Comparison of 30-Day Readmission Rates After Hospitalization for Acute Myocardial Infarction in Men Versus Women

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Readmission after hospitalization for acute myocardial infarction (AMI) significantly contributes to preventable morbidity and health-care costs. Outcomes after AMI vary by sex but the relationship of sex to readmissions warrants further exploration. Using the 2013 Nationwide Readmissions Database, we identified patients with a principal discharge diagnosis of AMI and stratified all-cause 30-day readmissions by sex and age. Of 214,824 patients, 44% were 18 to 64 years of age, 56% were ≥65 years, and 28% and 45%, respectively, were female. For patients 18 to 64 years, the readmission rate was 14% for women and 10% for men (p <0.001). For patients ≥65 years, the readmission rate was 18% for women and 16% for men (p <0.001). After adjusting for co-morbidities, women had a significantly higher risk of 30-day readmission compared with men, an effect that was strongest in younger women (odds ratio [OR] 1.21, 95% confidence interval [CI] 1.06 to 1.39, for ages 18 to 44; OR 1.13, 95% CI 1.07 to 1.18, for ages 45 to 64; OR 1.13, 95% CI 1.07 to 1.19, for ages 65 to 74, interaction p <0.001). The procedure rates during the index hospitalization were significantly lower for women. The most common readmission diagnoses were recurrent AMI, ischemic heart disease, and heart failure. Costs associated with readmissions after AMI totaled $447,506,740, of which $176,743,622 were attributed to readmissions of women. In conclusion, women are at higher risk of short-term readmission after an AMI hospitalization than men, particularly younger women. Sex-specific strategies to reduce these readmissions may be warranted. **(Am J Cardiol 2017;120:1070–1076)**

Despite efforts to reduce short-term unscheduled readmission to the hospital after an acute myocardial infarction (AMI), these readmissions remain an important contributor to preventable morbidity and health-care costs. In 2013, there were 71,300 readmissions within 30 days of discharge from an AMI hospitalization, resulting in an aggregate hospital cost of over 1 billion US dollars.[1] Readmission rates have been used as a marker of quality of care during hospitalization for AMI.[2,3] Moreover, the Centers for Medicare and Medicaid Services have instituted penalties for hospitals with excess readmission rates as part of the Hospital Readmissions Reduction Program.[2] For these reasons, there is a need to identify groups of patients who experience more frequent readmission after AMI. Sex differences exist in outcomes and quality of care after AMI,[4–7] but little is known about sex differences in 30-day readmission rates after AMI. We examined all-cause 30-day readmission rates for men and women initially admitted with AMI in 2013 using the Nationwide Readmissions Database (NRD), the largest all-payer database of hospital readmissions in the United States.

Methods

The NRD is a database produced by the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality, which provides a nationally representative sample of all-age, all-payer discharges from US nonfederal hospitals.[8] The NRD contains a unique patient identifier that allows linkage of individual patients across hospitalizations within a participating state, enabling the study of readmissions.[9] The NRD is composed of roughly 85% of discharges from the State Inpatient Databases taken from 21 geographically dispersed states, providing discharge data on approximately 49% of both total hospitalizations and the US resident population. The NRD is currently available only for 2013.

From the 2013 NRD, we identified patients ≥18 years of age with a principal discharge diagnosis of AMI using the

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International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 410.xx. These codes have been previously validated and are used in public reporting of readmission rates after AMI.[3] We excluded hospitalizations with ICD-9-CM codes 410.x2 because these codes indicates an AMI during a previous hospitalization. In addition, patients who died during the index hospitalization were excluded as they would have no opportunity to be readmitted. The Committee on Clinical Investigations at Beth Israel Deaconess Medical Center deemed this research exempt from institutional review board approval. The study was performed in accordance with the data use agreement set forth by the Agency for Healthcare Research and Quality.

The primary outcome was the rate of all-cause readmission within 30 days of discharge after an AMI hospitalization. We included patients hospitalized for AMI with discharge dates from January 1, 2013, to November 30, 2013, using December as a 30-day follow-up period.[8] We identified readmissions using the patient linkage, length of stay, and days to event data elements, as described previously.[8] We included only the first readmission within 30 days of discharge from an AMI hospitalization and excluded these readmissions as additional index hospitalizations, similar to the methods used by the Centers for Medicare and Medicaid Services in publicly reported metrics.[3] Any subsequent hospitalization that occurred after the 30-day follow-up time period was considered a new index hospitalization as long as it met the inclusion criteria specified previously. We also investigated the total costs accrued for the index and readmission hospitalizations using the Healthcare Cost and Utilization Project cost-to-charge ratio file, the length of stay for the index hospitalization, and the utilization rates of cardiac catheterization, percutaneous coronary intervention (PCI), and coronary artery bypass grafting (CABG) during the index AMI hospitalization.

