown that women who are hospitalized for coronary heart disease undergo fewer diagnostic and therapeutic procedures than men[3,4]and specifically, coronary angiography and angioplasty were used less often in women.[5] This is either represented by an underuse of procedures in women or an overuse of procedures in men. However, previous studies have also concluded that women with positive radionuclide exercise tests were referred for cardiac angiography less frequently than men[6] and that men are four to five times more likely to undergo coronary-artery bypass surgery.[7] Other conclusions show that of those men and women presenting with new-onset chest pain and similar symptoms in the emergency department, women are diagnosed and treated less aggressively than men.[8] Furthermore, in regards to the medical management of heart disease, it has been shown that there is a higher utilization of combination therapy by cardiologists in male versus female patients.[9] Even when controlling for factors that influence procedure rates, a sex differential remains in the rates of invasive cardiac procedures.[10]

Moreover, gender biased decision making has been seen in other areas of medicine. Although a gender bias has been noted mostly in cardiovascular medicine, it has been determined that women are diagnosed less frequently with sleep apnea when presenting with the same initial symptoms.[11] Also, studies have examined the influence of gender on medical students' decision-making ability. A number of clinical vignettes were placed in the United States Medical Licensing Examination (USMLE) Step 2 for evaluation of sex bias and the subsequent answers were examined. Data suggested that students were "variably influenced by gender bias in their investigation and management of patients in a written test of clinical decision making".[12]

Journal reviews of gender bias in the delivery of health care have shown that this topic is gaining force in the literature.[13,14] From 1966-1991 few papers were published on gender bias: Three papers from 1974-79, one in 1983, eight from 1986-91. From 1992-1995, 21 papers on gender bias were published, most in regards to cardiovascular diagnosis and therapy. And this number has grown since.

Although the majority of studies on gender bias and cardiac ailments have affirmed this bias, some have found that care is quite unbiased in relation to certain procedures and protocols. For instance, after undergoing stress Tc-99 sestamibi single-photon emission computed tomography perfusion imaging, there was no gender bias revealed in referral for invasive procedures.[15]

The purpose of this study was to determine if there is a gender related difference in the use of invasive cardiovascular procedures among hospitalized patients in the state of Texas by using a newly developed database of hospital discharge data. This study sought to determine whether a significant difference in the use of procedures between men and women with coronary heart disease exists in the state of Texas.

METHODS

Data Sources

Surgical procedures were identified from hospital discharge data in the Public Use Data File (PUDF) compiled by the Texas Health Care Information Council (THCIC). The THCIC was created by the 74th Texas Legislature in 1995 and is governed by the Texas Health and Human Services Commission. The THCIC collects data from hospitals using the UB92 patient billing form, an administrative form used to submit hospital charges to third party payers. The PUDF contains patient discharge information collected from 411 Texas hospitals and currently represents discharges during 1999. The patient information contained in the PUDF ranges from patient demographics to charges for hospital procedures and includes patient diagnosis. All individual patient identities are protected in the PUDF.

Study Sample

Identification of patients with coronary heart disease was based on the presence of International Classification of Disease version 9 Clinical Modification diagnostic code (ICD-9 CM) 410.0-410.9 identifying myocardial infarction, 413.0-413.9 identifying angina pectoris, 414.0, 414.8, 414.9 identifying chronic ischemic heart disease and 786.50, 786.51, 786.59 identifying non-respiratory chest pain. To ensure that all patients included for analysis were treated for the management of coronary heart disease, only patients with a principle ICD-9 CM diagnostic code previously stated as the primary reason for admission were included. Coronary heart disease patients admitted for hospitalizations due to co-morbidity or whose record was missing a designation of race or ethnicity were excluded. Overall, this study included 150,361 cases with surgical procedures from the Texas Health Care Information Council PUDF collected in 1999.

