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Age-specific gender differences in early mortality following ST-segment elevation myocardial infarction in China

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ABSTRACT

Objective To assess whether younger, but not older, women in China have higher in-hospital mortality following ST-Segment Elevation Myocardial Infarction (STEMI) compared with men, and whether this relationship varied over the last decade or across rural/urban areas.

Methods We analysed a nationally representative sample of 11 986 patients with STEMI from 162 Chinese hospitals in 2001, 2006 and 2011, in the China PEACE-Retrospective AMI Study and compared in-hospital mortality between women and men with gender–age interactions in multivariable models.

Results The overall in-hospital mortality rate was higher in women compared with men (17.2% vs 9.1%, p<0.0001; unadjusted OR 2.07, 95% CI 1.85 to 2.33). The unadjusted OR for mortality in women, compared with men, was 2.20 (95% CI 1.59 to 3.04), 2.21 (95% CI 1.74 to 2.79), 1.37 (95% CI 1.15 to 1.65) and 1.25 (95% CI 0.97 to 1.63) for ages <60, 60–69, 70–79 and ≥80 years, respectively. After adjustment for patient characteristics, hospital characteristics and year of study, the OR for mortality comparing women with men was 1.69 (95% CI 1.01 to 2.83), 1.64 (95% CI 1.24 to 2.19), 1.15 (95% CI 0.90 to 1.46) and 0.82 (95% CI 0.60 to 1.11) for ages <60, 60–69, 70–79 and ≥80 years, respectively. The gender–age interaction for mortality was statistically significant (p=0.009), even after adjustment for a wide range of confounders, and did not vary over time or across rural/urban areas.

Conclusions Among a Chinese population with STEMI, gender differences in early mortality were age-dependent and greatest in the younger groups <70 years of age.

Trial registration number http://www.clinicaltrials.gov (NCT01624883).

INTRODUCTION

Several studies from high-income areas, including the USA, Canada and Europe, have demonstrated gender differences in mortality following acute myocardial infarction (AMI) that vary by age,[1–8] with a higher risk of death in younger women compared with their male counterparts. For example, in a US study of patients hospitalised with AMI between 1994 and 1998, women aged ≤50 years had a more than twofold greater in-hospital mortality compared with similarly aged men,[2] but this difference was not present in older patients. A remaining question is whether this gender–age interaction in AMI mortality, in which gender differences are greater in younger patients, exists in diverse populations and healthcare systems, especially in low-income and middle-income countries.

In China, home to one-fifth of the world's women, there is a rising burden of cardiovascular disease.[9] Moreover, as observed in the recently published China Patient-centered Evaluative Assessment of Cardiac Events (China PEACE)- Retrospective AMI Study of patients with ST-Segment Elevation Myocardial Infarction (STEMI), there was a fourfold increase in hospital admissions among both men and women over the last decade, with women persistently accounting for nearly 30% of all patients.[10] In this growing population of women with AMI, it is critical to understand whether gender differences in survival among different age groups exist, especially as China prepares to embark on national efforts to improve the quality of AMI care.

Examining potential gender disparities in STEMI outcomes in China is important, as findings from Western countries may not be broadly applicable. Though prior studies from China have suggested higher rates of death in younger women after STEMI,[11] these data are not contemporary and may not reflect the experience of average patients as they were based on clinical trial populations. Further investigation is needed to understand whether age–gender disparities exist among a nationally representative sample and whether differences in outcomes have changed over the last decade. Additionally, to inform future interventions, it is important to understand whether any differences observed can be explained by patient risk, hospital care management or the settings in which care is delivered.

Accordingly, we examined a nationally representative sample of patients with STEMI in the China PEACE-Retrospective AMI Study in 2001, 2006 and 2011. The objectives of this study were to (a) assess whether there is a significant gender–age interaction with in-hospital mortality among Chinese patients with STEMI; (b) identify factors that may explain this gender–age interaction and (c) determine whether this gender–age interaction has changed over time or varies across rural/urban areas. We hypothesised that younger, but not older,

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Abstract

Objective- To assess whether younger, but not older, women in China have higher in-hospital mortality following ST-Segment Elevation Myocardial Infarction (STEMI) compared with men, and whether this relationship varied over the last decade or across rural/urban areas.

