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Sex based disparities in hospitalization and readmission outcomes for complete atrioventricular block: Insights from United States readmission data

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Abstract

Background: Sex disparities in cardiovascular disorders are well-documented, but data on hospitalization and readmission outcomes in the context of sex for Complete Heart Block (CHB) remains limited.

Methods: We analyzed the 2016–2020 Nationwide Readmission Database to identify patients with a principal diagnosis of CHB. Men served as the control group, while women comprised the study cohort. The primary outcome was mortality. Secondary outcomes included odds of cardiac arrest, ventricular tachycardia, heart failure, mechanical ventilation use, all-cause 30-day readmission, total and early pacemaker use, length of stay (LOS), and total hospitalization charges (THC). Multivariate regression models adjusted for confounders.

Results: Among 175,257 patients with CHB, 45% were female. Female sex was associated with higher odds of mortality (adjusted OR [aOR] 1.42, 95% CI 1.3–1.55) compared to males. Additionally, females had higher odds of cardiac arrest (aOR 1.13, 95% CI 1.06–1.2), ventricular tachycardia (aOR 1.1, 95% CI 1.05–1.17), heart failure (aOR 1.18, 95% CI 1.14–1.22), mechanical ventilation use (aOR 1.1, 95% CI 1.03–1.17), and all-cause 30-day readmission (aOR 1.1, 95% CI 1.03–1.14). Women also had lower odds of total pacemaker use (aOR 0.92, 95% CI 0.88–0.96) and early pacemaker use (aOR 0.89, 95% CI 0.86–0.82). Female patients exhibited longer LOS (4.13 days vs. 3.86 days, $p < 0.001$) but incurred lower THC ($89,908 vs. $94,590, $p = 0.002$).

Conclusion: Female sex in CHB patients was associated with higher mortality and adverse events but lower pacemaker use compared to male patients.

KEYWORDS

health inequalities, heart block, outcome analysis, sex disparities

1 | INTRODUCTION

A growing body of research underscores the presence of significant sex disparities in outcomes following cardiovascular-related hospitalizations. Numerous studies have consistently shown that female patients are at a higher risk of short-term morbidity and mortality during various cardiovascular emergencies compared to their male counterparts.[1] Among these conditions, one of the most critical

is complete heart block (CHB)—a life-threatening cardiac emergency that carries high risks of morbidity and mortality.[2] Given the severity of CHB, prompt diagnosis and intervention are essential to optimizing patient outcomes.

Despite the extensive documentation of sex differences in cardiovascular care, research specifically addressing how sex impacts clinical outcomes in CHB remains limited. This scarcity of data represents a critical gap in understanding whether female patients with CHB experience unique risks compared to males. Given that sex-based disparities have been observed in other cardiovascular conditions, it is reasonable to hypothesize that female sex may also predispose patients with CHB to worse hospitalization outcomes, such as increased mortality and morbidity. If confirmed, this finding highlights the need for heightened attention to sex-specific factors in the clinical management of CHB from the point of hospital admission.

This study aims to evaluate whether female sex is independently associated with adverse outcomes in patients hospitalized for CHB. Through a comprehensive analysis of national data and a review of the existing literature, we seek to uncover the mechanisms that may be driving these disparities and to propose areas where clinical interventions can be tailored to mitigate these risks.

2 | MATERIALS AND METHODS

2.1 | Data source and ethics statement

The Nationwide Readmissions Database (NRD) is part of the Healthcare Cost and Utilization Project (HCUP), which is overseen by the Agency for Healthcare Research and Quality (AHRQ). It is one of the most comprehensive inpatient data sources in the United States.[3,4] The NRD is constructed using billing data submitted by hospitals to HCUP. HCUP applies appropriate weighting variables to ensure that the data accurately reflects national trends in healthcare utilization. Given that NRD data is de-identified and publicly accessible, this research did not require prior approval from the any Institutional Review Board.

2.2 | Study population and outcomes

The NRD was queried for the period between January 1, 2016, and December 31, 2020, to identify adult patients (aged ≥18 years) with a primary diagnosis of CHB, based on the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) code I442. To ensure the accuracy of CHB diagnoses, only patients with a principal diagnosis of CHB where included. The patient cohort was divided into two groups by sex: male patients served as the control group, while female patients formed the cohort group under investigation.

