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Effect of Morbid Obesity on In-Hospital Mortality and Coronary Revascularization Outcomes after Acute Myocardial Infarction in the United States

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Abstract

We sought to investigate the impact of morbid obesity (body mass index (BMI ≥ 40 kg/m^2)] on in-hospital mortality and coronary revascularization outcomes on patients presenting with acute myocardial infarction (AMI). We used the Nationwide Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project (HCUP) and reviewed 413,673 patients hospitalized with acute myocardial infarction (AMI) in 2009. The morbidly obese comprised 3.7% of all AMI patients. Analysis of the unadjusted data revealed that morbidly obese patients compared to those not morbidly obese were more likely to undergo any invasive cardiac procedures when presenting with either STEMI (97.4% vs 93.8%, p<0.0001) or NSTEMI (85.5% vs 80.6%, p<0.0001). The unadjusted mortality rate for morbidly obese patients with AMI was 3.5% compared to 5.5% (p<. 0.0001) of those not obese. In adjusted analyses also, patients with morbid obesity had lower odds of in-hospital mortality compared to non-morbidly obese patients consistent with the phenomenon of "the obesity paradox."

Keywords

morbid obesity; mortality; acute myocardial infarction; percutaneous coronary intervention

Introduction

Given the previously reported worse short-term outcomes for morbidly obese patients presenting with ACS in prior registry studies (1–5), we explored whether this association was evident in a large national database. Using data from the Nationwide Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project (HCUP), we analyzed the association between morbid obesity, treatment utilization, and mortality while adjusting for baseline

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Disclosures

There are no conflicts of interest. All authors had full access to the data in the study and take responsibility for the integrity of the data and accuracy of the data analysis.

characteristics, including comorbidities, for 413,673 patients hospitalized with acute myocardial infarction (AMI).

Methods

This study involved a population-based sample of all patients admitted with AMI to 1,045 hospitals in 44 states in 2009 whose admission and discharge data were included in the Nationwide Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project (HCUP). Our sample included those admitted with a principal diagnosis of AMI according to the International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] codes 410.0 to 410.92. ST elevation myocardial infarction (STEMI) was recorded when the principal diagnosis was billed with ICD- 9 codes 410.0–410.62, 410.81–410.82 and Non ST elevation myocardial infarction (NSTEMI) with ICD-9 codes 410.70–410.72, 410.90–410.92. Patients were excluded if AMI was an in-hospital complication. Institutional review board approval was obtained from the authors' university.

These data include ICD-9–coded primary and secondary diagnoses; primary and secondary procedures; admission and discharge status; demographic information such as sex, age, race and ethnicity, and median income for zip code divided into quartiles; expected payment source; total charges; length of stay; and hospital region, teaching status, ownership type, and bed size. We used ICD-9 secondary diagnosis codes and a database defined variable for morbid obesity (BMI $\geq$ 40 kg/m^2) developed by the Agency for Healthcare Research and Quality (AHRQ). ICD-9 secondary codes were used to indicate the presence of up to 30 chronic comorbidities likely to have been present on admission, using the Elixhauser comorbidity adjustment method (6) developed at AHRQ. Variables in the risk adjustment algorithm include age, sex, peripheral vascular disease, paralysis, other neurological disorders, chronic pulmonary disease, diabetes mellitus, diabetes mellitus with chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer disease, AIDS, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis, coagulopathy, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, deficiency anemia, alcohol abuse, drug abuse, psychoses, and hypertension.

The principal outcome measure was short-term all-cause mortality (in-hospital mortality) which was defined as death that occurred during the initial hospitalization, between day of hospital admission and date before discharge, provided the length of stay was less than or equal to 30 days. Secondary outcomes included cardiac procedures and were defined using ICD-9 primary procedure codes to indicate whether diagnostic coronary angiography (ICD-9 codes: 37.22, 37.23, 88.53, 88.54, 88.55, 88.56, 88.57), percutaneous coronary intervention (PCI) (ICD-9 codes: 36.04, 36.06, 36.07, 00.66) or coronary artery bypass graft (CABG) surgery (ICD-9 codes: 36.10–36.19) were performed during the hospitalization.

