Impact of Sex on Long-term Mortality From Acute Myocardial Infarction vs Unstable Angina

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Background: Patient sex has been shown to differentially affect mortality from unstable angina (UA) and acute myocardial infarction (AMI). However, to our knowledge, no prior population-based studies have examined both cohorts simultaneously to explain this intriguing variation. Hence, we undertook to explore and explain sex differences in 5-year mortality after UA and AMI.

Methods: We used an administrative database of 22967 patients with AMI and 8441 patients with UA discharged from acute care hospitals in Alberta between April 1, 1993, and March 31, 2000.

Results: Women were older with more baseline comorbidities, more frequently had a diagnosis of UA, and had 30% lower relative odds of undergoing revascularization than men. Kaplan-Meier estimates of 5-year mortality were similar between sexes after UA (women vs men, 21.6% vs 19.5%; P = .09) but markedly higher for women after AMI (38.5% vs 26.6%, P < .001). After adjustment for baseline characteristics and revascularization, the hazard ratios (95% confidence intervals) for women vs men were 0.81 (0.72-0.92) after UA and 0.99 (0.93-1.05) after AMI. Only women younger than 65 years were at a significantly higher risk after AMI. The reasons for this difference in sex-related outcomes between UA and AMI may relate to greater disparities in the AMI cohort with respect to age, comorbidities, neighborhood incomes, and referrals to cardiovascular specialists.

Conclusions: Relative to UA, AMI has a more serious impact on women than men, such that women have a survival advantage when afflicted with UA but lose that advantage with AMI. Additional investigation into the causes, treatment, and policy implications of the age-sex interaction is warranted.

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For the last 15 years, women’s health issues, especially those related to heart disease, have received increasing attention.1 The clinical profile of women presenting with acute coronary syndromes (ACSs) differs substantially from that of men, and several studies2-7 have documented significant differences in the therapeutic strategies used to treat men and women with ACS. However, to our knowledge, there has been no comprehensive population-based analysis examining the relative prognostic importance of clinical vs process-of-care factors on short- and long-term mortality among men and women presenting with ACS.

To date, most studies examining sex differences have focused on subgroups and have not included the full spectrum of ACS, extending from ST-segment elevation myocardial infarction (MI) to non-ST-segment elevation MI and unstable angina (UA). In the acute myocardial infarction (AMI) population, certain studies2,8,9 have shown that women (especially younger women) tend to be at a higher short-term risk than men, yet these differences in mortality attenuated after adjusting for baseline characteristics or long-term follow-up3,4,8,10-16 while others have shown a higher mortality rate for women at 30 days2,5,17 and 1 year11,13 even after baseline adjustment. These inconsistent results may be, in some part, due to differences in study design. While some studies were population-based,2,5,18 most were hospital-based and depended on samples from consecutive admissions or on randomized clinical trials.

There have been few studies6,10,19,20 examining sex disparities in UA, and all have been based on patients enrolled in clinical trials. These studies reported short-term (infarct-free) survival that was similar or better among women compared with men. To our knowledge, there are no data on sex differences in long-term survival among patients with UA.
The present study is a comprehensive population-based examination of differences in short- and long-term outcomes among men and women across the ACS spectrum. Longitudinal data from the administrative database of all residents discharged from acute care hospitals in Alberta, a western Canadian province of more than 3 million residents (in 2001), were used for the study. The primary objectives of the study were to address the following questions: (1) Do the long-term (5-year) mortality rates after AMI and UA differ between women and men? (2) Are there disparities in baseline patient and provider characteristics and care processes that modulate differences between women and men in long-term survival after AMI and UA?

