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The obesity paradox in patients with severe soft tissue infections

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Abstract

BACKGROUND: The "obesity paradox" has been demonstrated in chronic diseases but not in acute surgery. We sought to determine whether obesity is associated with improved outcomes in patients with severe soft tissue infections (SSTIs).

METHODS: The 2006 to 2010 Nationwide Inpatient Sample was used to identify adult patients with SSTIs. Patients were categorized into nonobese and obese (nonmorbid [body mass index 30 to 39.9] and morbid [body mass index $\geq$ 40]). Logistic regression provided risk-adjusted association between obesity categories and inhospital mortality.

RESULTS: There were 2,868 records with SSTI weighted to represent 14,080 patients. Obese patients were less likely to die in hospital than nonobese patients (odds ratio [OR] = .42; 95% confidence interval [CI], .25 to .70; P = .001). Subanalysis revealed a similar trend, with lower odds of mortality in nonmorbid obesity (OR = .46; 95% CI, .23 to .91; P = .025) and morbid obesity (OR = .39; 95% CI, .19 to .80; P = .011) groups.

CONCLUSIONS: Obesity is independently associated with reduced inhospital mortality in patients with SSTI regardless of the obesity classification. This suggests that the obesity paradox exists in this acute surgical population.

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Obesity is a growing public health issue that affects 35% of adults in the United States.[1] It is known to be associated with a large range of diseases, including diabetes, dyslipidemia, hypertension, coronary artery disease, stroke, depression, sleep apnea, and a number of malignancies.[2–5] It is also considered a risk factor for poor outcomes following surgical procedures.[6] However, there is a growing body of evidence to support an "obesity paradox," which is a phenomenon that suggests a protective mortality effect of high body mass index (BMI) for some chronic diseases.[2,6,7]

The obesity paradox has been described in a number of acute[8,9] and chronic[10–12] disease populations, as well as following some interventional procedures.[2,6,13–16] However, there are few data to determine if this pattern is seen in surgical patients with severe skin and soft tissue infections (SSTIs), including necrotizing soft tissue infections. The latter are rapidly spreading infections within the soft tissue compartment (dermis, subcutaneous tissue, superficial fascia, and muscle or deep fascia) that are associated with necrotizing changes.[17,18] Their management typically requires extensive surgical debridement as well resuscitation and intravenous antibiotics.[18,19] As nutritional support plays an important role in patient recovery from SSTIs,[18,19] it has been suggested that individuals with higher BMIs have increased nutritional reserves conferring on them a nutritional advantage that could improve hospital recovery.[20] We conducted a small pilot study (n = 148) in a single academic center to examine outcomes in necrotizing soft tissue infection by nutrition feeding system and observed a trend toward reduced mortality in obese patients regardless of feeding technique. Although this study included a large number of patients with this relatively rare condition, the patients were all treated in 1 hospital and the results were not necessarily representative of the general population.

To examine the association between baseline BMI and hospital mortality in patients with SSTI, we examined hospital records from a nationally representative inpatient administrative database. We hypothesized that obesity will be associated with reduced mortality among these patients particularly in those with SSTI.

Methods

Data source

We used the 2006 to 2010 National Inpatient Sample (NIS), which is the largest publicly accessible all-payer inpatient database in the United States. This nationally representative data set includes all discharges from a 20% stratified sample of hospitals from across the United States. It is administered as part of the Healthcare Cost and Utilization Project by the Agency for Healthcare Research and Quality.

Inclusion criteria

Patients with SSTI were defined as those with a primary diagnosis *International Classification of Diseases, Ninth Edition, Clinical Classification* (*ICD-9-CM*) code pertaining to "gas gangrene" (040.0), "Fournier's disease" (608.83), or "necrotizing fasciitis" (728.86) and an *ICD-9-CM* procedure code corresponding to excisional or nonexcisional "debridement of wound, infection, or burn" (86.22 and 86.28, respectively). Patients younger than 18 years and those with any burn *ICD-9-CM* diagnosis code (940.0 to 949.5) were excluded. The remaining patients, therefore, had a soft tissue infection that was severe enough to require surgical debridement.[17–19,21]

Variables and outcome measures

Patients were categorized into nonobese or obese using the Agency for Healthcare Research and Quality comorbidity identifier for obesity. For bivariate and multivariable logistic regression analyses of mortality, obese patients were further stratified into obesity classes 1 and 2 (BMI 30 to 30.9) and morbid obesity (BMI $\geq$ 40); the latter identified by *ICD-9-CM* diagnosis code 278.01.

Extracted variables included age (categorized as 18 to 44, 45 to 64, 65 to 84, and $\geq$84 years), sex, race and/or ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Asian-Pacific Islander, Native American, other, and missing), estimated mean household income quartile based on ZIP code ($1 to $38,999; $39,000 to $47,999; $48,000 to $62,999; $63,000 or more), primary payer (private, Medicare, Medicaid, self-pay, and other), Charlson Comorbidity Index (CCI; 0, 1 to 2, 3, and $\geq$4), tube feeding (*ICD-9-CM* procedure codes 46.32, 46.39, and 96.6), total parenteral nutrition (*ICD-9-CM* procedure code 99.15), total hospital length of stay (coded as 0 to 3, 4 to 7, and >7 days), hospital size (NIS-defined large, medium, and small bed size), rurality (defined by Core Based Statistical Area codes corresponding to nonmetropolitan statistical areas), hospital region (Northeast, Midwest, South, and West), hospital teaching status, and hospital affiliation to a multihospital system.

The primary outcome measure was inhospital mortality, which was compared between obese vs nonobese groups.

Statistical analyses

Categorical variables were compared using Pearson chi-square tests. Multivariable logistic regression was used to determine the independent association of obesity with mortality. Models were adjusted for all variables that were *P* less than .5 in bivariate analysis, which included patient- and hospital-level factors: age, race, sex, insurance, CCI, length of stay, hospital teaching status, and hospital region.

NIS-provided population design weights were used to account for patient clustering within hospitals and to attain nationally weighted effects. Data analyses and management were performed using Stata 13 (College Station, TX), and the threshold for statistical significance was set at *P* less