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Original Research Article

Determining the Association between Body Mass Index and Outcomes in Acute Myocardial Infarction

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Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to assess the relationship Between Body Mass Index and Outcomes in Acute Myocardial Infarction.

Methods: The present study was conducted in the Department of Medicine, Ford hospital and research centre Pvt. Ltd, Patna, Bihar, India. Informed consent were not required for this study because NIS data are de-identified and publicly available. 200 estimated weighted admissions with AMI were identified. We identified hospitalizations for AMI with the International Classification of Diseases, Tenth Revision (ICD-10).

Results: The difference in comorbidities between different groups; most of our cohort had hypertension, with the highest percentage in patients with BMI > 40 kg/m2. Diabetes mellitus was also highest in patients with BMI > 40 kg/m2 with an incremental increase in percentage with elevated BMI. The presence of chronic kidney disease was higher at both extremes of BMI groups. Heart failure as a comorbidity was notably higher in lower BMI groups. Similarly, atrial fibrillation history was higher in those with BMI < 25 kg/m2. Stroke and transient ischemic attacks were higher in both BMI groups below 25 kg/m2. Charleston comorbidity index was higher in both BMI groups below 25 kg/m2. Ventricular fibrillation was more likely in BMI groups (25 - 29 and > 40 kg/m2). PCI was performed most commonly in the BMI 30 - 40 kg/m2 group. CABG was performed but mostly in BMI > 20 - 29 kg/m2 and BMI 30 - 40 kg/m2 groups. Systemic thrombolysis was only administered in 1.8% of hospitalizations and more commonly in the lowest BMI group < 20 kg/m2.

Conclusion: The current analysis of a nationally representative sample demonstrated the clinical implications of BMI in patients with AMI. Patients with a BMI of 30 - 40 kg/m2 had more favorable LOS, inpatient complications, and in-hospital mortality when compared to those with ideal body weight. Hence, this supports and expands on the concept of the "obesity paradox".

Keywords: Myocardial infarction, BMI, Obesity paradox

Introduction

The appropriate control of risk factors affecting the progression of cardiovascular (CV) disease and the incidence of complications is important to improving the clinical outcomes of patients diagnosed with acute myocardial infarction (AMI). Obesity has been considered a risk factor related to ischemic heart disease. [1,2] BMI, a parameter of obesity, has been used to estimate the degree of obesity. According to prior studies, obesity may contribute to atherosclerotic changes by activating inflammatory metabolism. [3] It may also be related to neurohormonal imbalance, predisposing left ventricular remodeling. [4] Higher BMI has been assumed to correlate with higher CV disease occurrence and worse patient prognosis. In contrast, several recent studies showed contrary results on the relationship between BMI and CV disease prognosis, which has been called the "BMI paradox". [5-8] The relationship was confirmed not only in patients with AMI but also in the general population. [9]

Several potential mechanisms accounting for protective effects of obesity on clinical outcomes after AMI have been proposed; greater metabolic reserves, less cachexia, younger ages, more aggressive medical therapy, more aggressive diagnostic and revascularization procedures, increased muscle mass and strength, diminished hormonal response including the renin-angiotensin-aldosterone system, and unmeasured confounders, including selection bias. [10] Another possible explanation is that lower BMIs do not distinguish well between lean body mass and adipose tissue. It would be better predictive of amount of adipose tissue at higher BMIs. [11] Central adiposity or body fat content might be more clinically important than

BMI, itself. The exact estimation of excess adipose tissue in accordance with weight status would be helpful to assess this issue.

The aim of the present study was to assess the relationship Between Body Mass Index and Outcomes in Acute Myocardial Infarction.

Materials and Methods

The present study was conducted in the Department of Medicine, Ford hospital and research centre Pvt. Ltd, Patna, Bihar, India for one year. informed consent were not required for this study because NIS data are de-identified and publicly available. 200 estimated weighted admissions with AMI were identified. We identified hospitalizations for AMI with the International Classification of Diseases, Tenth Revision (ICD-10).

We also identified patients whose BMI codes were collected and divided into five BMI groups: underweight (< 20 kg/m2), normal weight (20 - 24.9 kg/m2), overweight (25 - 30 kg/m2), obese class I and II (31 - 39.9 kg/m2), and obese class III (≥ 40 kg/m2). The included population in our analysis were patients aged above 18, who we identified as presenting with an MI as described above and had BMI codes identifying their obesity status.

