Sex-Specific Associations Between Body Mass Index and Vascular and Cardiometabolic Diseases: Evidence from 233,730 Patients in Germany

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Background

- Cardiovascular diseases (CVDs) are a major contributor to the global disease burden, and obesity is recognized as an important factor associated with their development (1,2)
- The occurrence of CVD and its complications differs between men and women, with risk factors often presenting in sex-specific ways (3). This underscores the importance of sex-stratified analyses and highlights a gap in the literature regarding the association between obesity and a broad spectrum of cardiovascular diseases in both sexes
- The aim of this study was therefore to examine the associations between obesity and several cardiovascular and vascular diseases, and to investigate whether these associations vary by sex in a real-world setting

Methods

- This retrospective cohort study was conducted using data from the IQVIA Disease Analyzer database, which contains anonymized records from more than 3,000 office-based physicians in Germany (4)
- We included 233,730 individuals aged 40 years or older with at least one documented body mass index (BMI) measurement between January 2005 and December 2023. The first BMI documentation was defined as the index date, and individuals with pre-existing cardiovascular, cerebrovascular, arterial, or venous diseases at or before the index date were excluded (**Figure 1**)
- In line with World Health Organization guidelines, individuals were categorized as having normal weight (BMI 18.5–24.9 kg/m²), overweight (BMI 25.0–29.9 kg/m²), or obesity (BMI ≥30 kg/m²). Those with BMI <18.5 kg/m² were rare and excluded from analyses
- Outcomes were defined as the first diagnosis of 14 cardiovascular and cerebrovascular disorders identified using ICD-10 codes
- Ten-year cumulative incidence was estimated using the Kaplan–Meier method, and Cox regression models were applied to assess associations between BMI categories and disease occurrence

Results

- Patients who were overweight or obese were significantly older than those of normal weight (55.8 years in the normal weight group, 57.2 years in the overweight group, and 56.7 years in the obesity group). The normal weight group had the highest proportion of females (63.9%), compared to 42.9% in the overweight group and 51.0% in the obesity group. Males were more prevalent in the overweight group (57.1%) than in the normal weight (36.1%) and obesity (49.0%) groups
- **Figure 2** shows the cumulative incidence of the fourteen diagnoses. The incidence rates of angina pectoris, pulmonary embolism, heart failure, varicose veins of the lower extremities, and phlebitis and vein thrombosis were highest in the obesity group, followed by the overweight and normal-weight groups
- **Figure 3** shows the results of the multivariable Cox regression analyses. Compared to those of normal weight, patients with obesity had a 95% higher risk of heart failure (HR: 1.95, 95% CI: 1.85–2.05), an 83% higher risk of pulmonary embolism (HR: 1.83, 95% CI: 1.62–2.07), a 63% higher risk of atrial fibrillation/flutter (HR: 1.63, 95% CI: 1.55–1.72), a 60% higher risk of phlebitis and vein thrombosis (HR: 1.60, 95% CI: 1.51–1.70), and a 57% higher risk of varicose veins of the lower extremities (HR: 1.57, 95% CI: 1.51–1.64). Additionally, obesity was associated with a 30% increased risk of angina pectoris (HR: 1.30, 95% CI: 1.21–1.41), a 28% increased risk of chronic ischemic heart disease (HR: 1.28, 95% CI: 1.23–1.34), and a 26% increased risk of myocardial infarction (HR: 1.26, 95% CI: 1.15–1.38)
- The positive association between obesity and cardiovascular conditions varied between sex. In men, obesity was more strongly associated with heart failure (HR: 2.01; 95% CI: 1.87–2.17), angina pectoris (HR: 1.33; 95% CI: 1.19–1.48), and atrial fibrillation/flutter (HR: 1.75; 95% CI: 1.62–1.88) compared to women (heart failure: HR: 1.87; 95% CI: 1.74–2.00; angina pectoris: HR: 1.25; 95% CI: 1.13–1.40; atrial fibrillation/flutter: HR: 1.51; 95% CI: 1.40–1.62). Conversely, the associations between obesity and phlebitis and vein thrombosis were stronger in women (HR: 1.69; 95% CI: 1.56–1.82) than in men (HR: 1.47; 95% CI: 1.34–1.61), as was the case for pulmonary embolism (women: HR: 2.09; 95% CI: 1.76–2.47; men: HR: 1.57; 95% CI: 1.32–1.86). Notably, obesity was associated with a lower risk of aortic aneurysm in women (HR: 0.74; 95% CI: 0.58–0.93), while no significant association was observed in men (HR: 1.13; 95% CI: 0.97–1.32)

Conclusion

In this large real-world study, obesity was consistently associated with multiple vascular conditions in both men and women. However, the magnitude and direction of these associations varied by sex, supporting the conclusion that obesity interacts with cardiovascular factors in a sex-specific manner

Figure 1. Selection of the study patients

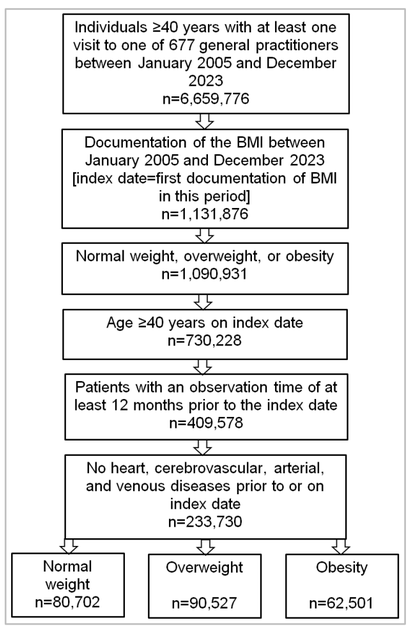


Figure 2. Sex-specific cumulative 10-year incidence of vascular and cardiometabolic diseases across BMI groups