We systematically collected baseline demographic data and comorbidities using ICD-10-CM codes, which included a comprehensive range of cardiovascular and non-cardiovascular conditions. Specifically, we assessed comorbidities such as prior stroke, prior acute myocardial infarction (AMI), body mass index (BMI), atrial fibrillation, hypertension, dyslipidaemia, pulmonary hypertension, chronic obstructive pulmonary disease (COPD), prior percutaneous coronary intervention (PCI), prior coronary artery bypass grafting (CABG), as well as lifestyle risk factors like tobacco and alcohol use. A full list of ICD-10-CM codes used for diagnoses and procedures is available in Table S1. The primary outcome of this study was inpatient mortality. Secondary outcomes included odds of mechanical ventilation use, cardiac arrest, ventricular tachycardia, heart failure, total pacemaker use, early pacemaker use, all-cause 30-day readmissions, hospital length of stay (LOS), and total charges. Early pacemaker use was defined as pacemaker intervention within the 1st day of hospitalization.

2.3 | Statistical analysis

To account for the complex survey design of the NRD, we incorporated weighting variables, strata, and clustering into our statistical analysis. This approach ensures that our findings are nationally representative and that the calculation of standard errors and p-values is accurate. Specifically, we applied hospital discharge weights provided by the NRD to generate national-level estimates, which correct for unequal probabilities of selection and account for survey design complexities.

To enhance the robustness of our analysis, we included all primary sampling units (hospitals), thereby minimizing the risk of underestimating standard errors and ensuring the proper calculation of p-values. All analyses were conducted using Stata 18.0 (College Station, TX), a statistical software specifically designed to handle complex survey data. Within Stata, appropriate survey procedures were applied to integrate the weights, strata, and clusters, ensuring that our estimates were both precise and unbiased.

Descriptive statistics were generated to summarize patient characteristics based on sex. To explore associations between patient characteristics and clinical outcomes, logistic regression models were utilized allowing for adjustment of the NRD's complex sampling design. Initially, unadjusted odds ratios (uORs) for both primary and secondary outcomes were calculated using univariate logistic and linear regression analyses. Multivariable logistic and linear regression analyses were subsequently conducted to control for potential confounders, including age, median household income by ZIP code, sepsis, in-hospital PCI and CABG usage, and comorbidities, measured by the 1993 Deyo adaptation of the Charlson Comorbidity Index (CCI), which is suitable for use with NRD data[5].

For continuous variables, comparisons were made using Student's t-tests, while categorical variables were compared using the Rao-Scott chi-square test, which adjusts for the survey design. Given the non-normal distribution of LOS, we utilized a weighted generalized linear model with a gamma distribution and log link

function. For all analyses, a p-value <0.05 was considered statistically significant.

3 | RESULTS

3.1 | Patient characteristics

Among patients with a primary diagnosis of CHB (N = 175,257), 45% (N = 78,865) were women. Female patients where older (mean age 77 years vs. 75 years), more likely to have Medicare as a primary payer (85% vs. 80%, p <.001), and a lower mean comorbidity index (2.12 vs. 2.35). On the other hand, female patients were less likely to have a prior MI (6.5% vs. 11%, p <.001), dyslipidemia (51% vs. 56%, p <.001), Atrial Fibrillation (18% vs. 20%, p <.001), COPD (13% vs. 15%, p <.001), prior PCI (7% vs. 13%, p <.001), prior CABG (5% vs. 14%, p <.001), tobacco use (26% vs. 43% p <.001) and alcohol use (0.8% vs. 3%, p <.001) compared to male patients. Additionally female patients were more likely to have hypertension (45% vs. 42%, p <.001), prior stroke (9.6% vs. 9%, p =.011), pulmonary hypertension (3.3% vs. 2.1%, p <.001) and sever obesity (BMI ≥40 42% vs. 31%, p <.001) compared to male patients. Baseline characteristics of patients stratified by sex are shown in Table 1.