We used SAS version 9.1 (SAS Institute, Inc.) for all analyses. Univariate and distributional analysis included measures of central tendency, kurtosis and skew. Differences between morbidly obese patients and non-morbidly obese patients were assessed with the $\chi 2$ test for categorical variables and with the Student t-test or one-way analysis of variance as appropriate for continuous variables. Adjusted ORs for in-hospital mortality as well as procedure use were estimated using unconditional logistic regression. To control for differential characteristics of morbidly obese patients and non-morbidly obese patients, covariates including age, gender, race, income, Elixhauser comorbidities, and hospital characteristics such as hospital location, hospital control (for-profit, non-profit), hospital teaching status and hospital volume were included in the models. All analyses were weighted using NIS provided weights to create national estimates.

Results

The 2009 NIS database included 413,673 admissions for AMI, with 32% due to STEMI and 68% due to NSTEMI (Table 1). Morbidly obese (BMI ≥ 40 kg/m^2) patients comprised 3.7% of all AMI patients. Morbidly obese patients presenting with AMI were more likely to be female (45.8% vs 36.7%, p<.0001), younger (59.6 years old vs. 65.3 years old, p<.0001), black (11.7% vs 9.2%, p<.0001) and had a higher incidence of co-morbid conditions such as diabetes mellitus (63.4% vs 33.0%, p<.0001), hypertension (77.3% vs 67.6%, p<.0001), and renal failure (21.6% vs 16.7%, p<.0001).

Analysis of the unadjusted data revealed that morbidly obese patients compared to those not morbidly obese were more likely to undergo any invasive cardiac procedures when presenting with either STEMI (97.4% vs 93.8%, p<0.0001) or NSTEMI (85.5% vs 80.6%, p<0.0001) (Table 2). In both the STEMI and NSTEMI subgroups, morbidly obese patients were slightly more likely to undergo only diagnostic catheterization with no further revascularization (10.3% vs 9.01%, p<0.0001 and 29.2% vs 27.1%, p<0.001, respectively.) Regardless of the type of AMI, morbidly obese patients were less likely to undergo PCI (45.1% vs 52.9%, p<0.0001) and more likely to receive CABG (18.6% vs 10.9%, p< 0.0001) than non-morbidly obese patients.

After adjusting for age, gender, race, income, hospital factors and Elixhauser comorbidities, these differences persisted. Morbidly obese patients presenting with STEMI who required revascularization were more likely to undergo CABG (OR 1.60, (95% CI 1.45- 1.78)) and less likely PCI (OR 0.86, (95% CI 0.80–0.94)) than non-morbidly obese patients (Table 3). Similarly, when presenting with NSTEMI, and undergoing revascularization, morbidly obese patients were more likely to undergo CABG (OR 1.61, (95% CI 1.53–1.69)) and less likely PCI (OR 0.78, (95% CI 0.80–0.94)).

A lower unadjusted in-hospital mortality rate was observed in the morbidly obese compared to those not morbidly obese in both the STEMI subsample (4.7% vs 6.3%, p< 0.0001) and the NSTEMI subsample (3.1% vs 5.1%, p<0.0001) (Table 4). After adjustment, no difference in mortality was found between morbidly obese patients and non-morbidly obese patients who were admitted with STEMI, regardless of whether they underwent no procedure, diagnostic cath, PCI, or CABG (Table 5). In those presenting with NSTEMI, however, the adjusted risk of in-hospital mortality was lower for morbidly obese patients compared to those not morbidly obese (OR 0.87, (95% CI 0.78–0.98)). When diagnosed with NSTEMI and subsequently undergoing no procedure, morbidly obese patients had a lower risk of in-hospital mortality than non-morbidly obese patients (OR 0.83, (0.71–0.98)).

