# Gender and the Treatment of Heart Disease in Older Persons in the United States, France, and England: A Comparative, Population-Based View of a Clinical Phenomenon

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## ABSTRACT

**Background:** Gender disparities in the treatment of coronary artery disease (CAD) have been extensively documented in studies from the United States. However, they have been less well studied in other countries and, to our knowledge, have not been investigated at the more disaggregated spatial level of cities.

**Objective:** This study tests the hypothesis that there is a common international pattern of gender disparity in the treatment of CAD in persons aged ≥65 years by analyzing data from the United States, France, and England and from their largest cities—New York City and its outer boroughs, Paris and its First Ring, and Greater London.

**Methods:** This was an ecological study based on a retrospective analysis of comparable administrative data from government health databases for the 9 spatial units of analysis: the 3 countries, their 3 largest cities, and the urban cores of these 3 cities. A simple index was used to assess the relationship between treatment rates and a measure of CAD prevalence by gender among age-adjusted cohorts of patients. Differences in rates were examined by univariate analysis using the Student *t* test for statistical differences in mean values.

**Results:** Despite differences in health system characteristics, including health insurance coverage, availability of medical resources, and medical culture, we found consistent gender differences in rates of percutaneous transluminal coronary angioplasty and coronary artery bypass grafting across the 9 spatial units. The rate of interventional treatment in women with CAD was less than half that in men. This difference persisted after adjustment for the prevalence of heart disease.

**Conclusions:** A consistent pattern of gender disparity in the interventional treatment of CAD was seen across 3 national health systems with known differences in patterns of medical practice. This finding is consistent with the results of clinical studies suggesting that gender disparities in the treatment of CAD are due at least in part to the underdiagnosis of CAD in women. (*Gender Med*. 2004;1:29–40) Copyright © 2004 Excerpta Medica, Inc.

**Key words:** CAD, coronary disease treatment, gender disparity.

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## INTRODUCTION

Although inequity in the provision of health services is anathema, there continue to be widely observed variations in the management of coronary artery disease (CAD) that cannot be attributed solely to clinical factors. Studies based on individual patient data have emphasized the importance of race and ethnicity,[1–8] insurance status,[9,10] age,[11,12] proximity to services,[13,14] socioeconomic status,[15,16] and geographic location[17–20] in accounting for variations in rates of treatment of CAD.

Gender differences in the treatment of diagnosed CAD have been well documented in many clinical studies from the United States[21–27] but rarely in population-based studies relying on administrative data.[28] Although gender may not overtly affect treatment decisions in clinical studies in patients with diagnosed heart disease, women are less likely to be diagnosed with heart disease than men. A meta-analysis of the English-language literature concluded that men were more likely to undergo noninvasive cardiac investigation than women, although subsequent evaluation and treatment showed "no clear evidence of gender differences."[29] Women have been reported to be less likely than men to be referred for cardiac catheterization and coronary angiography.[23,30] Another study suggested that women "are not being evaluated aggressively enough."[31]

Based on a search of the MEDLINE and ProQuest Direct databases for articles on the treatment of heart disease, we identified a small number of studies of gender disparities in the treatment of CAD from countries other than the United States. At least 5 studies from the United Kingdom[32–36] and 1 from Quebec[37] reported a systematic difference in the treatment received by men and women that could not be explained by disease severity or comorbidities. A study from Spain cited gender differences in clinical status at the time of treatment of CAD as an explanation for the observed disparities in treatment.[38] Reports from the Netherlands[39] and Israel[40] found no evidence of inappropriate undertreatment of women, but noted greater age and the presence of more comorbidities in women as a possible explanation for the different rates of intervention.