3.2 | Primary and secondary outcomes

In the unadjusted analysis, among patients with CHB, female sex was associated with a 32% increase in inpatient mortality (unadjusted OR [uOR] 1.32, 95% CI 1.2–1.44, p < 0.001) during index hospitalization. Additionally, female sex was associated with higher odds of cardiac arrest (uOR 1.09, 95% CI 1.02–1.16, p =.008), ventricular tachycardia (uOR 1.08, 95% CI 1.02–1.14, p =.006), and lower odds of early pacemaker use (50% vs. 52%, uOR 0.93, 95% CI 0.91–0.96, p <.001). No differences were observed between female and male patients regarding total pacemaker use (82.7% vs. 83.2%, uOR 0.97, 95% CI 0.93–1.01, p =.123), heart failure (uOR 1.03, 95% CI 0.99–1.06, p =.08), mechanical ventilation use (uOR 1.03, 95% CI 0.97–1.09, p =.279), and all-cause 30-day readmission (uOR 1.04, 95% CI 0.99–1.1, p =.126). Unadjusted outcomes are shown in Figure 1.

After adjustment for baseline characteristics, female sex remained associated with higher odds of inpatient mortality (adjusted OR [aOR] 1.41, 95% CI 1.3–1.55, p <.001) compared to male sex in cases of CHB. Additionally, after adjustment for confounders, female sex was associated with higher odds of cardiac arrest (aOR 1.13, 95% CI 1.06–1.2, p <.001), ventricular tachycardia (aOR 1.1, 95% CI 1.05–1.17, p <.001), heart failure (aOR 1.18, 95% CI 1.14–1.22, p <.001), mechanical ventilation use (aOR 1.1, 95% CI 1.03–1.17, p =0.004), and all-cause 30-day readmission (aOR 1.1, 95% CI 1.03–1.14, p =.004). Female sex was also associated with lower odds of total pacemaker use (aOR 0.92, 95% CI 0.88–0.96, p <.001) and early pacemaker use (aOR 0.89, 95% CI 0.86–0.92, p <.001) compared to

TABLE 1 Baseline characteristics and comorbidities of patients with CHB stratified by sex.

	Female group (n = 78,865)	Male group (n = 96,392)	p value
Age category, %			p <.001
18–34	0	0	
35–65	13	17	
>65	87	83	
CCI score, %			p <.001
0	23	21	
1	23	22	
2	19	18	
≥3	35	39	
Median household income, %			p <.001
$1–$49,000	26	24	
$50,000–$64,999	28	28	
$65,000–$85,999	26	26	
≥$86,000	20	22	
Insurance, %			p <.001
Medicare	85	80	
Medicaid	3	4	
Private	11	15	
BMI, %			p <.001
BMI 25–29, %	9	11	
BMI 30–39, %	49	59	
BMI ≥40, %	42	30	
Hypertension, %	46	42	p <.001
Dyslipidemia, %	52	56	p <.001
Prior PCI, %	7	13	p <.001
Atrial Fibrillation, %	18	20	p <.001
Prior CABG, %	5	14	p <.001
Alcohol use, %	0.8	3	p <.001
COPD, %	13	15	p =.013
Pulmonary Hypertension, %	3.3	2.1	p <.001

male patients hospitalized with CHB during the index hospitalization. Adjusted outcomes are shown in Figure 2.

3.3 | LOS and THC

Among patients with CHB, the mean LOS was 4.13 days for female patients and 3.86 days for male patients and this prolonged LOS in female patients compared to male patients remained statistically significant while adjusting for confounders (adjusted increase 0.4 days, 95% CI 0.3–0.44 days, p <.001). Contrariwise, among patients with CHB the mean THC were lower in female patients compared to male
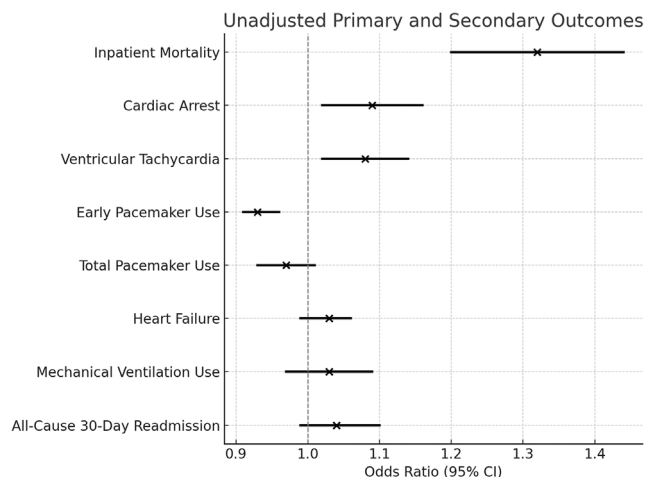
Unadjusted Primary and Secondary Outcomes