Definition of variables

The THCIC codes diagnostic and surgical procedures in the PUDF using the ICD-9 CM classification system. The surgical procedures, which were classified as the principal ICD-9 surgery code in the PUDF were used to identify the primary surgical procedure. The surgical procedures evaluated were ICD-9 CM classifications 37.22, 37.23 and 88.55-88.57 for coronary angiography and ICD-9 CM classifications for coronary revascularization: ICD-9 CM classifications 36.00-36.02, 36.05 for percutaneous transluminal coronary angioplasty and ICD-9 CM classifications 36.10-36.19 for coronary artery bypass surgery. Age was classified into 13 categories, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85-89 and 90+.

The PUDF classifies race and ethnicity as separate variables. Racial categories include White, Black, American Indian, Asian/Pacific Islander and other. Ethnicity is categorized as Hispanic or non-Hispanic. For the purposes of this study, race and ethnicity were classified into one variable defined as White non-Hispanic, Black non-Hispanic, Hispanic (i.e., White Hispanic and Black Hispanic), and Other. Due to the small numbers of American Indians and Asian/Pacific Islanders, these individuals were classified as Other.

Statistical Analysis

Descriptive statistics and an analytical analysis of male-to-female rate ratios with 95% confidence intervals were conducted. These rate ratios were then stratified according to principal diagnosis, age and race/ethnicity (White, Black, Hispanic and Other). The rate ratios were calculated separately for diagnostic procedures (i.e. angiography) and therapeutic procedures (i.e. coronary artery bypass graft, percutaneous transluminal coronary angioplasty). In this analysis the principal diagnosis of non-respiratory chest pain from the therapeutic procedure relative risk table was excluded because revascularization procedures are normally not preformed based solely on this diagnosis.

RESULTS

The total patient population used in our analysis was 150,361 with 84,173 (56%) male and 66,188 (44%) female patients. Clinical and demographic information are provided in Table 1. Overall, men were more likely to present with the diagnosis of myocardial infarction and chronic ischemic heart disease. This increased proportion of men with the above diagnoses was an expected, statistically significant finding ($p<0.05$). There was a greater proportion of females in the older age groups. Females were also more likely to be non-white.

The overall rate per 100 discharges of angiography according to the data was 20.4 for females and 18.6 for males. For all principal diagnoses with the exception of chronic ischemic heart disease the differences in the rates was not significant. In the young population (30-39) and the elderly population (85-90+) the rates of angiography in men were significantly higher than in women. In contrast though, the rate of angiography in the middle age groups (45-79) was significantly higher in women than in men. Furthermore, in all ethnicities, with the exception of African Americans, women had a higher statistically significant rate of angiography than men. In the black patient population the rates of angiography were significantly higher in men than in women. (Table 2)

The rate per 100 discharges of revascularization procedures (i.e. CABG, PCTA) was 29.2 in females and 45.9 in males. While stratifying the rates for all principal diagnoses, age groups and ethnicities, the rates of revascularization procedures in men were significantly higher than the rate in women. Furthermore, in some age groups (35-49) the rates of these therapeutic procedures in men were double the rate seen in women. (Table 3)

DISCUSSION

These results show a distinct relationship between gender and the rates of revascularization procedures within the state of Texas. However, the rates of angiography are similar if not higher in women than in men which proved to be an unexpected finding. The latter shows a shift in the administration of cardiovascular procedures from previous studies. We have shown at the turn of the century a women is just as likely to have an angiographic study performed as a man when presenting with the same diagnosis to a Texas hospital.

Although strides to eliminate bias, including gender bias, in the health care community have been steady, the fact remains that men have a much greater chance of receiving a revascularization procedure than women in the state of Texas. This difference represents either an underuse of these procedures in women or an overuse of these procedures in men. There are several factors that could possibly influence this difference.

First, the Framingham Heart Study and other sources observed that the incidence rate of coronary heart disease is higher in men than in women. Thus, if a man presents with the same cardiovascular symptomology as a woman, health care providers may be more inclined to place coronary heart disease higher on the differential diagnosis list for men than for women. Also, students are taught from early in their medical training that a women's presentation of a myocardial infarction is seemingly more variable than the presentation in a man.[16] This fact can also lead to a higher rate of initial cardiovascular procedures in men due to the apparent straightforward nature of the presentation in men.