The purpose of the present article was not to replicate previous clinical studies but to provide a comparative population-based perspective on the phenomenon of gender differences in the treatment of CAD. As part of a larger project examining 3 world cities with different health systems[41]—New York, Paris, and London—this article explores the extent of gender disparities in the treatment of CAD in the United States, France, and England. This broad perspective across 9 spatial units of analysis—the 3 countries, their 3 largest cities, and the urban cores of these 3 cities—should complement existing clinical studies and avoid the limitations of studies focusing on a specific segment of the population (eg, persons with a single type of insurance coverage, those receiving care in a small number of hospitals or in only one geographic area). In addition to providing an international perspective on gender differences in the treatment of CAD, our study makes it possible to compare findings between different areas within the same country.

Although, in this era of privacy concerns, analyses based on available administrative data cannot control for the differing clinical characteristics or treatment preferences of individual patients, it would appear from the available reports that the differences in observed outcomes of revascularization procedures can be explained by individual characteristics, including age,[21,31,42–45] and that gender should not be a factor in making treatment decisions. This article tests the hypothesis that there is a common international pattern of gender disparity in the treatment of CAD.



## MATERIALS AND METHODS

### Data Sources

To obtain comparable incidence data on mortality, hospital discharges, and specific procedures for our analysis by gender in persons aged ≥65 years in the 3 nations, we used equivalent diagnosis codes from the ninth and tenth revisions of the *International Classification of Diseases*. Mortality data for the United States and New York City were obtained from the National Center for Health Statistics and the New York State and New York City departments of health, respectively. For France and Paris, mortality data were obtained from the Institut National de la Santé et de la Recherche Médicale (the French counterpart of the

US National Institutes of Health). For England and London, mortality data were obtained from the Office of National Statistics.

US data on morbidity, hospital discharges of patients with acute myocardial infarction (AMI), and rates of percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass graft (CABG) surgery were obtained from the National Hospital Discharge Survey for the 3-year period from 1997 to 1999. For Manhattan and the outer boroughs of New York City, we obtained data for the same period from the Statewide Planning and Research Cooperative System, which includes information for all residents of Manhattan discharged from all hospitals in New York State (excluding Veterans Administration hospitals, which provide health care to a male population from a 3-state area [data by residence not available] and perform <160 CABG procedures per year). For France and Paris, data were obtained from the French Ministry of Health's hospital reporting system (Programme de Médicalisation des Systemes d'Information), which centralizes the collection of hospital discharge data by patient diagnosis, procedure, age, and residence, and includes data from all hospitals (public and private) having >100 beds (thus possibly excluding a small number of discharges for AMI). For England and London, data were obtained from the Department of Health for patients treated within the National Health System. Information on coronary revascularizations funded by private providers is not routinely collected in the United Kingdom and must be obtained by surveys. The estimated proportion of revascularizations paid for by private funding varies from 7% to 30%.[46,47] However, inflating estimates of revascularization rates for England and London by 30% does not change the interpretation of the data.

The city-level hospital discharge data are for residents of the 3 cities hospitalized within or outside these cities. Thus, the hospital discharge data provide a measure of residence-based population morbidity without the confusion associated with the methods used by the Organization for Economic Co-operation and Development (OECD) and the American Heart Association that count "procedures" as well as patients. For example, based on 1998 figures from the Health Resources Utilization Branch of the National Center for Health Statistics, one might mistakenly conclude that 336,000 people had undergone 553,000 CABG procedures. In fact, the number of procedures represents a combination of code and vessel data that are difficult to interpret.[48]

### Data Reliability

Because there are no international standards for death certificates, it is difficult to analyze causes of mortality based on data from this source.[49,50] Thus, morbidity data from hospital discharge records are used to confirm the reliability of mortality data. Comparison of the mortality data with hospital discharge records is particularly appealing in developed countries, where there are accepted clinical diagnostic criteria and hospitalization is the standard of care.

To ascertain differences in the use of invasive treatments for CAD, we calculated the rates of PTCA and CABG per 100,000 persons in age-adjusted cohorts, applying the direct standardization method to the 2000 United States standard population to obtain adjustment weights.[51] Age-adjusted rates were presented by gender, and a difference-of-means test was used to examine the significance of the observed differences. Rates of diagnostic cardiac catheterization and coronary angiography were not included, as they are performed as outpatient procedures in all 3 countries and data on their frequency are unreliable.