Descriptive statistics were presented as frequencies with percentages for categorical variables and as means with standard deviations and medians with interquartile ranges for continuous variables. Baseline characteristics were compared using a Pearson Chi-square test, Fisher's exact test for categorical variables, and the Student's t-test and Mann-Whitney U test for continuous variables. Multivariate regression analysis was done to adjust for possible confounders while calculating in-hospital mortality. The patient and hospital characteristics, as well as comorbidities, were obtained from the literature review. A univariate screen was done to further confirm these factors. Variables with P < 0.2 on a univariate screen were included in the multivariable regression model. A P-value of 0.05 was set as the threshold for statistical significance in the multivariate regression analysis. All analyses were conducted by weighting samples for national estimates in conjunction with the HCUP regulations for using the NIS database. Statistical analyses were performed using STATA version 17 for Windows and RStudio 2022.02.0.

Results

Table 1: Patient Baseline Comorbidities by Body Mass Index

Characteristics	Overall n=200	< 20 n=12	20 – 24 n=6	25 – 29 n=20	30 – 39 n=104	> 40 n=58	P Value
Hypertension	170	9	4	17	87	53	< 0.001
Diabetes mellitus	104	4	3	9	55	33	< 0.001
Chronic kidney disease	50	5	2	4	24	15	< 0.001
Heart failure	80	6	3	6	32	33	< 0.001
Stroke	5	1	1	1	1	1	< 0.001
Transient ischemic attack	6	2	1	1	1	1	< 0.001
Atrial fibrillation	40	4	3	4	20	9	< 0.001
Charleston comorbidity index	3.2 (SD 4.6)	3.9 (SD 4.8)	4.0 (SD 5.1)	3.2 (SD 4.6)	3.0 (SD 4.2)	3.4 (SD 5.1)	< 0.001

The difference in comorbidities between different groups; most of our cohort had hypertension, with the highest percentage in patients with BMI > 40 kg/m2. Diabetes mellitus was also highest in patients with BMI > 40 kg/m2 with an incremental increase in percentage with elevated BMI. The presence of chronic kidney disease was higher at both extremes of BMI groups. Heart failure as a comorbidity was notably higher in lower BMI groups. Similarly, atrial fibrillation history was higher in those with BMI < 25 kg/m2. Stroke and transient ischemic attacks were higher in both BMI groups below 25 kg/m2. Charleston comorbidity index was higher in both BMI groups below 25 kg/m2.

Table 2: Distribution of Clinical Course and Utilization of Revascularization Procedures by Body Mass Index

Characteristics	Overall n=200	< 20 n=12	20 – 24 n=6	25 – 29 n=20	30 – 39 n=104	> 40 n=58	P Value
STEMI	40	3	2	3	22	10	< 0.001
NSTEMI	140	8	4	14	70	44	< 0.001
Other MI (not MI/NSTEMI)	8	2	1	1	2	2	< 0.001
Ventricular tachycardia	12	3	1	2	3	3	0.14
Ventricular fibrillation	12	2	1	1	4	4	< 0.001
PCI	90	3	2	9	51	25	< 0.001
CABG	25	3	3	3	10	6	< 0.001
Systemic thrombolysis	5	1	1	1	1	1	< 0.001

Ventricular fibrillation was more likely in BMI groups (25 - 29 and > 40 kg/m2). PCI was performed most commonly in the BMI 30 - 40 kg/m2 group. CABG was performed but mostly in BMI > 20 - 29 kg/m2 and BMI 30 - 40 kg/m2 groups. Systemic thrombolysis was only administered in 1.8% of hospitalizations and more commonly in the lowest BMI group < 20 kg/m2.

Table 3: Patient Complications and Resource Utilization by Body Mass Index

Characteristics	Overall n=200	< 20 n=12	20 – 24 n=6	25 – 29 n=20	30 – 39 n=104	> 40 n=58	P Value
Length of hospital	5.0 (SD 5.7)	6.6 (SD 7.5)	6.7 (SD 7.0)	5.3 (SD 6.2)	4.6 (SD 4.9)	5.2 (SD 6.3)	< 0.001
Mechanical ventilation	10	1	1	1	4	3	< 0.001
Upper GI bleeding	5	1	1	1	1	1	< 0.001
Acute kidney injury	45	5	2	5	20	13	< 0.001
PRBC transfusion	6	1	1	1	2	1	< 0.001
Circulatory shock	12	2	1	1	5	3	< 0.001
Mortality	6	1	1	1	2	1	< 0.001

Length of stay (LOS) was longest in the 20 - 24 kg/m2 BMI group with an average stay of 6.7 ± 7 days ($P < 0.001$). Respiratory failure requiring mechanical ventilation was highest in BMI < 20 kg/m2 group. Multiple in-hospital complications were highest for 20 - 24 kg/m2 BMI group including upper gastrointestinal (GI) bleeding, acute kidney injury, circulatory shock and requiring packed red blood cell (PRBC) transfusion.