Secondly, it has been postulated that this gender difference in cardiovascular procedures can be partly attributed to differing patient preferences regarding these procedures. This school of thought was prevalent due to studies showing that women were possibly more likely than men to adapt their lifestyle and use medications in order to avoid surgery, thus leading the medical community to assume that men had a preference for more invasive cardiovascular procedures.[17] More recently though, a cohort of patients with cardiovascular disease showed that women actually have a greater preference for cardiac catheterization, angioplasty and CABG after controlling for factors such as health status, socioeconomic status, symptom severity and prior use of procedures.[18] The idea of gender preference for procedures is obviously under debate, but we believe this is a factor that may need to be assessed on an individual basis in which the health care provider must obtain personal historical patient information that is influential in the decision making process. The provider can then present unbiased information about the procedure and also subside unfounded fears or anxieties.

Thirdly, it has been reported that women may present with more intense and frequent bodily symptoms overall than men.[19] This idea may be leading providers to take the complaints of men more seriously than women. The lesser intensity and frequency of cardiovascular symptoms in men could be leading to a greater provider fear of missing a potential diagnosis. This in turn could account for the greater number of procedures in men than in women.

There are a number of potential limitations that pertain to this study. First, in this study we are adjusting for selected potential confounders, therefore a number of confounding variables exist that are not being adjusted for such as secondary procedures, secondary diagnoses, initial vs. secondary hospitalization and so on. Secondly, the extent of the cardiac disease is not documented in the data. For instance, the amount of left ventricular function remaining is not known, the percentage of arterial blockage is not known and so on. This information would obviously influence the decision making process in regards to whom should receive a diagnostic procedure. If this information was known, then the reasons why certain patients might be referred for procedures could possible be better explained. Also, this study only pertains to the state of Texas. It has been documented that different regions of the nation have different outcomes in regards to similar studies. Extrapolating the results of this study to include other geographical regions and other areas of medicine should be done with caution.

Gender bias in diagnosing disease with similar clinical presentations is not an uncommon theme in the literature. It has been shown that depression is diagnosed more often in women[20], that chronic obstructive pulmonary disease is diagnosed more often in men[21] and even clinical trials use significantly more men than women.[22] The essential question is whether or not this represents a true gender bias or not. In the case of COPD it has been noted that the use of specific diagnostic tests (i.e. spirometry) can cancel out any gender bias.

The results of this study support the finding of studies done in other population groups. Further studies should be undertaken to determine if differences exist at the physician level with respect to treatment and diagnosis of patients. The ultimate test could be measuring patient outcomes.[23] If a lack of gender differences in disease outcomes is present then can it be extrapolated that there is a true absence of gender bias in diagnosis and treatment? If this is the proper measuring stick this question could lead us to a revelation - that minimal or no gender bias exists in today's medical community or that a true gender bias, devoid of external controllers, is present in the diagnosis of some diseases.

APPENDIX A

<u>TABLE 1</u>

Demographic Data

	Men	Women
Total discharges	84,173	66,188
		percent of discharges in parentheses
Principal Diagnosis		
Myocardial infarction	23,412 (27.8)	15,755 (23.8)
Angina pectoris	1,043 (1.2)	1,532 (2.3)
Chronic ischemic disease	45,847 (54.5)	29,787 (45.0)
Chest pain	13,871 (16.5)	19,114 (28.9)
Age		
30-34	874 (1.0)	411 (0.6)
35-39	2,371 (2.8)	1,422 (2.1)
40-44	4,900 (5.8)	2,902 (4.4)
45-49	7,432 (8.8)	4,699 (7.7)
50-54	10,156 (12.1)	6,154 (9.3)
55-59	10,940 (13.0)	6,474 (9.8)
60-64	10,179 (12.1)	6,684 (10.1)
65-69	10,997 (13.1)	8,472 (12.8)
70-74	10,562 (12.5)	9,191 (13.9)
75-79	8,433 (10.0)	8,613 (13.0)
80-84	4,582 (5.4)	5,955 (9.0)
85-89	2,070 (2.5)	3,578 (5.4)
90+	677 (0.8)	1,633 (2.5)
Race/Ethnicity		
White	59,965 (71.2)	43,663 (66.0)
Black	6,166 (7.3)	7,691 (11.6)
Hispanic	13,120 (15.6)	11,772 (17.8)
Other	4,922 (5.8)	3,062 (4.6)