To ensure adequate numbers of deaths, hospital discharges, and procedures for statistically meaningful comparisons and to reduce the likelihood of the results being affected by an annual anomaly, we calculated averages over a 3-year period. We assessed the independent influence of gender on access to PTCA and CABG by examining the rates of these procedures and their relation to AMI rates in the cohort aged ≥65 years across all geographic areas.

### Assessment of Disease Burden and Treatment Rates

Approximately 85% of Americans who die of CAD are aged ≥65 years. Rates of mortality attributable to CAD converge across gender as the population ages,[52] as does the prevalence of diagnosed cardiovascular disease. At 45 to 54 years, the prevalence of cardiovascular disease in men and women is 34.2 and 28.9 million, respectively; at 55 to 64 years, the corresponding values are 51.0 and 48.0 million. At 65 to 74 years, the prevalence is the same in men and women (65.2 million); it begins to be greater in women than in men at age ≥75 years (79.0 and 70.7 million, respectively).[53]

In ascertaining the burden of CAD among older men and women, we drew on the recent OECD study of heart disease,[54] which proposed that the incidence of ischemic heart disease can be approximated using the number of AMIs. We therefore focused on indicators of mortality and morbidity related to AMI. To ensure meaningful numbers and because the onset of heart disease in women is 6 to 10 years later than in men,[55] we examined mortality, morbidity, and procedure rates for the treatment of CAD among men and women aged ≥65 years. As described earlier, we relied on population-based hospital discharge data, by area of residence, to confirm the reliability of the mortality data.

To assess the relationship between treatment rates and the burden of CAD, we used an index calculated by dividing age-adjusted procedure rates for the population of each geographic area (no matter where the procedure was performed) by age-adjusted rates of hospital discharge for AMI in the population of each area (no matter where hospitals were located) and compared them across national and city-level areas. Because CAD may be asymptomatic and its true prevalence in any population is unknown, we followed the example of the OECD study[54] and used hospital discharge rates for AMI as a proxy for CAD prevalence. With respect to this proxy, a higher index reflects a higher level of service. To test the sensitivity of this index to a different measure of disease prevalence, we also calculated the index using AMI mortality rather than AMI discharges.

Although adjustment for individual patient characteristics is preferable to the use of such an index, our index represents a preliminary effort based on currently available data. Failure to consider some measure of disease prevalence when analyzing treatment rates, particularly across national boundaries, would be misleading. We are aware that AMI is not a prerequisite, or even the major indication, for an intervention, and we have not attempted to measure the appropriateness of therapy or quality of care.

## RESULTS

### Mortality

The mortality rates due to AMI across all 3 geographic areas examined—nation, city, and urban core—were consistent with well-known differences in the prevalence of CAD in the United States, France, and England.[50] At all 3 levels analyzed, older persons in France had significantly lower mortality rates due to AMI ($P < 0.05$)—the "French paradox"[56]—whereas the difference between the United States and England was small. The gender difference in mortality varied by geographic area, but, with the exception of Manhattan, where there was no gender difference, the AMI mortality rate was 14.3% to 43.1% lower in older women than in older men ($P < 0.05$) (**Table I**).

### Morbidity

Using AMI hospital discharge rates as a proxy for morbidity due to CAD, we found that the morbidity data were generally consistent with the mortality data in all 3 countries. Residents of the United States and England had higher AMI hospital discharge rates than their French counterparts—again consistent with the French paradox (**Table I**). Rates of a discharge diagnosis of AMI were significantly lower in women than in men in all areas examined (30.4%–52.9% lower; $P < 0.05$).

### Procedures

The rates of PTCA and CABG procedures in older persons were highest in the United States, followed by France and England (**Table II**). We found a striking gender disparity between men and women: rates of PTCA and CABG were significantly lower for women than for men in all geographic areas ($P < 0.05$). Furthermore, the disparities in procedure rates were remarkably similar (46.3%–71.7% for PTCA; 63.4%–81.8% for CABG), not only across nations but in the smaller, more comparable geographic areas as well.