METHODS

ALBERTA HEALTH AND WELLNESS DATABASES

We used the data collected and maintained by the Ministry of Health and Wellness. In Alberta, the health care system is publicly administered and funded, which guarantees universal access to hospital and medical services for all residents. The province was divided into 17 regional health authorities, with 3 regional tertiary care centers (capable of performing coronary angiography, percutaneous coronary intervention [PCI], and coronary artery bypass graft surgery [CABG]) located in the 2 metropolitan health regions of Edmonton and Calgary. For this study, we retrieved computerized hospital discharge abstracts from April 1, 1993, to March 31, 2000, with a most responsible diagnosis of AMI or UA according to the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 410 or 411.1. There were 48326 ACS hospital discharges in Alberta during the study period for patients aged 18 years or older: 33015 (68.3%) and 15311 (31.7%) had AMI and UA, respectively, as the most responsible diagnosis. To identify the index admission for each discrete patient, we included only those AMI discharges that were identified as initial episodes of care, based on the fifth digit of the ICD-9-CM code, and adopted a decision rule that designated the first AMI admission, if any, to be the index admission even if there was a prior UA admission. Therefore, UA patients were those whose most responsible diagnosis for any readmission was UA and who had no AMI admission during the study period. This approach was justified on the grounds that long-term mortality was lowest for patients with UA admissions only, and patients with UA followed by AMI fared no better than those with an initial AMI admission (crude mortality rates for these 3 groups were 4.8%, 13.2%, and 16.3% at 1 year, respectively). Moreover, to track mortality over time using the administrative records, we restricted our study population to the residents of Alberta. There were 22967 initial care AMI and 8441 UA patients in our final database.

Each discharge record contained up to 16 diagnostic and 10 procedure codes based on the ICD-9-CM coding scheme. Diagnosis type was used to further distinguish between readmission and postadmission comorbidities. All these codes were scanned to identify the preexisting comorbidities, in-hospital complications, and procedures during the index and repeat hospitalizations. To ascertain the survival status following discharge, this database was further linked with the health care insurance registry files containing information on the termination of provincial health care insurance because of death, if any, and the date of termination. We found that there was a high degree of concordance in the recorded in-hospital mortality status between the inpatient discharge abstracts and the health care insurance registry files for Alberta residents: 95% overall, 92% for the first 2 years, and 95% to 99% for the remaining 5 years.

NEIGHBORHOOD INCOME DATA

These administrative databases were further linked with the Statistics Canada 1995 neighborhood income data, using the first 3 digits of postal codes, that are publicly available from the Statistics Canada Web site. The mean household income was available for 134 of the 169 postal codes in our database, as Statistics Canada suppressed income data for 35 postal codes because of small samples. We were able to assign a mean neighborhood household income to 30745 patients based on their recorded place of residence, leaving 663 patients with missing neighborhood income data.

STATISTICAL ANALYSIS

For the purpose of data analysis, postal codes were initially divided into quintiles from lower to higher annual income but were later dichotomized into lower (<$45000) and higher ($>45000) income neighborhoods in 1995 Canadian dollars, based on a preliminary analysis of the relationship between income and mortality. We also grouped 17 regions into 2 metropolitan regions and an “other” (nonmetropolitan) region. Hospitals were characterized as CABG capable or non–CABG capable, according to whether they were capable of performing this procedure or not. Physicians were categorized into 3 groups in terms of the involvement of a cardiovascular specialist (ie, cardiologist or cardiovascular surgeon): (1) non–cardiovascular specialist (ie, no cardiovascular specialist involved); (2) consulting (ie, a cardiovascular specialist acting as a consultant, etc, but not as the primary physician); and (3) cardiovascular specialist (ie, a cardiovascular specialist acting as the primary physician).

Categorical data were summarized in terms of percentages and group differences were tested using the χ2 test; continuous variables were summarized in terms of medians and interquartile ranges and group differences were tested using the Kruskal-Wallis test. To estimate 5-year mortality outcomes, we censored the data for those patients whose follow-up was less than 5 years, ie, their date of the index admission was between the fiscal years 1995-1996 and 1999-2000. We used the Kaplan-Meier method to estimate unadjusted mortality rates for women and men over time. To estimate the adjusted hazard ratios for women vs men, we performed backward stepwise Cox proportional hazards regression in which revascularization (coronary angioplasty and bypass surgery) was treated as a time-dependent covariate. Fixed baseline variables included baseline patient characteristics (eg, age, sex, and preexisting health conditions such as diabetes mellitus, previous MI, and previous angioplasty), neighborhood income, and other factors such as physician specialty and hospital type (CABG capable or not).

