Clinical outcomes for the obese hospital inpatient: An observational study

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Abstract

Objectives: The prevalence of obesity presents a burden for Australian health care. The aim of this study was to determine whether severely obese hospital inpatients have worse outcomes.

Methods: This is an observational cohort study, using data from all adult patients admitted to hospital for all elective and emergency admissions of patients aged over 18 years to two large Australian urban hospitals. We measured their length of stay, intensive care unit admission rate, intensive care unit length of stay, mortality and readmission rates within 28 days of discharge and compared these outcomes in the severely obese and non-severely obese subjects using t-test or chi-square test as appropriate.

Results: Between February 2008 and February 2012, 120,872 were admitted to hospital 193,800 times; 2701 patients were identified as severely obese (2.23%) and 118,171 patients were non-severely obese. If admitted as an emergency, severely obese patients have worse outcomes and consume more resources than other patients. These outcomes are still worse, but less so, if the obese patient is admitted as an elective patient suggesting that anticipation of any obesity-specific problems can have a beneficial effect.

Conclusion: Upon admission or discharge of severely obese hospital inpatients, health care plans should be even more carefully laid than usual to reduce the risk of readmission.

Introduction

Following admission to hospital, the length of stay (LOS) for patients with severe obesity is greater than for those who are non-severely obese[1] although less is known about other health outcomes of their admission.[2] It is difficult to tease out the confounding and sometimes important effects of socio-demographic factors, co-morbid conditions,[3] altered medical decisions[1] or the effects of additional precautions that may, or may not, be instigated on the basis of a patient's obesity. For moderately obese subjects (body mass index (BMI) < ~40 kg/m²) admitted for coronary artery bypass grafting or for general surgery, obesity has been associated paradoxically with favourable health outcomes such as reduced LOS and mortality.[4,5] The explanations offered for this paradox include a greater prevalence of optimal medical care offered to the obese patient,[6] additional precautions taken peri-operatively[5,6] or more intensive screening of obese patients pre-operatively.[7]

Severely obese patients, once admitted to hospital, consume more resources than non-severely obese patients and this trend is increasing over time.[8] This additional resource use occurs over and above both the rising prevalence of obesity in the community[9] and the increased risk of an obese patient being admitted to hospital.[10–12] The clinical explanations for the severely obese occupying hospital beds for longer than

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non-severely obese patients are complex and the phenomenon is not obviously limited to those patients with several recognised co-morbidities of obesity. For example, hospital LOS increases together with patient BMI in overweight and obese patients with biliary disease[8] and degenerative knee and hip disease,[7] but the role for the plethora of other co-morbidities that also accompany obesity including cardiovascular disease and thromboembolic disease is difficult to identify.[13,14]

The aim of our research was to use a large inpatient database from two teaching hospitals in South Australia to clarify the medical outcomes of subjects with severe obesity who were admitted to hospital. As well as hospital LOS, we addressed patients' risk of and duration of intensive care unit (ICU) admission, in-hospital mortality and risk of readmission to hospital. We adjusted for the possible influence of co-morbidities and patient socio-demographic factors in producing these outcomes. We also compared the characteristics and outcomes of electively admitted severely obese patients with those admitted to hospital as an emergency.

Methods

We examined a computerised database of patients admitted to hospital as either an elective or emergency overnight stay over the period February 2008 to February 2012. The two hospitals examined in this survey were Flinders Medical Centre (FMC) and the Royal Adelaide Hospital (RAH). Both hospitals are situated in Adelaide, South Australia. Each has over 500 inpatient beds and in total they service a population of over 750,000. The study was approved by the Clinical Research Ethics committees of Southern Adelaide (387.11) and the Royal Adelaide Hospital (110909).

Those patients who were either administratively coded as being severely obese using the International Classification of Diseases, Ninth Revision (ICD-9) classifications of 278.00, 278.01, 278.0 or V45.86[15] or were identified by nursing staff as weighing over 120 kg were included on this database. In 2007–2008, the average height of an Australian was either 176 cm if male or 162 cm if female.[16] At these heights, 120 kg translates to a BMI of 38.7 kg/m² in males and 45.7 kg/m² in females. A BMI greater than 35 kg/m² is considered severe obesity. Specific characteristics of each patient were recorded including their age, gender, postcode of residence (used to determine the patient's Index of Relative Socio-Economic Disadvantage (IRSD)), primary diagnosis, Charlson co-morbidity index (as modified by Quan and colleagues, was used to compute a weighted index for each patient)[17] and whether the admission was classified as elective or an emergency. Adjustment for these characteristics was performed where indicated. Specific outcomes of each admission were recorded including inpatient LOS while acutely unwell, ICU admission, hours spent in ICU, inpatient mortality and occurrence and rapidity of readmission. Readmissions within 7 days of discharge are more likely to indicate a failed discharge plan than a readmission within 28 days which is more likely to reflect progression of disease.

Statistics

Statistical analysis was performed using Stata Statistical Software, Release 12.1 (StataCorp LP, College Station, TX, USA). For each patient we derived an IRSD, one of the socio-economic indexes for areas.[18] For statistical comparisons, we used a t-test for continuous data and a chi-square test for categorical data. Poisson regression analysis was used to calculate relative risks when adjusting for potential confounding categorical variables and negative binomial regression for multivariate analysis of determinants of inpatient LOS and duration of ICU stay. Data are presented as means (standard deviation (SD)) or odds ratios (95% confidence intervals) where appropriate. $p < 0.05$ was taken as the level determining statistical significance.