Table I. Comparison of mortality and hospital discharge rates attributable to acute myocardial infarction (AMI) in men and women aged ≥65 years, 1998–2000 mean values.*

| Level | AMI Mortality Rate, per 100,000 Population | | | | | AMI Hospital Discharge Rate, per 100,000 Population | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Men (N) | Women (N) | Rate Difference (95% CI) | *t* | % Difference, Women vs Men | Men (N) | Women (N) | Rate Difference (95% CI) | *t* | % Difference, Women vs Men |
| National | | | | | | | | | | |
| United States | 585.2 (80,304) | 404.6 (86,588) | 180.6 (175.8–185.4) | 54.5† | –30.9 | 1762.8 (249,993) | 1127.5 (236,698) | 635.3 (627.1–643.5) | 133† | –36.0 |
| France | 293.1 (10,882) | 174.9 (10,454) | 118.2 (111.8–124.6) | 30.4† | –40.3 | 1065.9 (41,554) | 514.3 (30,291) | 551.6 (539.9–563.3) | 87.8† | –51.8 |
| England | 699.9 (20,871) | 398.0 (19,201) | 301.9 (290.9–312.9) | 43.9† | –43.1 | 1131.7 (35,320) | 661.8 (30,941) | 469.9 (456.1–483.7) | 60.2† | –41.5 |
| City | | | | | | | | | | |
| Manhattan and outer boroughs | 485.3 (1735) | 415.8 (2492) | 69.5 (41.5–97.5) | 7.9† | –14.3 | 1181.1 (4333) | 805.8 (4738) | 375.3 (335.1–415.5) | 20.8† | –31.8 |
| Paris and First Ring‡ | 244.2 (746) | 147.2 (811) | 97.0 (76.8–117.2) | 7.4† | –39.7 | 548.6 (1756) | 258.2 (1393) | 290.4 (260.4–320.4) | 18.9† | –52.9 |
| Greater London | 654.0 (2302) | 366.4 (2171) | 287.6 (256.8–318.4) | 13.4† | –43.9 | 1037.5 (3829) | 573.9 (3281) | 463.6 (425.5–501.7) | 10.6† | –44.7 |
| Urban core | | | | | | | | | | |
| Manhattan | 392.7 (288) | 394.7 (470) | –2.0 (–59.6–55.6) | –0.1 | <0.5 | 829.2 (623) | 576.9 (673) | 252.3 (174.3–330.3) | 7.6† | –30.4 |
| Paris | 241.0 (287) | 143.4 (326) | 97.6 (65.7–129.5) | 4.1† | –40.5 | 505.8 (611) | 254.5 (559) | 251.3 (206.1–296.5) | 9.7† | –49.7 |
| Inner London | 589.8 (726) | 343.9 (656) | 245.9 (195.9–295.9) | 7.9† | –41.7 | 907.1 (1163) | 539.3 (1010) | 367.8 (306.2–429.4) | 10.6† | –40.5 |

*All rates were age standardized by a direct method using age-adjustment weights based on the 2000 US population aged ≥65 years.[51]

†$P < 0.05$.

‡The First Ring includes the departments of Hauts-de-Seine, Seine–St.-Denis, and Val-de-Marne.