TABLE 2

Angiography

	RATE IN MEN	RATE IN WOMEN	RELATIVE RISK (95% confidence interval)
Principal diagnosis			
Myocardial infarction	16.6	15.9	1.04 (1.00-1.08)
Angina pectoris	20.2	21.2	0.95 (0.80-1.12)
Chronic ischemic disease	19.1	22.9	0.83 (0.80-0.85)*
Chest pain	20.1	20.3	0.99 (0.95-1.04)
Age			
30-34	22.1	13.6	1.62 (1.24-2.11)*
35-39	22.6	22.2	1.02 (1.01-1.02)*
40-44	22.1	21.3	1.04 (0.94-1.15)
45-49	21.2	24.6	0.86 (0.79-0.94)*
50-54	19.7	24.3	0.81 (0.75-0.87)*
55-59	18.8	25.1	0.75 (0.71-0.79)*
60-64	18.2	23.4	0.78 (0.73-0.83)*
65-69	17.8	22.9	0.78 (0.74-0.82)*
70-74	18.2	20.2	0.90 (0.85-0.95)*
75-79	17.5	18.8	0.93 (0.87-0.99)*
80-84	16.4	14.9	1.10 (1.00-1.21)
85-89	11.0	9.6	1.15 (0.92-1.35)
90+	4.4	2.9	1.52 (0.98-2.34)
Race/Ethcicity			
White	18.1	19.9	0.91 (0.89-0.93)*
Black	22.1	20.0	1.11 (1.04-1.19)*
Hispanic	19.5	22.1	0.88 (0.84-0.92)*
Other	17.5	22.0	0.79 (0.72-0.87)*

*$p < 0.05$

TABLE 3

Revascularization

	RATE IN MEN	RATE IN WOMEN	RELATIVE RISK (95% confidence interval)
Principal diagnosis			
Myocardial infarction	43.7	29.9	1.46 (1.42-1.50)*
Angina pectoris	2.5	0.9	2.78 (1.48-5.22)*
Chronic ischemic disease	61.9	49.1	1.26 (1.24-1.28)*
Age			
30-34	15.6	8.5	1.83 (1.30-2.58)*
35-39	24.2	11.5	2.10 (1.80-2.44)*
40-44	34.1	15.9	2.14 (1.96-2.33)*
45-49	42.2	20.8	2.03 (1.92-2.15)*
50-54	47.7	26.6	1.79 (1.71-1.87)*
55-59	51.6	32.6	1.58 (1.52-1.64)*
60-64	53.3	34.5	1.54 (1.49-1.59)*
65-69	54.2	37.0	1.46 (1.41-1.51)*
70-74	50.4	37.2	1.35 (1.28-1.39)*
75-79	45.2	33.9	1.33 (1.28-1.38)*
80-84	35.0	26.4	1.33 (1.25-1.41)*
85-89	21.1	14.4	1.46 (1.30-1.64)*
90+	9.9	6.1	1.62 (1.21-2.17)*
Race/Ethcicity			
White	47.6	30.8	1.54 (1.52-1.56)*
Black	28.3	19.1	1.48 (1.39-1.57)*
Hispanic	42.4	27.3	1.55 (1.50-1.60)*
Other	56.4	40.3	1.40 (1.34-1.60)*

*$p < 0.05$

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