Sex was the primary predictor variable. We assessed baseline demographic characteristics (age and socioeconomic status), primary payer information, discharge disposition, length of stay, total charges, patient residency (whether the patient resided within the state in which the hospitalization occurred), rate of emergency department admission, and presence of a major procedure. Socioeconomic status was examined using the median household income national quartile by residential zip code.[9] Patient co-morbidities were identified using the Elixhauser Comorbidity Software, Version 3.7 (Agency for Healthcare Research and Quality, Rockville, MD), representing 21 different conditions.[10]

Categorical variables are presented as frequencies and percentages, and differences between men and women were assessed using Fisher's exact and chi-square tests. Parametric continuous variables are presented as means and standard deviations and were compared using *t* tests, and nonparametric continuous data were expressed as medians and interquartile ranges and were compared by Wilcoxon rank-sum tests. We calculated the unadjusted readmission rates stratified by age and sex. To evaluate the independent association between sex and readmission rates, we constructed a multivariable logistic regression model including patient baseline characteristics and co-morbidities as covariates in the model, with the hospital as a random effect. We additionally evaluated interactions of sex with age (stratified into 5 age groups) and with insurance type for the outcome of 30-day readmission in the model. All analyses were performed using SAS Version 9.4 (SAS Institute Inc., Cary, NC) with a 2-sided p value for a significance of <0.05.

Results

In total, 214,824 patients were hospitalized with the principal discharge diagnosis of AMI during the study period (Table 1). Of these, 44% were 18 to 64 years of age and 56% were 65 years of age or older. In patients aged 18 to 64 years, 28% were women, compared with 45% among those ≥65 years of age. Women were older (54.3 ± 7.7 vs 53.8 ± 7.7 years, $p<0.001$, for ages 18 to 64; 78.8 ± 8.1 vs 75.8 ± 7.7 years, $p<0.001$, for ages ≥65) and more frequently lived in a lower median household income quartile compared with men (2.17 ± 1.06 vs 2.35 ± 1.09, $p<0.001$, for ages 18 to 64; 2.37 ± 1.10 vs 2.41 ± 1.09, $p<0.001$, for ages ≥65). For both age groups, more women than men used Medicare or Medicaid as their primary insurance ($p<0.001$). Women disproportionately experienced a non–ST elevation myocardial infarction (NSTEMI) versus ST-elevation myocardial infarction (STEMI) compared with men (Table 1).

Women had a higher rate of most co-morbidities compared with men. Men had a higher frequency of alcohol/drug abuse (6.3% vs 2.4%, $p<0.001$, for ages 18 to 64; 2.7% vs 0.7%, for ages ≥65) and more frequently underwent a major procedure during the index hospitalization (79% vs 64%, $p<0.001$, for ages 18 to 64; 59% vs 43%, $p<0.001$, for ages ≥65), whereas women were more frequently admitted to the emergency department.

Men more frequently underwent cardiac catheterization (74% vs 63%, $p<0.001$), PCI (59% vs 43%, $p<0.001$), and CABG (10% vs 6%, $p<0.001$) during the initial AMI hospitalization. This finding was also true for each individual age group, with the exception of CABG in those aged 18 to 44 years, for which the rates were similar between sexes (Table 2). This difference was present regardless of the presentation and was more marked in the NSTEMI group. In the STEMI group, 85% of men versus 81% of women underwent catheterization ($p<0.001$), and 87% of men versus 79% of women underwent PCI ($p<0.001$). In the NSTEMI group, 69% of men versus 58% of women underwent catheterization ($p<0.001$), and 46% of men versus 33% of women underwent PCI ($p<0.001$).

Discharge dispositions also differed by sex, with more women discharged to skilled nursing facilities/intermediate care facilities and home health care than men, and more men discharged to home or self-care, or against medical advice.

Of the 214,824 patients discharged alive after AMI hospitalization, 30,970 were readmitted within 30 days (43% female, 57% male). The all-cause crude 30-day readmission rate for patients presenting after index hospitalization for AMI was 14%. The unadjusted 30-day readmission rate after an AMI hospitalization for women ages 18 to 64 years old was 14% compared with 10% for men ($p<0.001$). In patients ≥65 years of age, the unadjusted 30-day readmission rate for AMI was 18% for women, compared with 16% for men ($p<0.001$).

The crude readmission rates were assessed across 5-year increments of age (Figure 1). The largest disparity in unadjusted readmission rates between sexes occurred between the ages of 30 and 75, narrowing in the youngest and oldest age categories. After adjusting for differences in demographic