All tests were 2-sided, with the level of significance set at P= .05. All analyses were performed using the SPSS statistical software package, version 11.0 (Chicago, Ill).

RESULTS

BASELINE CHARACTERISTICS

Of the 31408 Alberta residents who were hospitalized and discharged between April 1, 1993, and March 31, 2000, with a primary diagnosis of ACS, 20839 (66.3%) were men and 10569 (33.7%) were women. Women were older, with a median age of 73 vs 64 in men for AMI and
71 vs 65 for UA. In addition, women had more comorbidities, such as diabetes mellitus, hypertension, congestive heart failure, and chronic obstructive pulmonary disease, and they were more likely to arrive at the hospital by ambulance (Table 1). Significantly more women developed UA than men (32.3% vs 24.1%, \( P<.001 \)), and this differential was more pronounced between the ages of 45 and 64 than in other age groups (Figure 1).

Regional representations of patients by sex were comparable in the AMI cohort but differed between the 2 metropolitan regions in the UA cohort (Table 1). However, fewer women than men in the UA and AMI cohorts resided in higher-income neighborhoods, had a cardiovascular specialist as their primary physician for their index admission, and were admitted to CABG-capable hospitals.

### VARIATIONS IN PROCESS OF CARE

Women had longer lengths of stay following AMI, although fewer women were admitted to an intensive care or coronary care unit. As shown in Table 1, women were less likely to undergo inpatient angiography within the first 6 months of index admission after UA (27.6% vs 37.8%, \( P<.001 \)) and AMI (32.1% vs 41.6%, \( P<.001 \)) and were less likely to have revascularization procedures after angiography in the UA (52.9% vs 68.4%, \( P<.001 \)) and the AMI cohorts (62.7% vs 65.6%, \( P=1.00 \)). This is especially true for CABG (20.5% vs 29.2%, \( P=.001 \), al-
though there was no sex difference in the rate of PCI after inpatient angiography among AMI patients (49.5% vs 49.4%, \( P = .98 \)). The lower procedure rates among women were fairly consistent across all age categories for PCI and CABG after UA (Figure 2). However, there was a distinct negative correlation between the PCI rate and age after AMI and UA. Whereas PCI was as common in women as in men across most age groups after AMI, the overall PCI rates were still lower for women than men (21.4% vs 27.1%, \( P < .001 \)), because more women were in older age categories with lower PCI rates.

After adjusting for baseline factors, the odds of undergoing revascularization procedures remained 30% lower for women than men (Table 2). Advanced age was by far the most significant predictor of reduced revascularization rates for older (\( \geq 75 \) years) compared with younger (<65 years) patients (odds ratio, 0.31; 95% confidence interval [CI], 0.29-0.33). Two other factors were also more significant than sex in predicting revascularization: admission to a CABG-capable hospital (odds ratio, 2.37; 95% CI, 2.21-2.54) and having a cardiovascular specialist as the primary physician (odds ratio, 1.74; 95% CI, 1.61-1.88). While previous CABG was shown to reduce the likelihood of subsequent revascularization by more than half, previous PCI was associated with an increased likelihood of 89%. Except for hypercholesterolemia, hypertension, and anemia, most other comorbidities, such as a history of MI, heart failure, peripheral vascular disease, chronic obstructive pulmonary disease, and chronic renal disease, were associated with reduced procedure use. Procedure use varied among patients residing in different health regions, and the adjusted revascularization rates increased over time, especially during the last 2 fiscal years. A significant 3-way interaction among sex, age, and diagnosis (\( P < .001 \)) further confirmed the sex differences in baseline-adjusted revascularization rates, which varied among age and diagnostic groups.