Table II. Comparison of hospital discharge rates for percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass grafting (CABG) in men and women aged ≥65 years, 1998–2000 mean values.*

| | Discharges for PTCA, per 100,000 Population | | | | | Discharges for CABG, per 100,000 Population | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Level | Men (N) | Women (N) | Rate Difference (95% CI) | *t* | % Difference, Women vs Men | Men (N) | Women (N) | Rate Difference (95% CI) | *t* | % Difference, Women vs Men |
| National | | | | | | | | | | |
| United States | 1274.8 | 360.9 | 913.9 | | | 956.9 | 335.5 | 621.4 | | |
| | (185,386) | (73,581) | (907.6–920.2) | 281.0† | –71.7 | (139,159) | (68,410) | (615.8–627.0) | 216.0† | –64.9 |
| France | 629.4 | 196.8 | 432.6 | | | 470.5 | 104.4 | 366.1 | | |
| | (21,783) | (9360) | (423.4–441.8) | 94.8† | –68.7 | (18,409) | (5908) | (358.8–373.4) | 98.6† | –77.8 |
| England | 114.9 | 61.7 | 53.2 | | | 228.3 | 66.1 | 162.2 | | |
| | (5123) | (2786) | (49.3–57.1) | 39.2† | –46.3 | (7815) | (2910) | (156.6–167.8) | 60.0† | –71.0 |
| City | | | | | | | | | | |
| Manhattan and | 736.7 | 343.6 | 393.1 | | | 550.9 | 201.9 | 349.0 | | |
| outer boroughs | (2673) | (402) | (349.5–436.7) | 27.1† | –53.4 | (2419) | (236) | (315.2–382.8) | 28.8† | –63.4 |
| Paris and | 642.7 | 202.6 | 440.1 | | | 584.9 | 114.0 | 470.9 | | |
| First Ring‡ | (1994) | (961) | (409.2–471.0) | 28.7† | –68.5 | (1987) | (553) | (443.6–498.2) | 35.0† | –80.5 |
| Greater London | 234.7 | 95.0 | 139.7 | | | 260.4 | 78.3 | 182.1 | | |
| | (935) | (499) | (122.2–157.2) | 32.1† | –59.5 | (1038) | (411) | (164.6–199.6) | 21.4† | –69.9 |
| Urban core | | | | | | | | | | |
| Manhattan | 815.6 | 356.0 | 459.6 | | | 479.7 | 142.9 | 336.8 | | |
| | (599) | (402) | (385.9–533.3) | 12.9† | –56.4 | (353) | (167) | (282.0–391.6) | 12.3† | –70.2 |
| Paris | 597.1 | 206.8 | 390.3 | | | 606.8 | 110.5 | 496.3 | | |
| | (676) | (378) | (344.8–435.8) | 15.9† | –65.4 | (762) | (180) | (450.4–542.2) | 22.8† | –81.8 |
| Inner London | 268.8 | 118.6 | 150.2 | | | 230.1 | 75.7 | 154.4 | | |
| | (494) | (229) | (122.0–178.4) | 13.3† | –55.9 | (319) | (132) | (126.1–182.7) | 11.4† | –67.1 |

*All rates were age standardized by a direct method using age-adjustment weights based on the 2000 US population aged ≥65 years.[51]
†$P < 0.05$.
‡The First Ring includes the departments of Hauts-de-Seine, Seine–St.-Denis, and Val-de-Marne.

Differences in procedure rates must be interpreted in light of information about estimated rates of the illness for which they were indicated. When we examined the ratios of procedures to AMI hospital discharge rates (a proxy for disease burden), we found that CABG ratios were approximately twice as high for men as for women in all areas and that PTCA ratios were approximately one and one half times as high for men as for women (**Table III**). Despite differences in the index across geographic areas (and a markedly high CABG/AMI index for residents of Paris, particularly men), the male/female ratios were strikingly similar. When we tested the sensitivity of this index by calculating the index using AMI mortality instead of AMI discharges, we found no significant difference in the results. The ratios for CABG changed to 2.0, 2.7, and 2.0 for the United States, France, and England, respectively; to 2.3, 3.1, and 1.9 for New York City, Paris and the First Ring (departments of Hauts-de-Seine, Seine–St.-Denis, and Val-de-Marne), and London, respectively; and to 3.4, 3.3, and 1.6 for Manhattan, Paris, and Inner London. The corresponding ratios for PTCA changed to 2.4, 1.9, and 1.1; 1.8, 1.9, and 1.4; and 2.3, 1.7, and 1.3.



