Association of Obesity With 30-Day Readmission Rates Among Patients Hospitalized With Acute Bacterial Skin and Skin-Structure Infections (ABSSSI)

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BACKGROUND

- ABSSSI is a skin infection characterized by large spreading areas of redness, edema and/or induration[1]
- ABSSSI carries a large and growing economic burden in the United States (US); the inflation-adjusted costs of hospitalizations for skin and subcutaneous tissue infections more than doubled between 1997 and 2006, and the number of hospitalizations recorded for skin and subcutaneous tissue infections grew by 81%[2]
- Treatment failure, readmissions, and poor outcomes are prevalent in ABSSSI: one study reported combined 30-day readmission and mortality rates at 12% for community-acquired infections, and 26% for healthcare-associated infections[3]
- Specifically, evidence has been found regarding the association between obesity and ABSSSI treatment failure/recurrent infections[4,5]
- However, the association between obesity and long-term clinical outcomes in ABSSSI patients is not well-studied

OBJECTIVE

- To assess the association of obesity with 30-day hospital readmission rates among ABSSSI patients

METHODS

Data source

- Cerner Health Facts database
  - This is a de-identified EMR database containing information from over 1,000 hospitals and for over 35,000,000 patients
  - The essential data elements include longitudinal data for each patient, which contains patient demographic information (e.g., age, gender, and body mass index [BMI])
  - For each admission, the data include diagnosis codes (ICD-9), DRGs, microbiology information, admission date, and discharge date
  - The analysis used data from 2009 to 2013 across various census regions (northeast, midwest, south, and west) and facility settings (urban/rural)

Sample selection

- Inclusion criteria
  - Patients (age 18 years or older) with at least one primary ABSSSI diagnosis for an inpatient stay in 2009 or later. The index admission was defined as the first inpatient admission with a primary ABSSSI diagnosis
  - Patients treated with parenteral antibiotics (administered intravenously or via injection) during the index admission
  - Patients with body mass index (BMI) or both height and weight data available for the index admission. Limited to patients with BMI between 15 and 100 kg/m^2 (Obese patients were defined as BMI>30)
- Exclusion criteria
  - Inpatient stay with a primary or secondary ABSSSI diagnosis in 3 months prior to the index admission
  - Patients with index admissions that are the result of a transfer from another hospital or healthcare facility

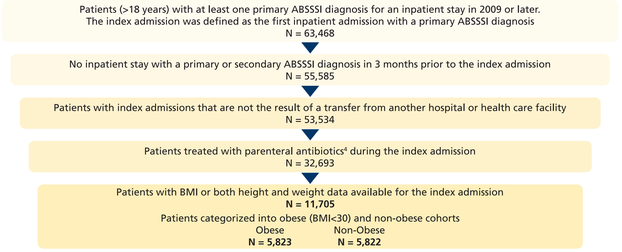
Measures and definitions

- Patient characteristics on the index admission
  - Patient demographics, insurance coverage, and infection type
  - Causative pathogen identified from microbiology tests
  - Patient comorbidity profiles
- Hospital characteristics at which the index admission occurred
  - Number of beds, census region, facility setting, and teaching status
- Readmission within 30 days to the same hospital after the index admission
  - Proportion of patients with all-cause readmission
  - Proportion of patients with ABSSSI-related readmission
  - Proportion of patients with all-cause and ABSSSI-related readmission in subgroups defined by gender, age, and causative pathogen

Statistical analysis

- Patient and hospital characteristics
  - Patient and hospital characteristics were summarized descriptively
  - Chi-square tests were used to compare categorical variables between obese and non-obese patients. Wilcoxon rank-sum tests were used to compare continuous variables
- Readmission within 30 days to the same hospital after the index admission
  - Proportion of patients with all-cause and ABSSSI-related readmission were compared between obese and non-obese cohorts descriptively overall and in subgroups defined by gender, age, and causative pathogen
  - Multivariable logistic regression models were fitted to assess association of all-cause or ABSSSI-related 30-day readmission rates and obesity when adjusting for hospital size, demographics, insurance type, causative pathogen and comorbidities (congestive heart failure, peripheral vascular disorders, hypertension, chronic pulmonary disease, diabetes, renal failure, cancer, deficiency anemia, drug abuse, and depression)