Methods- We analyzed a nationally representative sample of 11 986 patients with STEMI from 162 Chinese hospitals in 2001, 2006 and 2011, in the China PEACE-Retrospective AMI Study and compared in-hospital mortality between women and men with gender–age interactions in multivariable models.

Results- The overall in-hospital mortality rate was higher in women compared with men (17.2% vs 9.1%, $p<0.0001$; unadjusted OR 2.07, 95% CI 1.85 to 2.33). The unadjusted OR for mortality in women, compared with men, was 2.20 (95% CI 1.59 to 3.04), 2.21 (95% CI 1.74 to 2.79), 1.37 (95% CI 1.15 to 1.65) and 1.25 (95% CI 0.97 to 1.63) for ages <60, 60–69, 70–79 and ≥80 years, respectively. After adjustment for patient characteristics, hospital characteristics and year of study, the OR for mortality comparing women with men was 1.69 (95% CI 1.01 to 2.83), 1.64 (95% CI 1.24 to 2.19), 1.15 (95% CI 0.90 to 1.46) and 0.82 (95% CI 0.60 to 1.11) for ages <60, 60–69, 70–79 and ≥80 years, respectively. The gender–age interaction for mortality was statistically significant ($p=0.009$), even after adjustment for a wide range of confounders, and did not vary over time or across rural/urban areas.

Conclusions- Among a Chinese population with STEMI, gender differences in early mortality were age-dependent and greatest in the younger groups <70 years of age.

Table 1. Unadjusted OR for characteristics of patients and hospitals comparing women with men according to age

	All patients		Age group, year			
	Women n=3574 Per cent	Men n=8412	<60 n=3914 OR*	60–69 n=3213	70–79 n=3562	≥80 n=1297
Cardiovascular risk factors						
Hypertension	56.4	45.5	1.84†	1.43†	1.37†	1.13
Diabetes	25.6	16.3	2.06†	1.98†	1.68†	1.27
Current smoker	10.1	44.5	0.09†	0.16†	0.26†	0.26†
Medical history						
MI	9.2	10.8	0.87	0.72†	0.80†	0.50†
PCI	1.2	1.8	0.64	0.58	0.85	0.16†
Stroke	12.7	10.8	1.26	1.02	0.93	1.00
Clinical characteristics at admission						
Symptom onset to presentation (h)						
≤12	46.8	51.3	0.70†	0.95	0.91	1.18
>12 to ≤24	14.5	12.1	1.18	1.18	1.21	1.01
>24	38.8	36.6	1.36†	0.97	1.00	0.84
Chest discomfort	89.7	93.3	0.81	0.66†	0.77†	0.93
SBP (mm Hg)						
≥140	39.2	32.1	1.57†	1.22†	1.27†	1.29†
90–139	54.0	62.4	0.66†	0.81†	0.78†	0.69†
<90	6.8	5.6	0.91	1.09	1.06	1.62†
HR (bpm)						
≥100	19.7	13.2	1.68†	1.47†	1.44†	1.29
Anterior AMI	23.9	23.6	0.95	0.94	1.06	1.22
Cardiac arrest	0.9	1.4	0.33†	0.86	1.53	0.86
Cardiogenic shock	7.5	5.4	1.15	1.33	1.25	1.22
eGFR (mL/min/1.73 m^2)						
≥90	23.6	35.0	0.68†	0.75†	0.90	0.92
≥60–<90	31.2	32.5	1.19	0.81†	0.83†	0.76†
<60	28.6	16.9	2.08†	1.61†	1.26†	1.23†
Unmeasured	16.6	15.7	0.99	1.24†	1.09	1.20