FIGURE 1 Forest plots of unadjusted odds ratios with 95% confidence intervals for In-Hospital outcomes for female vs. Male patients with complete heart block.

Adjusted Primary and Secondary Outcomes

FIGURE 2 Forest plots of adjusted odds ratios with 95% confidence intervals for In-Hospital outcomes for female vs. Male patients with complete heart block.
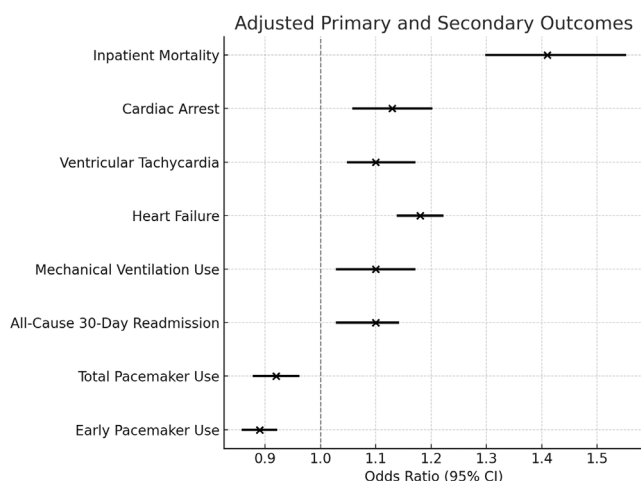
patients ($89,908 vs. $94,590). Sed lower THC in female patients compared to male patients remained significant after adjusting for confounders (adjusted decrease $1832, 95% CI (–) $2929– (–) $735, $p = .001$).

4 | DISCUSSION

To our knowledge, this is the first study to examine sex disparities among United States. patients hospitalized with CHB. Our findings reveal that female patients with CHB have distinct clinical profiles compared to their male counterparts. Women face higher risks of adverse outcomes, including increased mortality, cardiac arrest, ventricular tachycardia, heart failure, 30-day readmissions, and a greater need for mechanical ventilation. Despite experiencing longer

hospital stays, female patients incur lower total charges and are less likely to early pacemaker intervention compared to male patients.

4.1 | Demographic and clinical risk

Among patients with a primary diagnosis of CHB, 45% were female. Female patients admitted for CHB were found to have fewer comorbidities compared to their male counterparts, a finding consistent with prior studies.[6] Specifically, females were less likely to present with traditional cardiovascular comorbidities, such as a history of AMI, dyslipidemia, prior PCI or CABG, as well as modifiable behavioral risk factors like tobacco and alcohol use. Similar demographic differences between sexes have been observed in other cardiovascular diseases, such as AMI and heart failure, where men generally exhibit a higher incidence of classic heart disease risk factors than women.[7,8]

In contrast, female patients admitted for CHB were more likely to have a history of hypertension, prior stroke, pulmonary hypertension and sever obesity. These observations are consistent with findings in current literature, which reveal notable sex disparities in the prevalence, awareness, treatment, and management of hypertension. Typically, men exhibit higher rates of hypertension in younger age groups, while older women tend to demonstrate a greater overall prevalence,[9] a trend that aligns with our demographic data. Similarly, research highlights sex differences in stroke prevalence, indicating that older women experience a higher incidence compared to their male counterparts.[10] Furthermore, pulmonary hypertension is more frequently diagnosed in women than in men,[11] and this condition has been proposed to be independently linked to worse functional outcomes and increased mortality rates in patients suffering from high-grade conduction disease.[12] Female patients also exhibited higher rates of sever obesity compared to men. Obesity is an additional characteristic that would predispose patients to a higher cardiovascular disease related morbidity and mortality.[13] Furthermore, several studies have reported that obesity is linked to a higher prevalence of conduction disease as well as increased severity of conduction abnormalities through mechanisms related to structural and functional changes to the heart.[14–16] Given these findings, further research to thoroughly explore the demographic and clinical risk profile differences between male and female patients with CHB is crucial, as understanding these disparities could inform tailored interventions and improve patient outcomes.

