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Original article

## Influence of obesity and metabolic syndrome on clinical outcomes of ST-segment elevation myocardial infarction in men undergoing primary percutaneous coronary intervention

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### ABSTRACT

**Background:** The correlation between obesity and metabolic syndrome (MetS) and its impact on cardiovascular disease remains unclear. This study aims to investigate the impact of metabolic status and obesity on clinical outcomes of male patients with ST-segment elevation myocardial infarction (STEMI).

**Methods:** Data from the Korea Acute Myocardial Infarction Registry-National Institutes of Health registry were used to evaluate the impact of obesity and MetS on patients undergoing primary percutaneous coronary intervention (PPCI) from November 2005 to November 2015. Patients were grouped according to the presence or absence of obesity and MetS ('obese-/MetS-', 'obese-/MetS+', 'obese+/MetS-', or 'obese+/MetS+', respectively). All-cause death and major adverse cardiac events (MACE) were recorded during 12 months of follow-up.

**Results:** A total of 14,357 patients were included. Multivariate analysis showed that the presence of MetS was an independent risk factor for all-cause death (HR 2.08, 95% CI 1.30–3.31,  $p = 0.002$ ) and cardiovascular death (HR 2.44, 95% CI 1.33–4.46,  $p = 0.004$ ) at 12 months among normal weight patients. The protective effect of obesity was observed, compared with the obese-/MetS+ group, in terms of all-cause death (HR 0.50, 95% CI 0.31–0.81,  $p = 0.005$ ) and cardiovascular death (HR 0.52, 95% CI 0.28–0.96,  $p = 0.038$ ; vs. total obese individuals), but it might have disappeared compared with the obese-/MetS- group. The rate of MACE did not differ significantly according to category by obesity and MetS.

**Conclusions:** The obesity paradox has not been observed between obese and normal weight patients without MetS. Risk stratification on the basis of the presence or absence of MetS is not a clinically useful indicator of outcome in obese male patients with STEMI after PPCI.

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### Introduction

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The association between obesity and ischemic heart disease (IHD) is well established [1–4]. A possible hypothesis for this correlation is that many obese individuals concurrently present with components of metabolic syndrome (MetS). Although there is no consensus regarding the definition of MetS, it is generally considered to be a cluster of conditions that together increase the risk of atherosclerotic disease and diabetes, which can lead to IHD [5]. Meanwhile, obesity itself is associated with an increased risk of IHD and myocardial infarction (MI) regardless of metabolic status [4,6].

Previous studies show that once IHD has developed, obese patients paradoxically exhibit more favorable clinical outcomes with respect to in-hospital mortality and short- and long-term mortality than non-obese counterparts [7–10]. However, the clinical impact of MetS on obesity remains unclear. On the assumption that MetS may represent a risk factor for poor prognosis in obese individuals with IHD, the assessment of MetS status could prove to be an important part of patient management. The authors therefore have investigated the clinical profile and outcomes of obese MI individuals, and compared the prognosis according to metabolic status.