Discussion

Acute myocardial infarction (AMI) is one of the most prominent complications of cardiac disease.[12] It can present with cardiac arrest, shock, and multiple organ dysfunction. [12] The treatment of AMI usually requires inpatient hospitalization and close monitoring, which places a substantial financial burden not only on the patient but also on the healthcare system as a whole. [13] AMI has been linked with many conditions including obesity. [14]

AMI. A recent meta-analysis of five primary studies showed a clear correlation between obesity and risk for AMI.15 In addition, underweight patients have been shown to have a higher risk of cardiovascular events including cerebrovascular accidents and AMI. [16,17] The difference in comorbidities between different groups; most of our cohort had hypertension, with the highest percentage in patients with BMI > 40 kg/m2. Diabetes mellitus was also highest in patients with BMI > 40 kg/m2 with an incremental increase in percentage with elevated BMI. The presence of chronic kidney disease was higher at both extremes of BMI groups. Heart failure as a comorbidity was notably higher in lower BMI groups. Similarly, atrial fibrillation history was higher in those with BMI < 25 kg/m2. Stroke and transient ischemic attacks were higher in both BMI groups below 25 kg/m2. Charleston comorbidity index was higher in both BMI groups below 25 kg/m2. Obese patients were more likely to be younger when presenting with AMI, which could be related to obesity being a risk factor for coronary artery disease (CAD). A total of 111,847 patients were involved in a retrospective analysis comparing NSTEMI frequency and risk factors, revealing that excess adipose tissue is a primary risk factor for a premature cardiac event. [18,19] Obese patients were more likely to have diabetes mellitus and hypertension, as it is well established that obese patients have higher rates of metabolic disease. [19,20]

The higher prevalence of these two additional CAD risk factors in obese patients may also contribute to them presenting at a younger age with AMI than in lower BMI groups. [18,21] Although these patients' young age may contribute to the decreased mortality rate in those with class I and II obesity, when we adjusted for age and other patient characteristics, they continued to have lower inpatient mortality rates.

Ventricular fibrillation was more likely in BMI groups (25 - 29 and > 40 kg/m2). PCI was performed most commonly in the BMI 30 - 40 kg/m2 group. CABG was performed but mostly in BMI > 20 - 29 kg/m2 and BMI 30 - 40 kg/m2 groups. Systemic thrombolysis was only administered in 1.8% of hospitalizations and more commonly in the lowest BMI group < 20 kg/m2. Length of stay (LOS) was longest in the 20 – 24 kg/m2 BMI group with an average stay of 6.7 ± 7 days (P < 0.001). It is well established that patients with STEMI have higher rates of mortality than those with NSTEMI [17-20]. Interestingly despite the two lower BMI groups (< 25 kg/m2) having fewer rates of STEMI, they experienced higher mortality rates. The higher rates of STEMI in class I and II obesity likely also contributed to these patients receiving higher rates of coronary revascularization through PCI and CABG. [22-25] Respiratory failure requiring mechanical ventilation was highest in BMI < 20 kg/m2 group. Multiple in-hospital complications were highest for 20 – 24 kg/m2 BMI group including upper gastrointestinal (GI) bleeding, acute kidney injury, circulatory shock and requiring packed red blood cell (PRBC) transfusion. The relationship between a higher BMI and better survival rates post-ACS is not very well understood. One concept proposed is "metabolically healthy obesity", which indicates despite these patients having large adipose reserves some do not have classic sequela of metabolic disease. [26,27] Several other mechanisms have been postulated such as improved nutritional and caloric reserve may hinder the metabolic effects of the disease for those who are critically ill. [28-31]

Conclusion

The current analysis of a nationally representative sample demonstrated the clinical implications of BMI in patients with AMI. Patients with a BMI of 30 - 40 kg/m2 had more favorable LOS, inpatient complications, and in-hospital mortality when compared to those with ideal body weight. Hence, this supports and expands on the concept of the "obesity paradox".

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