## DISCUSSION

Because it is not possible to control for individual patient characteristics, the use of administrative data as a basis for international comparisons of gender disparities in medical practices can never fully explain the observed differences. It can, however, reveal the magnitude of any disparities across large populations with differences in health care coverage, availability of medical resources, and other health system characteristics, including medical culture. England provides universal health care coverage under the National Health Service, and France provides universal coverage through national health insurance. In the United States, inpatient care for older persons is only partially covered by Medicare, and, until recently, beneficiaries received no prescription drug coverage for ambulatory care unless they had previously purchased supplemental insurance or retained coverage from a former employer.

Table III. Relationship between rates of coronary artery bypass grafting (CABG) and percutaneous transluminal coronary angioplasty (PTCA) and estimated disease burden in men and women aged ≥65 years.*

| | Rates of CABG per AMI | | | Rates of PTCA per AMI | | |
|---|---|---|---|---|---|---|
| Level | Men | Women | Male:Female Ratio | Men | Women | Male:Female Ratio |
| National | | | | | | |
| United States | 0.56 | 0.29 | 1.9 | 0.74 | 0.31 | 2.4 |
| France | 0.44 | 0.21 | 2.2 | 0.59 | 0.38 | 1.5 |
| England | 0.20 | 0.10 | 2.0 | 0.13 | 0.09 | 1.4 |
| City | | | | | | |
| Manhattan and outer boroughs | 0.47 | 0.25 | 1.9 | 0.62 | 0.43 | 1.5 |
| Paris and First Ring† | 1.07 | 0.44 | 2.4 | 1.17 | 0.78 | 1.5 |
| Greater London | 0.25 | 0.14 | 1.8 | 0.23 | 0.16 | 1.4 |
| Urban core | | | | | | |
| Manhattan | 0.59 | 0.25 | 2.3 | 0.98 | 0.61 | 1.5 |
| Paris | 1.20 | 0.43 | 2.8 | 1.18 | 0.81 | 1.5 |
| Inner London | 0.25 | 0.14 | 1.8 | 0.30 | 0.22 | 1.3 |

*Discharge rates for acute myocardial infarction (AMI) were used as a proxy for the estimated disease burden. The index for assessing use of these procedures was calculated by dividing age-adjusted procedure rates for the population of each geographic area (no matter where the procedure was performed) by the age-adjusted AMI discharge rates (no matter where hospitals were located). Thus, in relation to the proxy, a higher index reflects a higher level of service.
†The First Ring includes the departments of Hauts-de-Seine, Seine–St.-Denis, and Val-de-Marne.

Comparison of national health systems can provide insights into the effects of health system characteristics on medical practices, but a sole focus on national aggregates masks important variations within nations—for example, between urban and rural areas, large and small cities, and cities and suburbs. In addition to differences in systems of health care financing and delivery, there are differences in medical resources and medical culture within[57,58] and between countries. This makes it difficult to assess the effects of any one factor on medical practices. To address these limitations, we examined city-level data in addition to national data.

Compared with their nations overall, New York, Paris, and London share many sociodemographic characteristics (greater inequalities in income and more ethnic diversity) but have different health system characteristics. Looking at these cities provided a unique framework within which to investigate the influence of health systems on gender disparities in the treatment of CAD. We took advantage of data collected across 3 different spatial units—nations, cities, and urban cores—to test the consistency of our findings.

CAD is known to be the leading cause of death for both men and women in nations belonging to the OECD. Despite this, older persons are often excluded from clinical trials of CAD.[59] The impression that CAD is a "man's disease" and not an urgent concern in women has resulted in policies and programs that appear to address women with heart disease inadequately. Even when heart disease is recognized as a problem in women, it is generally associated with the "older old" and is often not well documented or properly investigated. Between 1979 and 1998, the rate of mortality attributed to AMI decreased much more rapidly in men aged ≥65 years than in women in the same age group.[60]

Our analysis points to significant gender disparities in the incidence of procedures for CAD among older persons in all areas of the United States, France, and England studied. The consistency of the results across spatial units was striking given the differences in treatment rates for CAD. Despite differences in the use of CABG and PTCA that reflect differences in health system characteristics, there was a consistent pattern of gender disparity in the treatment of CAD.