Sample selection



RESULTS

Patient characteristics (Table 1)

- Males formed a lower proportion of obese patients compared to non-obese patients (47.8% vs 55.8%, p<0.0001)
- A significantly lower percent of obese patients were ≥ 65 years compared to non-obese patients (28.2% vs 34.3%, p<0.0001); while the mean age was comparable between the two cohorts (54.5 vs 55.2, p=0.0884)
- The percent of patients with MRSA as the causative pathogen was lower in obese patients compared to non-obese patients (8.4% vs 10.6%, p=0.0001)
- More obese patients tended to have combined (abscess and cellulitis) infection (74.1% vs 70.4%, p<0.0001); but fewer obese patients tended to have cellulitis only infection (2.2% vs 3.6%, p<0.0001)
- Obese patients were more likely to have certain comorbidities including congestive heart failure, hypertension, chronic pulmonary disease, diabetes, hypothyroidism, renal failure, and depression

Table 1. Patient characteristics

	Obese (N = 5,823)	Non-Obese (N = 5,882)	P-Value
Demographics			
Male, N (%)	2,784 (47.8%)	3,280 (55.8%)	<0.0001
Age at admission, years, Mean (SD)	54.50 (16.35)	55.21 (20.36)	0.0884
Age at admission, ≥ 65 years, N (%)	1,643 (28.2%)	2,018 (34.3%)	<0.0001
BMI, kg/m^2, Mean (SD)	39.77 (9.43)	24.90 (3.26)	<0.0001
Type of ABSSSI, N (%)			
Causative pathogen[a]			
Methicillin-resistant staphylococcus aureus (MRSA)	492 (8.4%)	621 (10.6%)	0.0001
Non-MRSA gram-positive	1,146 (19.7%)	1,167 (19.8%)	0.8283
Gram-negative	283 (4.9%)	320 (5.4%)	0.1556
Mixed infection (postive & negative, excluding MRSA)	516 (8.9%)	533 (9.1%)	0.7047
Unknown	3,386 (58.1%)	3,241 (55.1%)	0.0009
Infection type			
Abscess only	58 (1.0%)	65 (1.1%)	0.5630
Cellulitis only	131 (2.2%)	213 (3.6%)	<0.0001
Abscess and cellulitis	4,313 (74.1%)	4,141 (70.4%)	<0.0001
Surgical wound infection	1,219 (20.9%)	1,338 (22.7%)	0.0176
Comorbidities, N (%)			
Congestive heart failure	661 (11.4%)	477 (8.1%)	<0.0001
Cardiac arrhythmias	746 (12.8%)	739 (12.6%)	0.6875
Peripheral vascular disorders	338 (5.8%)	439 (7.5%)	0.0003
Hypertension, uncomplicated	2,651 (45.5%)	1,853 (31.5%)	<0.0001
Hypertension, complicated	655 (11.2%)	566 (9.6%)	0.0040
Chronic pulmonary disease	1,184 (20.3%)	953 (16.2%)	<0.0001
Diabetes, uncomplicated	1,807 (31.0%)	919 (15.6%)	<0.0001
Diabetes, complicated	548 (9.4%)	341 (5.8%)	<0.0001
Hypothyroidism	634 (10.9%)	493 (8.4%)	<0.0001
Renal failure	715 (12.3%)	634 (10.8%)	0.0110
Fluid and electrolyte disorders	1,194 (20.5%)	1,156 (19.7%)	0.2501
Depression	809 (13.9%)	647 (11.0%)	<0.0001

Notes:
[a] Causative pathogens were identified using the following steps: (1) Each pathogen type was classified into two groups, those pathogens that cause ABSSSI and those that are unlikely to be causative of ABSSSI (determined using available literature and web research); (2) Of the ABSSSI-causing pathogens, each bacteria type's gram stain (positive or negative) was identified. Patients with MRSA were also identified; (3) Patients without a microbiology test were classified as 'Unknown'.