Discussion

Our analysis of the relationship between morbid obesity, invasive cardiac procedures, and mortality for 413,673 patients hospitalized with AMI revealed that: 1) morbidly obese patients presenting with AMI are more often women, black, have more comorbidities, and have lower socioeconomic status than non-morbidly obese patients; 2) after adjustment for comorbidities and demographic factors, morbidly obese patients have lower mortality when presenting with NSTEMI than non-morbidly obese patients. 3) In current practice, morbidly obese patients have higher rates of CABG and lower rates of PCI compared to non-morbidly obese patients when revascularization is chosen after AMI.

The morbidly obese patients with AMI in our study were on average about six years younger than the non-morbidly obese patients yet had higher rates of comorbid risk factors, such as diabetes mellitus and hypertension, consistent with the findings of the previously cited registry studies by Diercks et al. and Das et al. (7,8). This finding is likely due to the

influence of the comorbidities associated with morbid obesity on accelerating the pathogenesis of myocardial infarction resulting in a younger age of presentation.

As mentioned previously, prior studies evaluating the association between obesity and in-hospital mortality post-AMI revealed that morbidly obese patients have higher adjusted mortality, despite overweight and moderately obese patients having a lower adjusted mortality compared to normal weight patients (7,8). This suggests that the apparent protective effect of "the obesity paradox" for post-MI mortality does not extend to patients whose BMI is greater than 40. Our study, however, found a significantly lower risk of adjusted in-hospital mortality for morbidly obese patients presenting with NSTEMI compared to non-morbidly obese patients. Morbidly obese STEMI patients had the same risk of mortality as non-morbidly obese patients.

The reason for the discrepancy between our results and those of previously published papers is unclear. One possible explanation is differences in the comparison group. The Das et al. and Diercks et al. studies used the lowest risk groups for comparison (overweight and class I obese groups, respectively), which would have enhanced the odds ratio for morbidly obese patients (7,8). The morbidly obese patients in our study, however, were compared to the entirety of the non-morbidly obese patients, which include underweight patients. Another reason for the difference in outcomes is the use of Elixhauser comorbidities and hospital characteristics in our study, which may have resulted in adjusting for more confounders in our study than prior studies.

Another interesting finding from our review of the national database was the preference for CABG surgery over PCI in morbidly obese patients. Possible explanations for this disparity include more extensive coronary disease in morbidly obese patients, which required surgical revascularization and the younger age of morbidly obese patients, which made them better surgical candidates.

In our study, morbidly obese patients also had lower risk of mortality than non-morbidly obese patients if no procedure was performed when presenting with NSTEMI but not with STEMI. It is possible that the marginal benefit of the early invasive strategy following NSTEMI that is recommended in the current ACC/AHA guidelines (9) is negated by increased theoretical peri-procedural complications and technical challenges in administering therapeutic interventions to morbidly obese patients. Further prospective studies are warranted to evaluate the outcomes of invasive cardiac therapies in morbidly obese patients.

This study has several limitations. The data was extracted from an administrative database that may not have included potentially important confounding variables and details on medical treatments. Undiscovered confounders are widely believed to explain "the obesity paradox" (10). Also, as previously mentioned, the heterogeneity of the comparison cohort in this study makes comparisons to previous similar studies difficult. Finally, since this was a retrospective study, we can only comment on the association of morbid obesity, therapeutic interventions and outcomes. Prospective studies would be needed to prove causation of morbid obesity and adverse or beneficial effects.

In this large nationwide contemporary cohort of 413,673 patients presenting with AMI, morbid obesity was associated with a lower risk of adjusted in-hospital mortality compared to non-morbidly obese patients consistent with the phenomenon of "the obesity paradox." Factors that may impact the better survival in morbidly obese patients include presenting at a younger age on presentation, the tendency to present with NSTEMI rather than STEMI, and the higher rate of referral for CABG.