Table 1. Continued

	All patients		Age group, year			
	Women n=3574 Per cent	Men n=8412	<60 n=3914 OR*	60–69 n=3213	70–79 n=3562	≥80 n=1297
LDL-C (mg/dL)						
<100	27.7	34.9	0.77†	0.55†	0.66†	0.73†
≥100 to <130	23.8	24.1	1.00	1.04	1.04	1.15
≥130	19.6	16.2	1.08	1.37†	1.62†	1.52†
Unknown	29.0	24.9	1.23†	1.44†	1.09	1.00
Hospital characteristics						
Economic–geographic region						
Eastern	62.4	57.6	1.24†	1.35†	1.16†	0.96
Central	20.0	22.0	0.80†	0.80†	0.99	1.10
Western	17.6	20.5	0.92	0.79†	0.80†	0.95
Rural/Urban						
Rural	40.3	37.4	1.29†	0.98	0.98	1.09
Urban	59.7	62.6	0.78†	1.02	1.02	0.92
PCI-capable hospital	58.7	61.0	0.88	0.93	0.99	0.93
Hospital with CCU	78.2	78.8	0.85	1.00	1.07	1.10
Teaching hospital	79.2	81.1	0.90	0.75†	1.00	0.89
Year of discharge						
2001	15.9	16.2	1.11	1.20†	0.91	0.74
2006	29.1	30.2	0.94	0.93	0.95	0.88
2011	55.0	53.6	0.99	0.94	1.10	1.26†

*The OR is for the comparison of women with men.
†The OR is significant between women and men.
CCU, coronary care unit; eGFR, estimated glomerular filtration rate; HR, heart rate; LDL-C, low-density lipoprotein cholesterol; MI: myocardial infarction; PCI, percutaneous coronary intervention; SBP, systolic blood pressure.

Table 2. Unadjusted OR for treatments, testing and in-hospital outcomes comparing women with men according to age

	All patients		Age group, year			
	Women (n=3574) Per cent	Men (n=8412)	<60 (n=3914) OR*	60–69 (n=3213)	70–79 (n=3562)	≥80 (n=1297)
Acute medications						
Aspirin≤24 h	83.9	87.5	0.83	0.75†	0.90	0.90
Clopidogrel≤24 h	51.5	56.6	0.80†	0.81†	0.86†	1.01
β-Blocker≤24 h	43.8	48.5	0.87	0.84†	1.06	0.98
ACE-I/ARB‡	60.2	63.8	0.90	0.88	0.90	0.73†
Statin‡	73.0	75.2	0.79†	0.85†	1.02	1.02
Reperfusion therapies ≤24 h						
Primary PCI	8.5	12.8	0.54†	0.85	0.81	0.76
Fibrinolytic therapy	18.9	24.7	0.88	0.88	0.87	1.00
Any reperfusion	27.4	37.5	0.68†	0.84†	0.82†	0.86
Staged procedures						
Cardiac catheterisation	18.8	28.8	0.72†	0.68†	0.71†	0.64†
PCI	8.6	13.9	0.84	0.67†	0.66†	0.59
CABG	0.34	0.61	0.58	0.41	1.02	–
Any revascularisation	8.9	14.4	0.84	0.64†	0.67†	0.59
Testing						
Troponin	48.9	49.9	0.85	0.90	0.96	1.06
Echocardiogram	46.1	52.6	0.97	0.67†	0.90	0.93
In-hospital outcomes						
Death‡	12.5	6.7	2.29†	2.21†	1.20	1.38
Death‡ + withdrawal from treatment	17.2	9.1	2.20†	2.21†	1.37†	1.25
Death within 24h	5.5	2.9	1.75	2.21†	1.34	1.89†
Composite complications	15.3	11.8	1.46†	1.21	1.17	1.29
Major bleeding	0.8	1.0	0.22	0.74	1.07	0.44
Length of stay (days)						
<8	29.5	22.7	1.03	0.73†	1.07	1.21†
8–11	20.9	24.0	1.35†	0.87	0.89	0.96
12–15	21.4	23.4	1.22†	1.06	0.87	0.88
≥16	28.2	29.8	1.60†	0.83	1.07	0.62†

*The OR is for the comparison of women with men.
†The OR is significant between women and men.
‡During hospitalisation.
ACE-I/ARB, angiotensin converting enzyme inhibitor/angiotensin receptor blocker; Composite complication: recurrent MI, cardiac shock, cardiac arrest, congestive heart failure and ischaemic stroke; CABG, coronary artery bypass graft; PCI, percutaneous coronary intervention.