Hospital characteristics (Table 2)

- Obese and non-obese patients tended to be admitted to hospitals with comparable number of beds, and located in similar census regions
- A slightly lower percent of obese patients were admitted to teaching hospitals compared to non-obese patients (70.7% vs 73.4%, p=0.0009)

Table 2. Hospital characteristics

	Obese (N = 5,823)	Non-Obese (N = 5,882)	P-Value
Hospital Characteristics, N (%)			
Number of beds			
< 5	188 (3.2%)	189 (3.2%)	0.9624
6-99	467 (8.0%)	418 (7.1%)	0.0616
100-199	702 (12.1%)	713 (12.1%)	0.9127
200-299	1,025 (17.6%)	958 (16.3%)	0.0578
300-499	2,038 (35.0%)	2,095 (35.6%)	0.4843
500+	1,403 (24.1%)	1,509 (25.7%)	0.0509
Census region			
Northeast	1,825 (31.3%)	1,836 (31.2%)	0.8819
Midwest	1,120 (19.2%)	1,062 (18.1%)	0.1015
South	2,236 (38.4%)	2,261 (38.4%)	0.9646
West	642 (11.0%)	723 (12.3%)	0.0328
Facility setting			
Urban	5,766 (99.0%)	5,816 (98.9%)	0.4475
Rural	57 (1.0%)	66 (1.1%)	0.4475
Teaching status			
Teaching hospital	4,115 (70.7%)	4,318 (73.4%)	0.0009
Non-teaching hospital	1,708 (29.3%)	1,564 (26.6%)	0.0009

30-Day readmission rates (Table 3)

- Same-hospital readmission rates within 30 days were higher for obese patients for both all-cause (12.9% vs 11.8%, p=0.0850) and ABSSSI-related (5.3% vs 4.0%, p=0.0019) readmission rates. Non-ABSSSI-related readmission rates were similar (7.6% vs 7.8%, p=0.7427)
- When stratified by gender, obese patients continued to have a higher ABSSSI-related 30-day readmission rate than non-obese patients (5.1% vs 3.8%, p=0.0086) in the male subgroup
- Obese patients in the younger age group (< 65 years) had a lower ABSSSI-related 30-day readmission rate than non-obese patients (5.0% vs 3.6%, p=0.0026)

Table 3. 30-Day readmission rates (overall and subgroups)

Overall Population	Overall			Males			Females		
	Obese (N = 5,823)	Non-Obese (N = 5,882)	P-Value	Obese (N = 2,784)	Non-Obese (N = 3,280)	P-Value	Obese (N = 3,039)	Non-Obese (N = 2,602)	P-Value
30-day readmission rates[a], N (%)									
All-cause	749 (12.9%)	695 (11.8%)	0.0850	337 (12.1%)	390 (11.9%)	0.7976	412 (13.6%)	305 (11.7%)	0.0391
ABSSSI-related[b]	306 (5.3%)	238 (4.0%)	0.0019	143 (5.1%)	123 (3.8%)	0.0086	163 (5.4%)	115 (4.4%)	0.1025
Age < 65 years Subgroup	**Overall < 65 years**			**Males < 65 years**			**Females < 65 years**		
	Obese (N = 4,180)	Non-Obese (N = 3,864)	P-Value	Obese (N = 2,071)	Non-Obese (N = 2,303)	P-Value	Obese (N = 2,109)	Non-Obese (N = 1,561)	P-Value
30-day readmission rates[a], N (%)									
All-cause	490 (11.7%)	383 (9.9%)	0.0091	232 (11.2%)	227 (9.9%)	0.1471	258 (12.2%)	156 (10.0%)	0.0340
ABSSSI-related[b]	210 (5.0%)	141 (3.6%)	0.0026	106 (5.1%)	78 (3.4%)	0.0044	104 (4.9%)	63 (4.0%)	0.1982
MRSA Subgroup	**Overall (MRSA)**			**Males (MRSA)**			**Females (MRSA)**		
	Obese (N = 492)	Non-Obese (N = 621)	P-Value	Obese (N = 245)	Non-Obese (N = 394)	P-Value	Obese (N = 247)	Non-Obese (N = 227)	P-Value
30-day readmission rates[a], N (%)									
All-cause	51 (10.4%)	51 (8.2%)	0.2163	21 (8.6%)	33 (8.4%)	0.9311	30 (12.1%)	18 (7.9%)	0.1285
ABSSSI-related[b]	21 (4.3%)	18 (2.9%)	0.2171	7 (2.9%)	9 (2.3%)	0.6522	14 (5.7%)	9 (4.0%)	0.3886
Non-MRSASubgroup	**Overall (Non-MRSA)**			**Males (Non-MRSA)**			**Females (Non-MRSA)**		
	Obese (N = 5,331)	Non-Obese (N = 5,261)	P-Value	Obese (N = 2,539)	Non-Obese (N = 2,886)	P-Value	Obese (N = 2,792)	Non-Obese (N = 2,375)	P-Value
30-day readmission rates[a], N (%)									
All-cause	698 (13.1%)	644 (12.2%)	0.1874	316 (12.4%)	357 (12.4%)	0.9327	382 (13.7%)	287 (12.1%)	0.0882
ABSSSI-related[b]	285 (5.3%)	220 (4.2%)	0.0049	136 (5.4%)	114 (4.0%)	0.0137	149 (5.3%)	106 (4.5%)	0.1485