**SEX DIFFERENCES IN 5-YEAR MORTALITY**

The Kaplan-Meier estimates of 5-year mortality rates did not differ significantly between women and men after UA (21.6% vs 19.5%, \( P = .09 \)) but were markedly higher in women after AMI (38.8% vs 26.8%, \( P < .001 \)) (Figure 3). A series of bivariate and multivariate Cox regression analyses, with baseline characteristics as fixed covariates and revascularization as a time-dependent variable, was performed to examine these sex differences in 5-year mor-
It exerted similar influences after AMI and UA: the baseline-adjusting for other baseline factors in both cohorts (Table 1). Age was the most influential predictor of 5-year mortality after UA (HR, 0.81; 95% CI, 0.72-0.92) but not after AMI (HR, 0.99; 95% CI, 0.93-1.05). The adjusted risk of 5-year mortality after AMI was nearly 2-fold higher than that after UA. However, the interaction between sex and the diagnosis of AMI was highly significant (P=.005) in the model for all patients, thus confirming a differential impact of patient sex after AMI and UA. Separate modeling of the AMI and UA cohorts further revealed that, after adjustment, sex was a significant predictor of 5-year mortality after UA (HR, 0.81; 95% CI, 0.72-0.92) but not after AMI (HR, 0.99; 95% CI, 0.93-1.05).

OTHER FACTORS

Age was the most influential predictor of 5-year mortality (as measured by the Wald statistic), with or without adjusting for other baseline factors in both cohorts (Table 3). It exerted similar influences after AMI and UA: the baseline-adjusted relative risk in both cohorts was increased by more than 2-fold for those aged 65 to 74 and those older than 74, relative to those younger than 65. Moreover, the effect of sex varied significantly with age after AMI and UA, although the interaction was statistically significant only in the AMI cohort (P=.008). The differential impact of sex by age group is depicted in Figure 4. The higher unadjusted 5-year mortality in women vs men after AMI (Table 1) was, in fact, confined to those in the age group younger than 65, who were at a significantly higher risk even after adjustment (Figure 4).

A history of congestive heart failure was the next most important risk factor, which doubled the risk of 5-year mortality after AMI and UA (Table 3). There was also a strong 3-way interaction among sex, prior congestive heart failure, and the diagnosis of AMI (P<.001) (Figure 4).

Other independent risk factors after AMI and UA were chronic renal disease (HR, 2.38), diabetes mellitus (HR, 1.47), peripheral vascular disease (HR, 1.41), previous MI (HR, 1.25), anemia (HR, 1.20), and chronic obstructive pulmonary disease (HR, 1.16) (Table 3). Diabetes mellitus, in particular, demonstrated a strong interaction with sex after UA (P=0.001), such that a substantially lower baseline-adjusted risk was associated only with women free of diabetes mellitus. A history of PCI was also associated with a lower risk (HR, 0.74).

Provider and environmental factors had much stronger influences on long-term mortality outcomes after AMI than after UA. Having a cardiovascular specialist as the primary physician was associated with a lower 5-year mortality after AMI (HR, 0.55; 95% CI, 0.51-0.60) and UA (HR, 0.74; 95% CI, 0.62-0.89), but the benefit of having a cardiovascular specialist acting in other capacities (eg, consulting) was less pronounced and only significant after AMI (HR, 0.87; 95% CI, 0.77-0.98). Admission to a hospital capable of performing CABG did not affect mor-

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Table 2. Predictors of Revascularization Within 6 Months of Index Admission