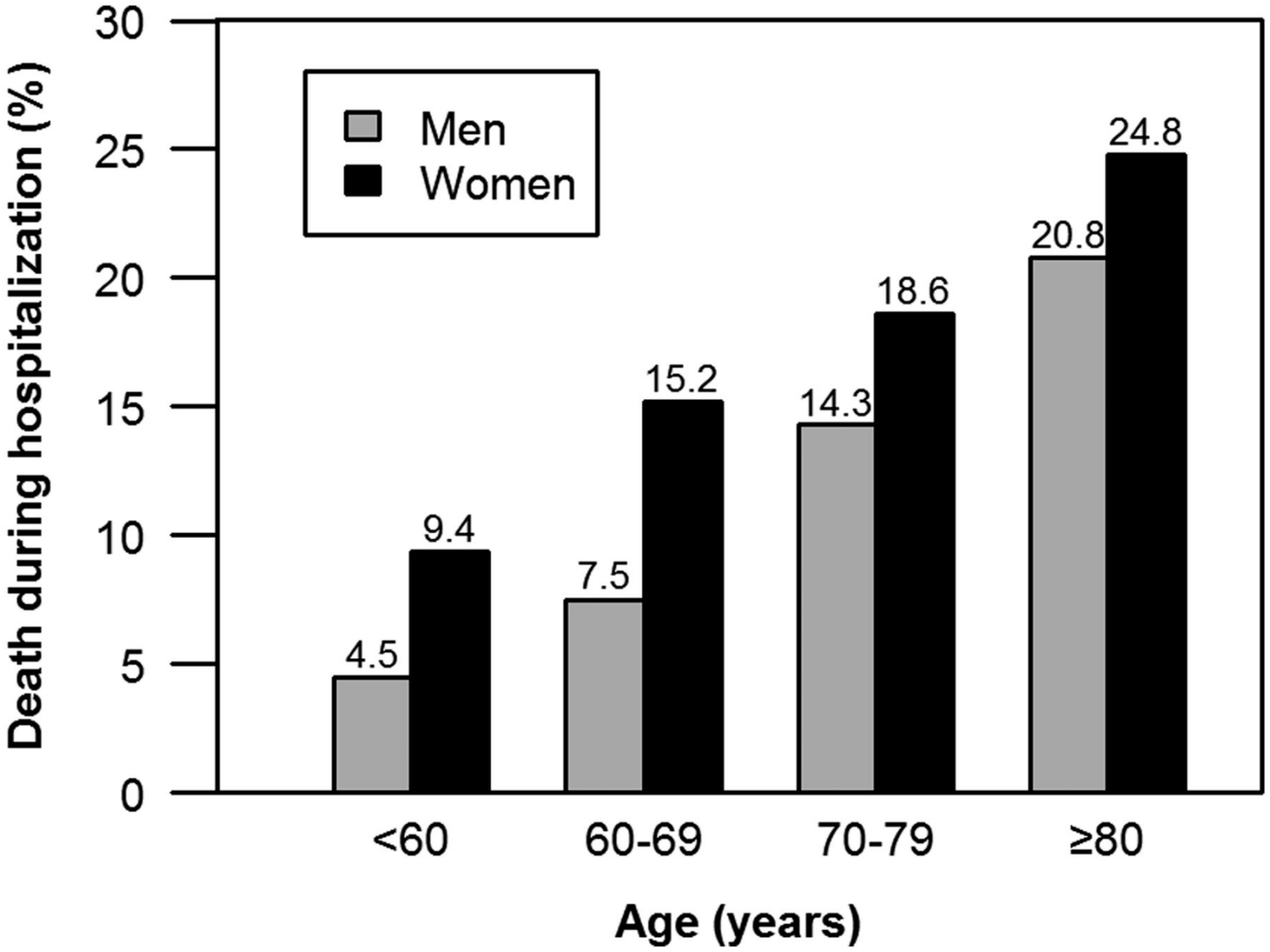

Figure 1. In-hospital mortality rate following ST-segment elevation myocardial infarction among women and men by age. The interaction between gender and age was statistically significant (*p*=0.0007).