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Table 1

Baseline characteristics of Acute Myocardial Infarction (AMI) patients with morbid obesity

		AMI [a] patients	Morbid obesity		P-Value [d]
Number of cases		**Overall sample**	**Yes**	**No**	
	Overall	413,673	3.7 (15,254)	96.3 (398,419)	
	Female	37.0 (153,147)	45.8 (6,993)	36.7 (146,154)	<0.0001
	Males	63.0 (260,526)	54.2 (8,262)	63.3 (252,265)	<0.0001
	STEMI [b]	32.4 (134,032)	23.8 (3,623)	32.7 (130,409)	0.0001
	NON- STEMI [c]	67.6 (279,641)	76.3(11,631)	67.3 (268,010)	0.0001
	In-hospital death	5.4 (22,315)	3.5 (529)	5.5 (21,786)	<0.0001
	Diagnostic Cath	18.7 (77,157)	21.1 (3,215)	18.6 (73,942)	<0.0001
	PCI	48.7 (201,291)	41.5 (6,327)	48.9 (194,964)	<0.0001
	CABG	9.6 (39,551)	16.2 (2,470)	9.3 (37,081)	<0.0001
Mean age					
	Overall	65.6 ± 31.1	59.6 ± 26.2	65.9 ± 31.2	<0.0001
	STEMI	62.3 ± 30.6	57.3 ± 26.6	62.5 ± 30.6	<0.0001
	NSTEMI	67.1 ± 30.7	60.4 ± 25.9	67.5 ± 30.1	<0.0001
Race					
	White	76.7 (317,413)	77.0 (11,742)	76.7 (305,671)	
	Black	9.3 (38,361)	11.7 (1,780)	9.2 (36,581))	
	Hispanic	7.3 (29,991)	7.0 (1,057)	7.3 (28,934)	<0.0001
	Asian	2.2 (8,873)	0.9 (135)	2.2 (8,738)	
	Others	4.6 (19,035)	3.5 (540)	4.6 (18,495)	
Median household Income ($)					
	1– 39,999	26.9 (111,165)	31.3 (4,771)	26.7 (106,393)	
	40,000 – 49,999	26.7 (110,471)	27.0 (4,117)	26.7 (106,354)	<0.0001
	50,000– 65,000	25.0 (103,238)	25.0 (3,813)	25.0 (99,424)	
	66,000+	21.5 (88,799)	16.7 (2,553)	21.7 (86,246)	
Co-morbidities					
	Diabetes Mellitus	34.1 (140,916)	63.4 (9,677)	33.0 (131,239)	<0.0001

	AMI [a] patients	Morbid obesity		P-Value [d]
Number of cases	**Overall sample**	**Yes**	**No**	
Hypertension	68.0 (281,044)	77.3 (11,787)	67.6 (269,258)	<0.0001
Perivascular disorders	11.8 (48,868)	10.9 (1,664)	11.9 (47,204)	0.0004
Renal Failure	17.0 (69,841)	21.6 (3,292)	16.7 (66,550)	<0.0001

Values are expressed as mean ± standard deviation for continuous variables or % (n) for dichotomous variables

[a] Acute Myocardial Infarction (AMI)- ICD9 codes 41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061, 41062, 41070, 41071, 41072, 41080, 41081, 41082, 41090, 41091, 41092

[b] ST Elevation myocardial infarction (STEMI)- ICD9 codes 41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061,41062, 41080

[c] non ST Elevation myocardial infarction (NSTEMI)-ICD9 codes 41070, 41071, 41072, 41090, 41091, 41092

[d] P value obtained by Chi-Square test of Independence for categorical variables

[e] Morbid obesity is defined as body mass index (BMI) >40 in kg/m2

Table 2

Relationship Between Cardiac procedures and Morbid Obesity[i] in all Acute Myocardial Infarction, STEMI and NSTEMI patients