Notes:
[a] 30-day readmission is defined as any inpatient stay of at least 12 hours that occurred within 30 days of the index admission discharge date.
[b] Includes admissions with both primary and non-primary diagnoses of ABSSSI.

Regression on readmission (Table 4)

- After adjusting for hospital size, demographics, insurance type, causative pathogen, and comorbidities, the multivariable logistic regression showed that obese patients have higher odds of 30-day all-cause readmission compared to non-obese patients (OR=1.10, p=0.0944, 95% CI: 0.98, 1.24)
- Obese patients also had significantly higher odds of 30-day ABSSSI-related readmission compared to non-obese patients (OR=1.28, p=0.0073, 95% CI: 1.07, 1.54)

Table 4. Association of obesity with readmission

	Odds Ratio[a] Obese vs. Non-Obese		
	Odds Ratio	(95% Confidence Interval)	P-Value[a]
30-day Readmission			
All-cause	1.10	(0.98,1.24)	0.0944
ABSSSI-related[b]	1.28	(1.07,1.54)	0.0073

Notes:
[a] Odds ratios and p-values were estimated from the multivariate logistic regression adjusting for hospital type (number of beds), demographics (age, gender, and race), insurance type, causative pathogen, and selected comorbidities (congestive heart failure, peripheral vascular disorders, hypertension, chronic pulmonary disease, diabetes, renal failure, cancer, deficiency anemia, drug abuse, and depression).
[b] Includes admissions with both primary and non-primary diagnoses of ABSSSI.

DISCUSSION

- Among ABSSSI patients, obese patients experienced significantly higher rates of same-hospital ABSSSI-related readmission compared with non-obese patients in the overall population
- In subgroup analyses, obese patients experienced significantly higher rates of same-hospital ABSSSI-related readmission compared with non-obese patients among male patients and patients less than 65 years old. The differences were not significant among females and patients >65 years old
- The odds of ABSSSI-related readmission within 30 days was significantly higher for obese ABSSSI patients compared to non-obese patients when adjusting for hospital type, demographics, insurance type, causative pathogen, and selected comorbidities

LIMITATIONS

- Cerner Health Facts database collected information within each hospital system separately. Thus, only same-hospital readmission could be captured. Further analyses are warranted to estimate total readmission rates
- The time frame of readmission rates was limited to be within 30 days of the primary readmission. Other longer-term clinical outcomes in ABSSSI patients would be beneficial
- A patient identifier allowed tracking of individual patients across multiple visits only within the same hospital system

CONCLUSIONS

- Obesity was associated with a higher rate of 30-day ABSSSI-related readmission to the same hospital
- The association between obesity and 30-day ABBSI-related readmission remained among ABSSSI male patients, patients less than 65 years old, and patients without MRSA
- After adjustment for confounding variables, the association remained significant
- Future studies should consider estimating the association of obesity with total readmission rates to expand upon same-hospital readmission rates explored in this study

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