Although the gender gap in the incidence of CAD has been explored in the literature,[61] the reasons for the disparity remain unclear. Women with AMI are twice as likely to die from the event as men, at least in part because of the occurrence of AMI at an older age and in those with more comorbid conditions.[56] Nonetheless, there is no evidence to support use of the different therapeutic approach to women that we observed.[47]

The discrepancy between the sexes may be the result of sociocultural or biological distinctions. For example, there were differences in the clinical profiles, presentations, and outcomes in men and women with acute coronary syndromes in the Global Use of Strategies to Open Occluded Coronary Arteries in Acute Coronary Syndromes angioplasty substudy (GUSTO IIb) that could not be accounted for by differences in baseline characteristics.[62] Although the investigators concluded that the findings could be explained by variations in underlying anatomy or pathophysiology, they also observed gender differences in the rates of referral for diagnostic testing and revascularization, which raises the possibility of a gender bias. Studies from Boston[23] and Chicago[30] reported lower rates of diagnostic coronary angiography in women that were related to age and symptom interpretation. However, having undergone catheterization, women were found to be as likely to undergo angioplasty as men but less likely to undergo CABG, based on both age and gender.[63] A study from the United Kingdom reported similar findings in patients with a diagnosis of AMI or ischemia: there was no gender difference in the use of revascularization overall, but men were more likely to undergo CABG.[64]

Whether female gender is an independent risk factor for a poor outcome after surgical revascularization remains controversial. Whereas some data indicate that female gender is no longer a predictor of increased risk,[65,66] particularly after adjustment for body size,[67] other studies have concluded that gender is a risk factor.[21,41] Similarly, although earlier studies of PTCA reported poorer results in women,[68,69] a more recent study described better outcomes for women than men.[70]

Data collected for administrative purposes may be used to analyze patterns of clinical care, as we have done here. Yet, these data, which typically contain only limited information on patient demographic characteristics, discharge diagnoses, and procedure codes, make it impossible to adjust adequately for risk factors and differences in disease severity or comorbidities. The results of some clinically based studies suggest that certain gender differences disappear after controlling for various risk factors, whereas others do not support this suggestion.[71–73] A more clinically detailed data set might explain our findings concerning gender differences; however, even a study that directly examined gender differences in the severity of illness provided no explanation, because use of different severity measures produced different estimates of whether women were sicker than men.[74]

A multiplicity of intangible and subjective factors influence medical decision-making: the doctor–patient relationship, unconscious physician bias,[75] patient preference (and the extent to which it is influenced by age and gender[76,77]), and, not least, practice patterns—whether related to professional "uncertainty"[78] or "enthusiasm."[79] Although the data do not allow assessment of the magnitude of the role played by these factors, our findings highlight the importance of conducting such assessments. In addition, our data did not allow us to assess the appropriateness of the procedures studied (ie, whether they were "overused" in men or "underused" in women). Rather, our findings highlight the need for additional research to evaluate these and other influences on the observed gender discrepancies.

## CONCLUSIONS

The magnitude of the gender disparities observed in the treatment of CAD in the United States, France, and England is incontrovertible. Moreover, despite differences in populations, health systems, health insurance coverage, medical resources, and medical culture, this pattern was consistent across the 3 countries, their 3 largest cities, and the cities' urban cores. Based on our literature review, the observed disparities cannot be explained on the basis of either clinical data or patient preference.

These findings call for more clinical and population-based research to examine the extent to which gender disparities result in inappropriate use of advanced medical procedures. Such analyses will require detailed data on individual-level socioeconomic and clinical variables. The present evidence is sufficient to support development of policies to encourage increased physician awareness of gender disparities and thus improve the care of women with CAD.

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