4.2 | In-hospital outcomes

This study reveals significant sex-based disparities in outcomes and management CHB patients. Female patients face increased odds of adverse outcomes, including higher inpatient mortality, cardiac arrest, ventricular tachycardia, heart failure, mechanical ventilation use, and 30-day readmissions. A female sex was also associated with a lower likelihood for total and early pacemaker implantations

compared to men, aligning with broader evidence of systemic sex biases in cardiovascular disease treatment.

The reduced pacemaker utilization in female patients is particularly concerning given the device's established necessity in CHB management. Pacemakers are crucial for addressing conduction abnormalities, stabilizing bradycardia, and preventing complications like syncope and sudden cardiac arrest.[17] Concurrent literature demonstrates that female patients consistently face intervention delays across cardiovascular care, including lower rates of percutaneous coronary interventions and left ventricular assist device implantation during AMI or cardiogenic shock hospitalizations.[18] In CHB cases, delayed pacemaker implementation may increase women's vulnerability to life-threatening arrhythmias, particularly ventricular tachycardias, which occur more frequently in women due to sex-based QT interval differences.[19]

These disparities extend to other electrophysiologic conditions. For instance, prior studies demonstrated that in older patients (≥80 years) men received more dual-chamber devices than women for AV block and sick sinus syndrome.[20] Women with atrial fibrillation report more severe symptoms and reduced quality of life but receive fewer referrals for advanced interventions like catheter ablation.[21-23] Female CHB patients present distinct demographic and clinical risk characteristics. While they show lower prevalence of traditional cardiovascular risk factors, they exhibit higher rates of pulmonary hypertension and severe obesity. Pulmonary hypertension can obscure CHB presentation and increase right ventricular failure risk, while obesity complicates procedural access and increases pacemaker implantation risks.

Age-related disparities compound these issues, as older female patients receive fewer diagnostic tests and therapeutic interventions compared to younger females or males.[24] This age-sex interaction often leads to treatment delays, which are strongly associated with adverse outcomes.[25-28] The combination of delayed diagnosis, underutilized pacemaker implementation, and increased cardiac arrest and heart failure could contribute to higher mortality and readmission rates among female patients.

Addressing these inequities requires a multifaceted approach, including increased healthcare provider awareness, standardized guideline adherence, and targeted strategies to improve treatment access for female patients. Further research must investigate the underlying mechanisms of these disparities, including clinical decision-making biases, symptom presentation differences, and systemic barriers to care, to develop effective interventions for improving women's CHB outcomes.

4.3 | Hospital LOS and THC

Among hospitalizations for CHB, female sex was linked to a longer average LOS and lower THC compared to male sex. This trend may be attributed to the increased likelihood of in-hospital adverse outcomes that female patients experience, which often necessitates a higher level of intensive care. Conversely, the association between female sex and lower THC is less straightforward. For instance, some studies have argued the presence of sex disparities in resource utilization and quality of care for postmenopausal women, particularly in cardiovascular disease management.[23] Therefore, additional research is essential to further investigate the influence of sex on LOS and THC in CHB cases and other related conduction disorders. Understanding these dynamics could help inform more equitable healthcare practices and resource allocation for both male and female patients.

4.4 | Limitations and strengths

The findings of this study should be interpreted with caution due to several inherent limitations associated with research utilizing the NRD. Firstly, there may be potential inaccuracies or incomplete information in the ICD-10 codes employed for patient classification. Secondly, details about CHB such as its etiology, patient baseline EKG characteristics and chronicity, were not factored into the analysis used in this study. Furthermore, specific details regarding regarding access to subspecialty services such as cardiovascular electrophysiology were not available. Additionally, NRD does not differentiate between secondary diagnoses that are present at admission and those identified during hospitalization, which restricts our ability to draw conclusions about the timing and duration of these secondary diagnoses.[3] Furthermore, the NRD does not capture data regarding race, as such race was not adjusted for during our analysis. Despite these limitations, it is noteworthy that the AHRQ routinely conducts data quality assessments on the NRD, which helps to enhance the integrity of the data and minimize the risk of errors. Moreover, when appropriately weighted, the NRD sample reflects a broad cross-section of the US population, allowing for a more comprehensive understanding of inpatient outcomes.