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
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<tr>
<td>Age, y, referent &lt;65</td>
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<tr>
<td>65-74</td>
<td>0.92</td>
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<td>≥75</td>
<td>0.31</td>
<td>(0.29-0.33)</td>
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<td>Female sex</td>
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<td>Diabetes mellitus</td>
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<td>Hypertension</td>
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<td>(1.08-1.21)</td>
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<td>Hypercholesterolemia</td>
<td>1.42</td>
<td>(1.33-1.51)</td>
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<tr>
<td>COPD</td>
<td>0.85</td>
<td>(0.75-0.96)</td>
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<tr>
<td>Previous MI</td>
<td>0.89</td>
<td>(0.83-0.96)</td>
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<tr>
<td>Previous CHF</td>
<td>0.72</td>
<td>(0.67-0.78)</td>
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<tr>
<td>Previous PCI</td>
<td>1.89</td>
<td>(1.64-2.18)</td>
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<tr>
<td>Previous CABG</td>
<td>0.42</td>
<td>(0.36-0.49)</td>
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<tr>
<td>PVD</td>
<td>0.72</td>
<td>(0.63-0.82)</td>
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<td>Most responsible diagnosis</td>
<td>0.92</td>
<td>(0.87-0.98)</td>
</tr>
<tr>
<td>(AMI vs UA)</td>
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<td>Chronic renal disease</td>
<td>0.58</td>
<td>(0.49-0.69)</td>
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<td>Anemia</td>
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<td>(1.04-1.29)</td>
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<td>Cardiovascular specialist</td>
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<tr>
<td>Consulting, etc</td>
<td>1.00</td>
<td>(0.86-1.16)</td>
</tr>
<tr>
<td>Primary</td>
<td>1.74</td>
<td>(1.61-1.88)</td>
</tr>
<tr>
<td>CABG capable hospital</td>
<td>2.37</td>
<td>(2.21-2.54)</td>
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<tr>
<td>Health region, referent metropolitan 1</td>
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<td>(1.14-1.32)</td>
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<tr>
<td>Metropolitan 2</td>
<td>1.14</td>
<td>(1.06-1.23)</td>
</tr>
<tr>
<td>Other</td>
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<td></td>
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<tr>
<td>Fiscal year, referent 1993-1994</td>
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<tr>
<td>1999-2000</td>
<td>1.46</td>
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</table>

Abbreviations: AMI, acute myocardial infarction; CABG, coronary artery bypass graft surgery; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; PCI, percutaneous coronary intervention; PVD, peripheral vascular disease.

There were significant interactions between age and sex (P=.004); among age, sex, and diagnosis (P<.001); and between cardiovascular specialist and CABG capable hospital. Age also interacted with cardiovascular specialist (P<.001). The c-index for this model was 0.73.

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EFFECTS OF REVASCULARIZATION

Revascularization was a strong predictor of reduced 5-year mortality before baseline adjustment but became nonsignificant after adjustment (Table 3 and Figure 5). The effect did not differ between sexes after UA, but 5-year mortality was somewhat worse for women than men after AMI (P = .05). Revascularization after UA, in particular, was associated with an early risk of 30-day mortality (adjusted HR, 3.38; P<.001), which was primarily due to CABG (adjusted HR, 5.56; P<.001). Although the risk remained significantly elevated after 1 year, it continued to diminish over time. The survival benefit of PCI after UA, on the other hand, was significant at 1 year but was not evident at 30 days and 5 years. Revascularization after AMI was associated with a lower risk at 1 year (HR, 0.76; 95% CI, 0.67-0.85), despite an early hazard of CABG at 30 days (HR, 2.21; 95% CI, 1.73-2.83), because of a significant benefit of PCI at 30 days and 1 year.
In the AMI and UA cohorts, women fared significantly worse than men after CABG, as indicated by the significant interactions with sex in the 30-day and 1-year models ($P = .002$ and $P = .02$, respectively) but not in the 5-year models ($P = .53$ and $P = .06$ after UA and AMI, respectively).