Cardiac Procedure	AMI [a] patients					STEMI [b] patients					NSTEMI [c] patients				
	Morbid obesity					Morbid obesity					Morbid obesity				
	n	Yes	No	Chi - square	P - Value	n	Yes	No	Chi - square	P - Value	n	Yes	No	Chi - square	P - Value
No procedure[d]	61,729	11.7 (1,779)	15.1 (59,950)	132.7	<0.0001	8136	2.6 (95)	6.2 (8,042)	191.9	<0.0001	53,593	14.5 (1,684)	19.4 (51,909)	171.9	<0.0001
Any procedure [e]	351,944	88.3 (13,475)	85.0 (338,468)	132.7	<0.0001	125,896	97.4 (3,529)	93.8 (122,368)	78.3	<0.0001	226,048	85.5 (9,947)	80.6 (216,101)	171.9	<0.0001
Diagnostic cath [f]	88,250	24.7 (3,763)	21.2 (84,487)	105	<0.0001	12,123	10.3 (373)	9.01 (11,750)	7.1	0.008	76,127	29.2 (3390)	27.1 (72,737)	22.6	<0.0001
PCI [g]	217,492	45.1 (6,878)	52.9 (210,615)	356.1	<0.0001	102,266	72.7 (2634)	76.4 (99,632)	26.6	<0.0001	115,227	36.5 (4244)	41.4 (110,983)	111.6	<0.0001
CABG [h]	46,201	18.6 (2,834)	10.9 (43,367)	877.2	<0.0001	11,508	14.4 (521)	8.4 (10,986)	159.8	<0.0001	34,694	19.9 (2313)	12.1 (32,381)	624.9	<0.0001

Values are expressed as % (n)

[a] Acute Myocardial Infarction (AMI) - ICD9 codes 41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061, 41062, 41070, 41071, 41072, 41080, 41081, 41082, 41090, 41091, 41092

[b] ST elevation myocardial infarction (STEMI) - ICD9 codes 41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061,41062, 41080, 41081,41082

[c] non ST Elevation myocardial infarction (NSTEMI) - ICD9 codes 41070, 41071, 41072, 41090, 41091, 41092

[d] Patients who have not undergone any procedure

[e] Patients who have undergone any of the cardiac procedures

[f] Diagnostic Catheterization- ICD9 codes 3722, 3723, 8853, 8854, 8855, 8856, 8857

[g] Percutaneous Intervention (PCI) - ICD9 codes 0066, 3604, 3606, 3607

[h] Coronary Artery Bypass Graft (CABG) - ICD9 codes 3610, 3611, 3612, 3613, 3614, 3615, 3616, 3617, 3619

[i] Morbid obesity is defined as body mass index (BMI) >40 in kg/m2

Table 3

Multivariate Regression showing association of Obesity with cardiac procedures in Acute Myocardial Infarction, STEMI, NSTEMI patients

		AMI patients [a]		STEMI patients[b]		NSTEMI patients [c]	
Models	**Outcome**	**Morbid obesity[j]**		**Morbid obesity**		**Morbid obesity**	
		Odds Ratio (95 % CI)	**P - Value**	**Odds Ratio (95 % CI)**	**P - Value**	**Odds Ratio (95 % CI)**	**P - Value**
Age, Gender, Race, Income, Hospital factors [e] and 30 Elixhauser morbidities [i]	Diagnostic cath [f]	1.09 (1.04 – 1.13)	<0.0001	1.12 (1.0003 – 1.25)	<0.0001	1.02 (0.98 – 1.07)	0.27
Age, Gender, Race, Income, Hospital factors and 30 Elixhauser morbidities	PCI [g]	0.74 (0.72 – 0.77)	<0.0001	0.86 (0.80 – 0.94)	0.0003	0.78 (0.0.75–0.0.81)	<0.0001
Age, Gender, Race, Income, Hospital factors and 30 Elixhauser morbidities	CABG [h]	1.66 (1.59 – 1.74)	<0.0001	1.60 (1.45 – 1.78)	<0.0001	1.61(.53– 1.69)	<0.0001
Age, Gender, Race, Income, Hospital factors and 30 Elixhauser morbidities	Any procedure [d]	1.08 (1.02 – 1.14)	0.01	2.25 (1.82 – 2.79)	<0.0001	1.04 (0.98 – 1.10)	0.21