5 | CONCLUSIONS

This analysis reveals significant sex-based disparities in CHB treatment and outcomes. Female patients experienced delayed and reduced pacemaker utilization alongside higher rates of fatal and non-fatal complications. Despite longer hospital stays, a female sex was associated with lower THC when compared to male sex, suggesting the presence of sex based disparities in pacing interventions for CHB. These findings parallel documented sex disparities across cardiovascular care, likely stemming from delays in guideline-directed treatment, under-studied sex based clinical risk differences, and inconsistent application of diagnostic and therapeutic interventions.

Healthcare providers must recognize female patients as a high-risk group for adverse outcomes in high-grade conduction disease. This understanding should drive focused research into the root causes of these inequities and inform targeted interventions. By

addressing these systemic disparities, the medical community can work toward reducing cardiovascular disease burden and establishing more equitable, sex-specific approaches to patient care that improve outcomes for all populations.

FUNDING INFORMATION

CONFLICT OF INTEREST STATEMENT

The authors have nothing to report.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are not publicly available due to their containing information that could compromise the privacy of research participants. However, the data are available from the Healthcare Cost and Utilization Project (HCUP) Central Distributor upon reasonable request at https://www.hcup-us.ahrq.gov/tech_assist/centdist.jsp. The underlying data used in this manuscript come from the Nationwide Readmissions Database (NRD), which is maintained by the Agency for Healthcare Research and Quality (AHRQ). Researchers can request access to the NRD through the HCUP Central Distributor by contacting them via email at hcup-requestdata@ahrq.gov.

ETHICS STATEMENT

Given that the data used in this study was derived from the Nationwide Readmissions Database, which is de-identified and publicly accessible, this study did not require approval from any Institutional Review Board. Additionally, written informed consent from participants was not required in accordance with local and national guidelines.