There is a need for a comprehensive, consistent, and unified overview of sex differences in the long-term outcomes across the ACS spectrum. To meet this need, we used a large comprehensive database ($n > 30,000$) that included all ACS patients hospitalized during 7 years in a jurisdiction with universal health care insurance coverage for all its residents. The inclusion of the AMI and the UA patients in our study enabled us to make direct long-term comparisons between these 2 important subgroups rather than examining them in isolation, as in many other short-term studies. All our risk estimates, moreover, have been consistently adjusted for revascularization and several key patient, provider, and ecological variables to provide more reliable comparisons between sexes.

In this article, we have demonstrated that, once admitted to the hospital, women possess a long-term survival advantage over men when afflicted with UA, thereby extending previous findings of their survival advantage in the general population, as indicated by longer life expectancies for women in almost all countries in the world. Although several clinical trials also showed that women are at a lower risk up to 12 months after the onset of UA, we demonstrate that this assertion can be generalized to a contemporary population for up to 5 years. Of interest is that this survival advantage was confined to older women ($> 65$ years, particularly those $> 75$), after adjusting for baseline factors and revascularization procedures performed within 6 months of the index admissions (Figure 4). We have further shown, as in other population-based studies and clinical trials, that the survival advantage enjoyed by women was lost (or even reversed) after AMI. In our study, this loss after AMI was confined only to women younger than 65 (Figure 4). This finding corroborates and extends earlier findings that younger female AMI patients constitute a particularly high-risk group relative to their male counterparts.

The reasons why AMI poses a greater threat than UA to women are not entirely clear, although they likely relate to a host of interrelated biological, process-of-care, lifestyle, and socioeconomic factors. Biologically, women are less likely than men to develop ACS at younger ages, perhaps due to the presumed protective effect of estrogen. However, when women are afflicted with ACS, they are more likely than men to have a diagnosis of UA, such that the onset of AMI is up to a decade later, as reflected in Table 1. Moreover, serious comorbidities such as congestive heart failure, diabetes mellitus, chronic renal disease, and anemia were more common among women than men, especially in the AMI cohort. These were powerful risk fac-

Figure 4. Unadjusted (A) and baseline-adjusted (B) hazard ratios (women vs men) and 95% confidence intervals comparing 5-year mortality by diagnosis of acute myocardial infarction (AMI) and unstable angina (UA), age group, and presence of congestive heart failure (CHF) or diabetes mellitus.

Figure 5. Baseline-adjusted hazard ratios (revascularization vs none) and 95% confidence intervals, comparing women and men after revascularization, percutaneous coronary intervention (PCI), and coronary artery bypass graft (CABG), for mortality at 30 days, 1 year, and 5 years by diagnosis of unstable angina and acute myocardial infarction.
tors in our predictive models (Table 3) and are likely to explain, in part, the differential impact of sex between AMI and UA. It is also possible that worse outcomes in women after AMI relative to UA may be due to their smaller coronary artery size, or the so-called small vessel disease, which may have reduced the effectiveness of invasive procedures when applied to women.

Institutional and ecological factors in our models may also explain the differential impact of sex between the AMI and UA cohorts. The sex disparities in neighborhood incomes and referrals to cardiovascular specialists were greater in the AMI cohort and had a greater adverse effect. These 2 factors, moreover, were interrelated such that patients from more affluent neighborhoods were more likely to be cared for by a cardiovascular specialist (53.7% vs 38.6%, \( P < .001 \)). This finding agrees with an earlier study\(^{26} \) that showed a negative correlation between area income and access to specialized cardiac services in Ontario, Canada. Because women were less likely to be treated by a cardiovascular specialist (Table 1), they may be disadvantaged compared with their male counterparts. Similarly, the effect of the physician specialty was confounded by the type of hospital: the adjusted 5-year mortality rate was lower or higher for patients admitted to CAGB-capable hospitals depending on whether the physician specialty was excluded or included in the model. Further research is required to elucidate these intricate relationships.