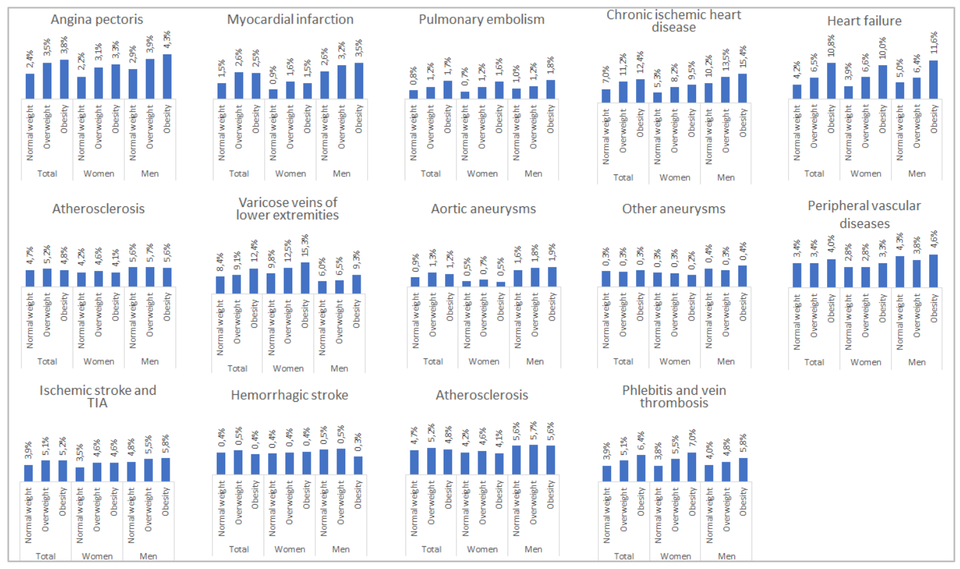
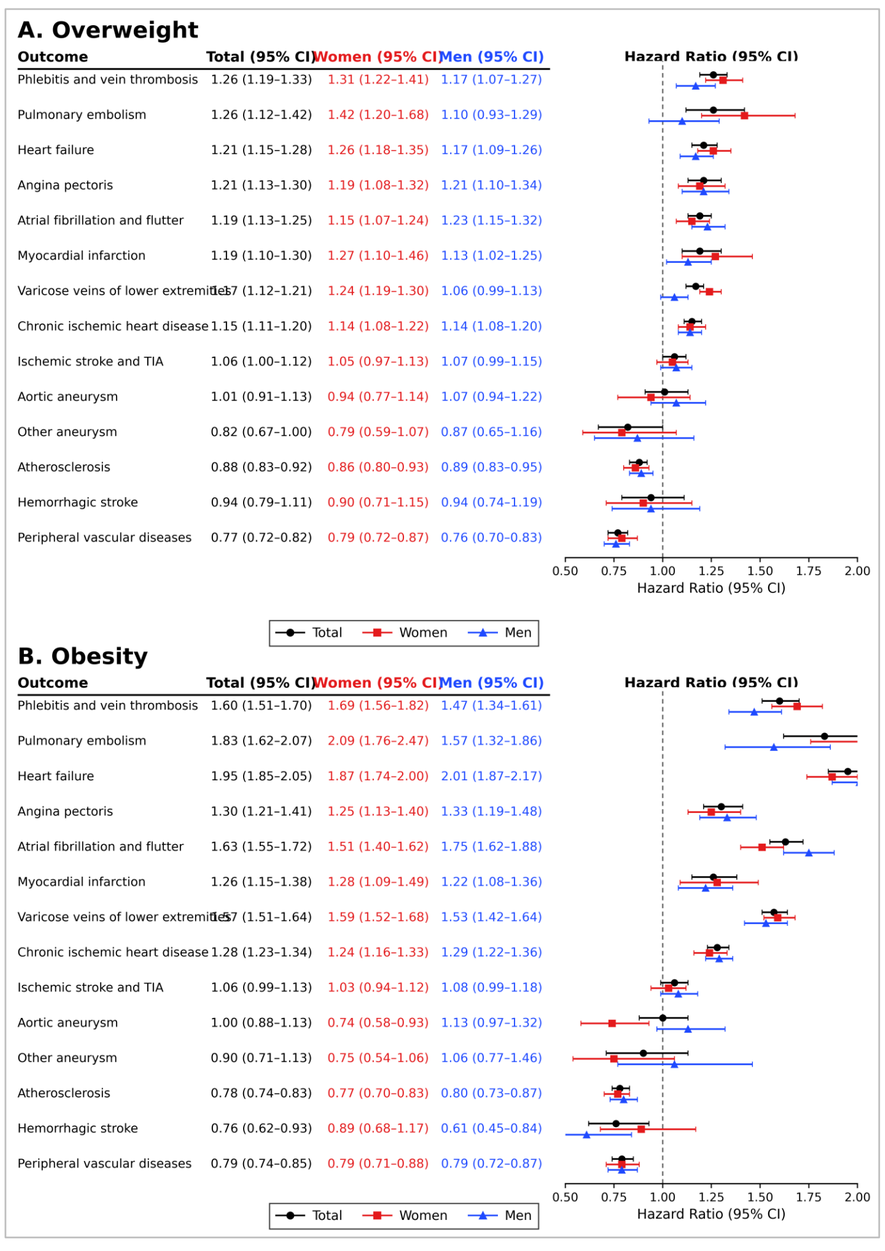


Figure 3. Overall and sex-specific associations between overweight and obesity and vascular and cardiometabolic diseases



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