[a] Acute Myocardial Infarction (AMI) - ICD9 codes 41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061, 41062, 41070, 41071, 41072, 41080, 41081, 41082, 41090, 41091, 41092

[b] ST Elevation myocardial infarction (STEMI) - ICD9 codes 41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061,41062, 41080, 41081,41082

[c] non ST Elevation myocardial infarction (NSTEMI) - ICD9 codes 41070, 41071, 41072, 41090, 41091, 41092

[d] Patients who have undergone any of the cardiac procedures

[e] Hospital factors such as hospital location, hospital control (government /private), hospital teaching status and total discharges

[f] Diagnostic Catheterization- ICD9 codes 3722, 3723, 8853, 8854, 8855, 8856, 8857

[g] Percutaneous Intervention (PCI) - ICD9 codes 0066, 3604, 3606, 3607

[h] Coronary Artery Bypass Graft (CABG)- ICD9 codes 3610, 3611, 3612, 3613, 3614, 3615, 3616, 3617, 3619

[i] 30 Elixhauser morbidities include Congestive heart failure, Cardiac arrhythmias, Valvular disease, Pulmonary Circulation Disorders, Peripheral vascular Disorders, Hypertension, uncomplicated and complicated, Paralysis, other neurological Disorders

[j] Morbid obesity is defined as body mass index (BMI) >40 in kg/m2

Table 4

Relationship between post Cardiac procedures mortality and Obesity in all Acute Myocardial Infarction, STEMI and NSTEMI patients

Cardiac Procedure	AMI [a] patients					STEMI [b] patients					NSTEMI [c] patients				
	Morbid obesity					Morbid obesity					Morbid obesity				
	n	Yes	No	Chi - square	P - Value	n	Yes	No	Chi - square	P - Value	n	Yes	No	Chi - square	P - Value
In-hospital mortality	22,315	3.5 (529)	5.5 (21,786)	114.9	<0.0001	8327	4.7 (171)	6.3 (8,157)	14.5	<0.0001	13,988	3.1 (359)	5.1 (13,629)	94	<.0001
Mortality for "no procedures" group	10,884	12.1 (216)	17.8 (10,669)	38.3	<0.0001	2,433	27.3(26)	29.9 (2407)	0.5	0.5	8,452	11.3 (190)	15.9 (8262)	26.1	<.0001
Post diagnostic cath[f] mortality	3321	2.1 (78)	3.8 (3243)	31.2	<0.0001	1272	7.0 (26)	10.6 (1246)	5.2	0.02	2049	1.5 (51.8)	2.8 (1997)	18.3	<.0001
Post PCI[g] mortality	6253	2.3 (156)	2.9 (6,097)	9.5	0.002	4027	3.8 (100)	3.9 (3,927)	0.14	0.7	2,226	1.3 (56)	2.0 (2,170)	8.7	0.003
Post CABG[h] mortality	1857	2.8 (80)	4.1 (1,777)	11.1	0.0009	595	3.7 (19)	5.2 (576)	2.4	0.12	1262	2.6 (61)	3.7 (1201)	7.1	0.008

Values are expressed as % (n)

[a] Acute Myocardial Infarction (AMI) - ICD9 codes 41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061, 41062, 41070, 41071, 41072, 41080, 41081, 41082, 41090, 41091, 41092

[b] ST Elevation myocardial infarction (STEMI) - ICD9 codes 41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061,41062, 41080, 41081,41082

[c] non ST Elevation myocardial infarction (NSTEMI) -ICD9 codes 41070, 41071, 41072, 41090, 41091, 41092