Revascularization played a minor role with respect to long-term survival in our study. Although revascularization was associated with a 42% reduction in 5-year mortality before baseline adjustment, it became nonsignificant after adjustment for all patients and for both cohorts, as shown in some studies\(^{2,23,27-30} \) but not in others.\(^{31,32} \) This was the case even among the 9.4% of women who underwent CAGB after UA within 6 months of their index admission, as shown by their declining risk of mortality relative to men, which fell from 5.56 and 1.32 at 30 days and 1 year, respectively, to a nonsignificant risk of 0.69 at 5 years. Because the mortality rates for most patients who did not undergo revascularization after UA were consistently lower for women even without baseline adjustment, women in the UA cohort maintained a 20% lower risk of mortality throughout the 5-year study, and there was no sex difference in the impact of revascularization on 5-year mortality. By contrast, revascularization after AMI did not seem to benefit women as much as men (\( P = .052 \) for interaction), and this was particularly the case for women younger than 65 (\( P = .008 \) for interaction between sex and age). Because the rate of revascularization after AMI was lower for women than men in those patients older than 64 (21.9% vs 28.1%, \( P < .001 \)), in whom the benefit of revascularization tended to be most pronounced, revascularization did not help to narrow the gaps in 5-year survival between women and men. Nevertheless, the consensus is that revascularization is worth the risk for women who have appropriate indications.\(^{28} \) Because this was a cohort study, further randomized clinical trials are required to validate these conclusions.

Several other possible explanations, including lifestyle and socioeconomic characteristics, pathophysiology, and clinical indicators, may also account for these sex differences, but these measures were not available in the present study. Studies have indicated that activities such as smoking\(^{33} \) and high dietary fat intake\(^{34,35} \) contribute significantly to sex differences in the prognosis of ACS patients. Data on income and education at the individual patient level,\(^{36} \) as well as the availability of social support,\(^{37} \) have been shown to partially account for sex differences.

Clinically, women tend to present more frequently with atypical chest pain and normal coronary arteries (ie, syndrome X) than their male counterparts.\(^{38} \) At the root of this difference, several sex differences in the pathophysiology of ACS have been implicated. For instance, plaque erosion is the underlying mechanism of UA, which is observed more often in women than in men.\(^{39,40} \) The menopausal status of women may also play a role, such that plaque erosion appears to be more common before rather than after menopause. Women also experience less development of collateral vessels after AMI,\(^{41} \) which compromises systolic and diastolic function.

In addition, detailed clinical data are also important predictors, such as electrocardiograms to distinguish patients with ST-segment elevation and non–ST-segment elevation AMI, time of the onset of symptoms, coronary anatomy,\(^{41} \) and medication use before, during, and after hospitalization. It is also possible that prehospital mortality rates were lower for women than men after AMI, so that postadmission mortality was higher for women even though the overall mortality rates were similar between sexes.\(^{18,62} \) Although this possibility cannot be completely ruled out, our postdischarge data among AMI patients did not indicate a lower rate of out-of-hospital deaths for women vs men (13.6% vs 10.6%). Unlike studies based on clinical trials or registries, however, the administrative data we used are comprehensive, so that the results of this study represent fairly accurate and unbiased descriptions of sex differences in the treatment of ACS patients in one significant jurisdiction of North America. Based on a previous study\(^{43} \) from Ontario, it is likely that the Canadian hospital discharge data in general, and AMI coding in particular, are accurate.

In conclusion, our population-based research demonstrated that women have a survival advantage when afflicted with UA; however, this advantage is lost when afflicted with AMI, thus illustrating that AMI has a more serious impact on women than men. After adjustment for age, comorbidities, neighborhood incomes, and referrals to cardiovascular specialists, the sex differences in long-term prognosis disappeared in the AMI cohort, whereas women had an improved chance of survival in the UA cohort. Revascularization is not an independent risk factor in this regard. Our results highlight the need for further investigation into the multifactorial causes, treatment strategies, and policy implications of the issues surrounding age and sex interactions in ACS populations.

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