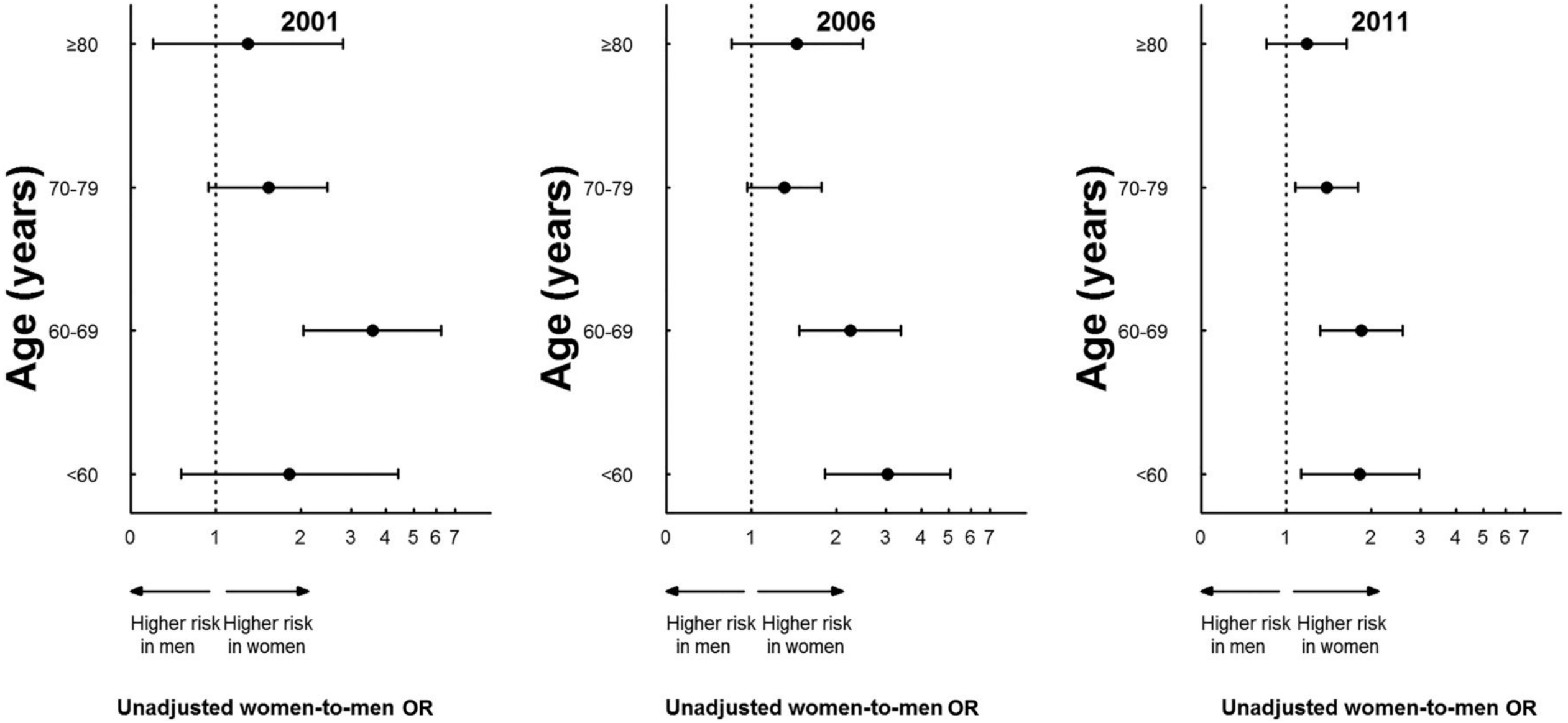

Figure 2. Unadjusted risk of in-hospital mortality comparing women with men according to age (2001, 2006 and 2011).
The interaction among gender, age and year was not statistically significant (p=0.38).