**Methods**

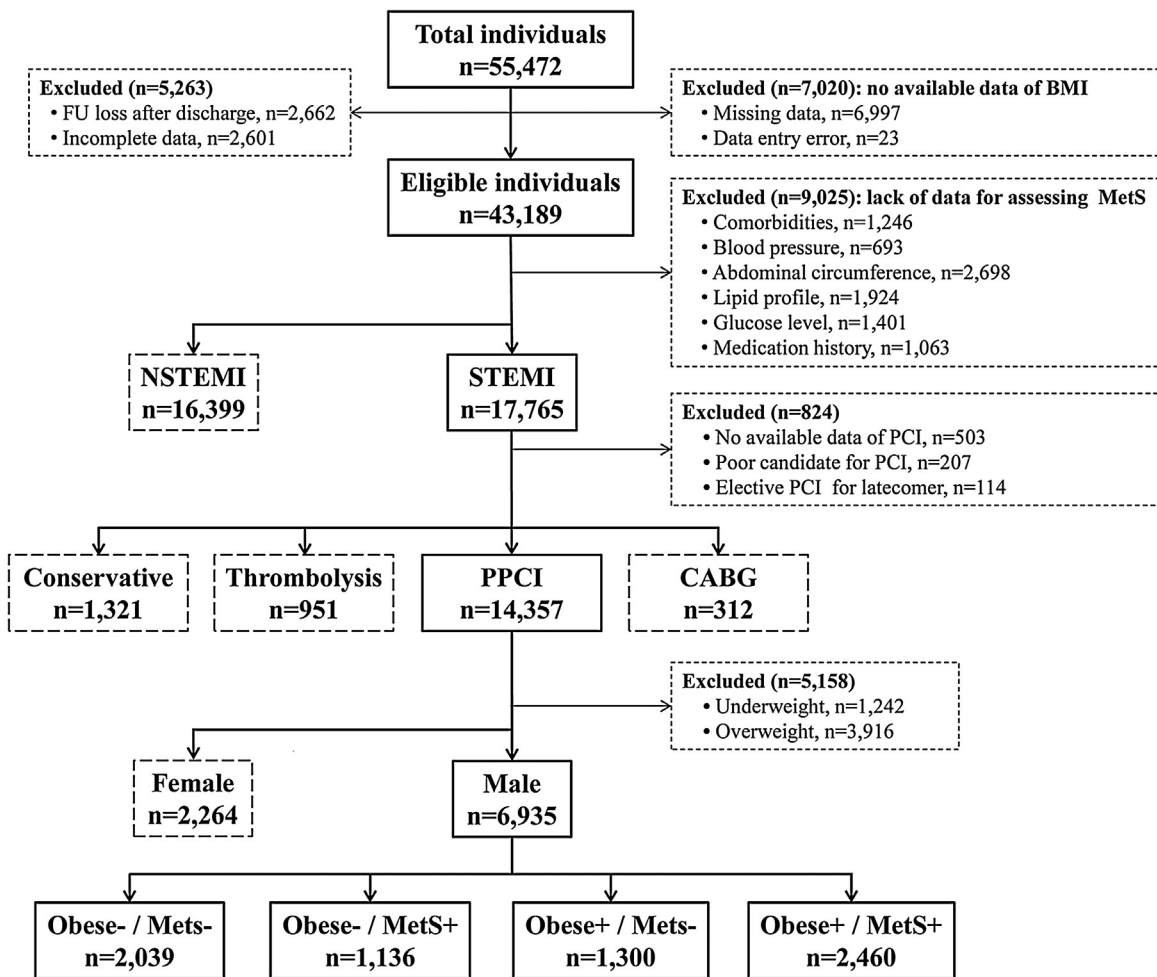
Data from the Korea Acute Myocardial Infarction Registry-National Institutes of Health registry (KAMIR-NIH) were used. The KAMIR-NIH is a prospective, multicenter, open, observational

on-line registry supported by the Korean Society of Cardiology and National Institutes of Health [11,12]. Protocols have been verified and approved by the institutional review board of each participating center, and all patients provided written informed consent. Details of the registry can be found at the KAMIR-NIH website (<http://www.kamir.or.kr>).

*Patient population and study design*

Data were collected from individuals with a diagnosis of ST-segment elevation myocardial infarction (STEMI) treated by primary percutaneous coronary intervention (PPCI) between November 2005 and November 2015. Patients were divided into four groups based on the presence or absence of obesity and MetS; these groups were termed the ‘obese–/MetS–’, ‘obese–/MetS+’, ‘obese+/MetS–’ or ‘obese+/MetS+’ groups, respectively. We included only male patients for this investigation, since the definition of MetS and prognosis of IHD differs between males and females. Both underweight and overweight individuals were excluded because of their potential difference in clinical profiles and outcomes. The details of patient selection and inclusion/exclusion criteria are outlined in Fig. 1.

Obesity was defined as a body mass index (BMI)  $\geq 25$  kg/m<sup>2</sup> based on the World Health Organization recommendation for an Asian population [13]. Underweight was defined as a BMI  $< 18.5$  kg/m<sup>2</sup>, and overweight as a BMI  $\geq 23$  kg/m<sup>2</sup> and  $< 25$  kg/m<sup>2</sup>. MetS was defined according to the revised National Cholesterol Education



**Fig. 1.** Study flow chart. FU, follow-up; BMI, body mass index; MetS, metabolic syndrome; STEMI, ST-segment elevation myocardial infarction; NSTEMI, non-ST-segment elevation myocardial infarction; PPCI, primary percutaneous coronary intervention; CABG, coronary bypass grafting.

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