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REFERENCES

1. Dixon LK, Dimagli A, Di Tommaso E, Sinha S, Fudulu DP, Sandhu M, et al. Females have an increased risk of short-term mortality after cardiac surgery compared to males: insights from a national database. J Card Surg. 2022;37(11):3507–19.
2. Simon AB, Steinke WE, Curry JJ. Atrioventricular block in acute myocardial infarction. Chest. 1972;62(2):156–61.
3. Introduction To The Hcup National Inpatient Sample (NIS). Ahrq. gov. 2017
4. Elixhauser A, McCarthy E. Clinical classifications for health policy research, version 2: hospital inpatient statistics. Rockville (MD): Agency for Health Care Policy and Research; 1996.
5. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. J Clin Epidemiol. 1992;45(6):613–9.
6. Möller-Leimkühler AM. Gender differences in cardiovascular disease and comorbid depression. Dialogues Clin Neurosci. 2007;9(1):71–83.
7. Liakos M, Parikh PB. Gender disparities in presentation, management, and outcomes of acute myocardial infarction. Curr Cardiol Rep. 2018;20(8):64.
8. Lawton JS. Sex and gender differences in coronary artery disease. Semin Thorac Cardiovasc Surg. 2011;23(2):126–30.
9. Dorobantu M, Gheorghe-Fronea OF, Scafa-Udriste A, Onciul S, Pop C, Dorobantu L, et al. Gender disparities in the prevalence, awareness, treatment, and control of high blood pressure. Curr Pharm Des. 2021;27(29):3173–9.
10. Towfighi A, Markovic D, Ovbiagele B. Persistent sex disparity in midlife stroke prevalence in the United States. Cerebrovasc Dis. 2011;31(4):322–8.
11. Rodriguez-Arias JJ, García-Álvarez A. Sex differences in pulmonary hypertension. Front Aging. 2021;2:727558.
12. Reddy SA, Nethercott SL, Teh W, De Bie EM, Pepke-Zaba J, Toshner MR, et al. Prevalence and clinical significance of conduction disease in patients with idiopathic pulmonary arterial hypertension. J Heart Lung Transplant. 2022;41(7):861–5.
13. Chrostowska M, Szyndler A, Hoffmann M, Narkiewicz K. Impact of obesity on cardiovascular health. Best Pract Res Clin Endocrinol Metab. 2013;27(2):147–56. https://doi.org/10.1016/j.beem.2013.01.004
14. Schram-Serban C, Heida A, Roos-Serote MC, Knops P, Kik C, Brundel B, et al. Heterogeneity in conduction underlies obesity-related atrial fibrillation vulnerability. Circ Arrhythm Electrophysiol. 2020;13(5):403–7. https://doi.org/10.1161/circep.119.008161
15. Poirier P, Alpert MA, Fleisher LA, Thompson PD, Sugerman HJ, Burke LE, et al. Cardiovascular evaluation and Management of Severely Obese Patients Undergoing Surgery. Circulation. 2009;120(1):86–95. https://doi.org/10.1161/circulationaha.109.192575
16. Csige I, Ujvárosy D, Szabó Z, Lőrincz I, Paragh G, Harangi M, et al. The impact of obesity on the cardiovascular system. J Diabetes Res. 2018;2018:1–12. https://doi.org/10.1155/2018/3407306
17. Friedberg CK, Donoso E, Stein WG. Nonsurgical acquired heart block. Ann N Y Acad Sci. 1964;111(3):835–47. https://doi.org/10.1111/j.1749-6632.1964.tb53151.x
18. Kapur NK, Esposito ML, Bader Y, Morine KJ, Kiernan MS, Pham DT, et al. Mechanical circulatory support devices for acute right ventricular failure. Circulation. 2017;136(3):314–26.
19. Kawasaki R, Machado C, Reinoehl J, Fromm B, Baga JJ, Steinman RT, et al. Increased propensity of women to develop torsades de pointes during complete heart block. J Cardiovasc Electrophysiol. 1995;6(11):1032–8.
20. Nowak B, Misselwitz B, Expert committee 'Pacemaker', Institute of Quality Assurance Hessen, Erdogan A, Funck R, IrnichW, et al. Do gender differences exist in pacemaker implantation?--results of an obligatory external quality control program. Europace. 2010;12(2):210–5.
21. Westerman S, Wenger N. Gender differences in atrial fibrillation: a review of epidemiology, management, and outcomes. Curr Cardiol Rev. 2019;15(2):136–44.
22. Piccini JP, Simon DN, Steinberg BA, Thomas L, Allen LA, Fonarow GC, et al. Differences in clinical and functional outcomes of atrial fibrillation in women and men: two-year results from the ORBIT-AF registry. JAMA Cardiol. 2016;1(3):282–91.
23. Michelena HI, Powell BD, Brady PA, Friedman PA, Ezekowitz MD. Gender in atrial fibrillation: ten years later. Gend Med. 2010;7(3):206–17.
24. Williams RI, Fraser AG, West RR. Gender differences in management after acute myocardial infarction: not 'sexism' but a reflection of age at presentation. J Public Health. 2004;26(3):259–63.
25. Almashari S, Al-Malki Y, Al-Riyami A, Nadar SK. Delays in presentation by patients with ST elevation myocardial infarction: a single centre experience from Oman. Sultan Qaboos Univ Med J. 2022;22(2):283–7.

26. Abdin A, Anker SD, Butler J, Coats AJS, Kindermann I, Lainscak M, et al. 'Time is prognosis' in heart failure: time-to-treatment initiation as a modifiable risk factor. ESC Heart Fail. 2021;8(6):4444–53.

27. Cha JJ, Bae S, Park DW, Park JH, Hong SJ, Park SM, et al. Clinical outcomes in patients with delayed hospitalization for non-ST-segment elevation myocardial infarction. J Am Coll Cardiol. 2022;79(4):311–23.

28. Owens G. Gender differences in health care expenditures, resource utilization, and quality of care. J Manag Care Pharm. 2008;14(3):2–6.

SUPPORTING INFORMATION

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