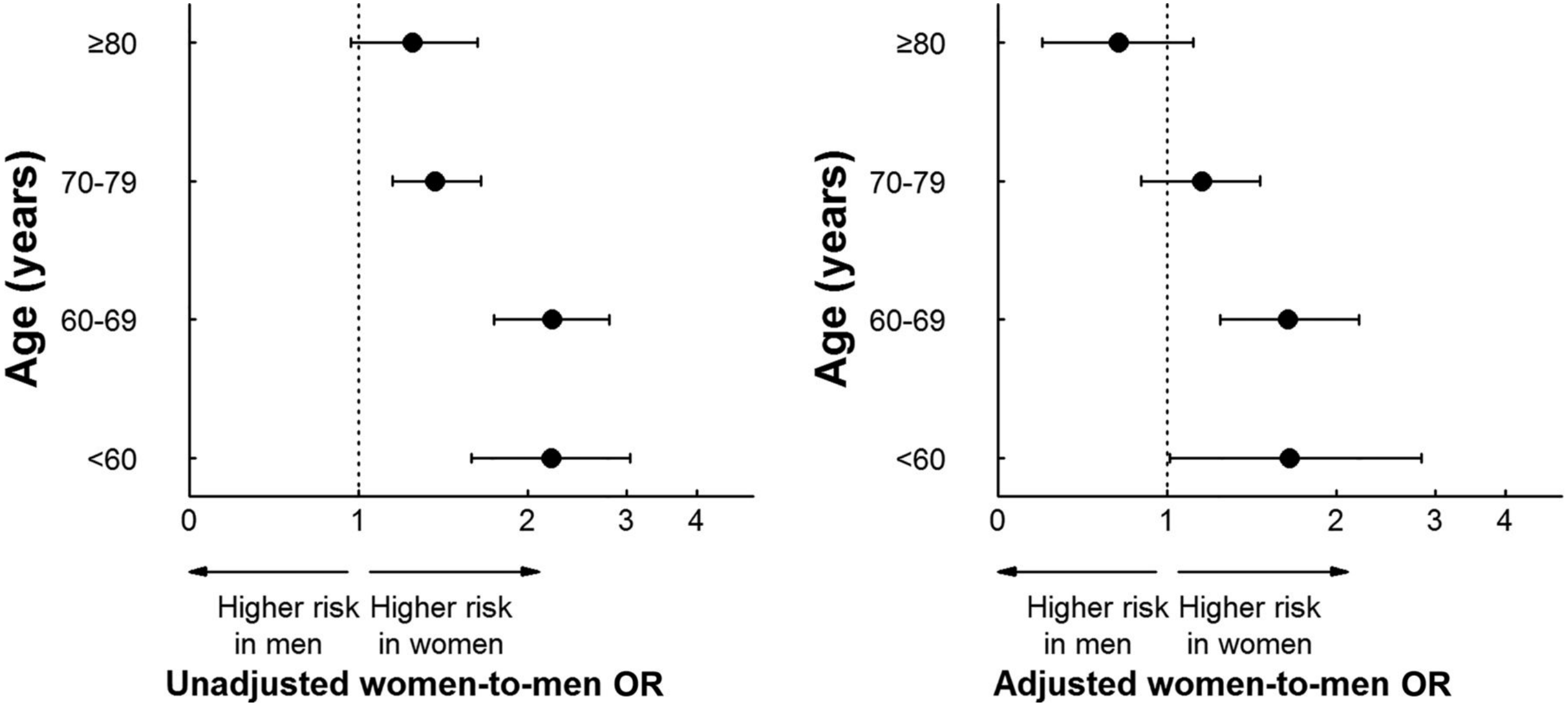

Figure 3. Unadjusted and adjusted risk of in-hospital mortality comparing women with men by age. In the unadjusted data (left panel), the interaction between gender and age was statistically significant (p=0.0009). After adjustment for differences in patient characteristics, hospital characteristics and year of discharge (right panel), the interaction between gender and age remained statistically significant (p=0.0012).

Key messages

What is already known on this subject?

In studies from high-income areas such as the USA, Canada and Europe, gender differences in mortality following acute myocardial infarction (AMI) vary by age, with a higher risk of death observed in younger women compared with their male counterparts.

What might this study add?

In China, a low-income and middle-income country with a diverse population and healthcare system, we also observed significantly higher in-hospital mortality among younger women compared with men, following hospitalization for ST-Segment Elevation Myocardial Infarction (STEMI). This pattern persisted after adjusting for a wide range of confounders, including patient- and hospital-level characteristics, and did not vary over time or across rural/urban areas. The gender differences were greatest in the younger groups <70 years of age.

How might this impact on clinical practice?

These findings indicate that the higher risk of death among younger women following AMI is a global health problem, found in high-income countries and in developing nations such as China. The findings identify young women as a vulnerable group for in-hospital mortality after STEMI and underscore the need for interventions to address this disparity.

Conclusions

- Similar to findings in the USA and other developed countries, among a Chinese population with STEMI, gender differences in early mortality were age-dependent and greatest among the younger groups <70 years of age.
- This pattern persisted even after adjusting for a wide range of confounders, including patient characteristics and hospital characteristics.
- Further research is required to enhance the understanding and development of interventions to improve the outcomes of younger women, especially in low-income and middle-income countries undergoing epidemiological transition like China.