[d] Patients who have not undergone any procedure

[e] Patients who have undergone any of the cardiac procedures

[f] Diagnostic Catheterization- ICD9 codes 3722, 3723, 8853, 8854, 8855, 8856, 8857

[g] Percutaneous Intervention (PCI)- ICD9 codes 0066, 3604, 3606, 3607

[h] Coronary Artery Bypass Graft (CABG)- ICD9 codes 3610, 3611, 3612, 3613, 3614, 3615, 3616, 3617, 3619

[i] Morbid obesity is defined as body mass index (BMI) >40 in kg/m2

Table 5

Multivariate Regression showing association of morbid obesity and in-hospital mortality in Acute Myocardial Infarction, STEMI and NSTEMI patients

		AMI [a] patients		STEMI[b] patients		NSTEMI[c] patients	
Models	**Procedures**	**Obesity**		**Obesity**		**Obesity**	
		Odds Ratio (95 % CI)	**P - Value**	**Odds Ratio (95 % CI)**	**P - Value**	**Odds Ratio (95 % CI)**	**P - Value**
Age, Gender, Race, Income, Hospital factors [e] and 30 Elixhauser morbidities[i]	Overall MI sample	0.86 (0.78– 0.94)	0.0008	0.90 (0.77– 1.07)	0.24	0.87 (0.78–0.98)	0.017
Age, Gender, Race, Income, Hospital factors[e] and 30 Elixhauser morbidities[i]	No procedures [d]	0.79 (0.68– 0.92)	0.002	1.14 (0.69– 1.88)	0.61	0.83 (0.71– 0.98)	0.026
Age, Gender, Race, Income, Hospital factors[e] and 30 Elixhauser morbidities[i]	Diagnostic cath only [f]	0.75 (0.60 – 0.95)	0.018	0.97 (0.64 – 1.49)	0.9	0.76 (0.57 –1.02)	0.063
Age, Gender, Race, Income, Hospital factors[e] and 30 Elixhauser morbidities[i]	PCI [g]	0.59 (0.51–0.69)	<.0001	1.06 (0.84 – 1.32)	0.64	0.91 (0.69– 1.20)	0.49
Age, Gender, Race, Income, Hospital factors[e] and 30 Elixhauser morbidities[i]	CABG [h]	0.91 (0.72 – 1.15)	0.41	0.81 (0.50 – 1.30)	0.38	0.99(0.75–1.30)	0.92

[a] Acute Myocardial Infarction (AMI) - ICD9 codes 41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061, 41062, 41070, 41071, 41072, 41080, 41081, 41082, 41090, 41091, 41092

[b] ST Elevation myocardial infarction (STEMI) - ICD9 codes 41000, 41001, 41002, 41010, 41011, 41012, 41020, 41021, 41022, 41030, 41031, 41032, 41040, 41041, 41042, 41050, 41051, 41052, 41060, 41061,41062, 41080, 41081,41082

[c] non ST Elevation myocardial infarction (NSTEMI) - ICD9 codes 41070, 41071, 41072, 41090, 41091, 41092

[d] Patients who have not undergone any procedure

[e] Hospital factors such as hospital location, hospital control (government /private), hospital teaching status and total discharges

[f] Diagnostic Catheterization- ICD9 codes 3722, 3723, 8853, 8854, 8855, 8856, 8857

[g] Percutaneous Intervention (PCI) - ICD9 codes 0066, 3604, 3606, 3607

[h] Coronary Artery Bypass Graft (CABG)- ICD9 codes 3610, 3611, 3612, 3613, 3614, 3615, 3616, 3617, 3619

[i] 30 Elixhauser morbidities include Congestive heart failure, Cardiac arrhythmias, Valvular disease, Pulmonary Circulation Disorders, Peripheral vascular Disorders, Hypertension, uncomplicated and complicated, Paralysis, Other neurological Disorders

[e] Morbid obesity is defined as body mass index (BMI) >40 in kg/m2