Results

Characteristics and outcomes

There were 2701 patients identified as being severely obese (2.23% of the individuals admitted), and these obese patients were admitted to hospital a total of 6617 times over the survey period. Over the same period, there were 118,171 patients who were not identified as severely obese ('non-severely obese') who were admitted a total of 193,800 times. In the dataset, there were 24,699 patients admitted electively and 96,173 admitted as an emergency. Data are presented comparing severely obese and non-severely obese patients in the dataset as a whole and then presented for the groups of patients admitted either as an emergency or as an elective admission.

The characteristics of each group are presented in Table 1. The severely obese patient group were of a similar gender distribution to the non-severely obese but were younger, were admitted to hospital more often during the period of study and had more complex disease. There were proportionally more elective admissions in the severely obese group. The outcomes of the hospital admissions of those identified as severely obese are also presented in Table 1. There were significant increases in LOS, ICU admissions, ICU LOS and 28-day readmissions in those patients identified as obese. Apart from ICU LOS, these increases were statistically significant whether or not adjustment was made for patients' age, gender, Charlson index, IRSD and the elective or emergency nature of the admission (Table 2). The readmission rate within 7 days of discharge and the in-hospital mortality, even when adjusted (Table 2), were not significantly increased in the severely obese inpatient population as a whole.

Principal diagnoses

Diabetes, with or without complications, deep venous thrombosis and septicaemia were at least three times more prevalent in the severely obese admitted inpatients than the non-severely obese. When comparing the wide-ranging reasons for admission, the severely obese and the non-severely obese groups shared seven of their 10 most frequent principal diagnoses.

Table 1. Patients' characteristics and outcomes of their admissions to hospital.

	Severely obese	Non-severely obese	p value
Number of subjects	2701	118,171	
Characteristics			
Number of admissions per patient (SD)	2.45 (2.58)	1.64 (1.51)	<0.001
Proportion of elective/total admissions, %	30.0	20.2	<0.001
Gender, % male	51.8	51.6	0.843
Age, years (SD)	54.4 (15.4)	56.7 (21.1)	<0.001
Charlson index (SD)	1.3 (2.0)	0.8 (1.7)	<0.001
IRSD	967	986	<0.001
Outcomes			
LOS days (SD)	8.7 (14.9)	5.2 (9.0)	<0.001
ICU admission rate, %	17.2	7.6	<0.001
ICU hours (SD)	116.8 (170.0)	100.4 (181.4)	0.056
In-hospital mortality, %	2.1	2.0	0.831
RR within 7 days, %	1.6	1.7	0.785
RR within 28 days, %	8.1	5.4	<0.001

SD: standard deviation; IRSD: Index of Relative Socio-Economic Disadvantage; LOS: length of stay; ICU: intensive care unit; RR: readmission rate.
Data are presented as means (SD) or odds ratios (95% confidence intervals). p values are expressed following a t-test or chi-square test as appropriate.

Table 2. Odds ratios (95% confidence intervals) of outcomes for severely obese patients.

	Severely obese (95% CI)	Non-severely obese	p value
LOS days	1.54 (1.48–1.60)	1.00	<0.001
ICU hours	1.07 (0.96–1.18)	1.00	0.211
ICU admission rate	1.95 (1.77–2.14)	1.00	<0.001
In-hospital mortality	1.21 (0.93–1.58)	1.00	0.159
RR within 7 days	0.97 (0.72–1.31)	1.00	0.910
RR within 28 days	1.44 (1.26–1.65)	1.00	<0.001

CI: confidence interval; IRSD: Index of Relative Socio-Economic Disadvantage ; LOS: length of stay; ICU: intensive care unit; RR: readmission rate.
Poisson or negative binomial regression was used for the multivariate analysis (adjusted for age, gender, IRSD, Charlson Index and nature of admission).

These specific diagnoses only covered 24% of all the obese admissions and 15% of all the non-severely obese. These diagnoses were chest pain (unspecified), acute sub endocardial myocardial infarction, pneumonia (unspecified), chronic obstructive pulmonary disease with acute lower respiratory tract infection, atrial fibrillation/flutter, atherosclerotic heart disease and 'other chest pain'. The other three most common diagnoses in the severely obese group were congestive heart failure, cellulitis of lower limb and pulmonary embolism without acute cor pulmonale. Syncope, acute appendicitis and urinary tract infection were the other three most common diagnoses in the non-severely obese population.

Emergency admissions: characteristics and outcomes

The severely obese emergency group had a significantly higher proportion of males, were on average younger but had a higher Charlson index compared to the non-severely obese group admitted as an emergency (Table 3). For the entire group of patients within this study, the ICU admission rate and the LOS in ICU were higher in the severely obese group admitted as an emergency. Their hospital LOS and readmission risk within 28 days of discharge were also increased.

Elective admissions: characteristics and outcomes

The severely obese group admitted electively were more likely to be female. The Charlson index was similar in elective patients whether identified as severely obese or non-severely obese. The severely obese group admitted electively were more likely to go to the ICU and to have a slightly longer LOS in hospital. The time spent in ICU by severely obese patients who had been admitted to hospital electively was significantly less, after adjustment, than the time spent in ICU by electively admitted non-severely obese patients (Table 3).

The comparisons of certain patient characteristics and outcomes between the severely obese and non-severely obese in the electively admitted group revealed striking differences to the same comparisons within the group admitted to hospital as an emergency. As distinct from patients

Table 3. Patients' characteristics and outcomes of their admissions to hospital by admission type (emergency or elective admission).

Emergency	Severely obese	Non-severely obese	p value
Number of subjects	1891	94,282	
Gender, % male	55.1	52.1	0.012
Age, years (SD)	55.5 (16.0)	56.9 (21.8)	0.006
Charlson index (SD)	1.51 (2.03)	0.73 (1.61)	<0.001
LOS days (SD)	10.46 (16.77)	5.46 (9.45)	<0.001
ICU admission rate, %	18.5	6.93	<0.001
ICU hours (SD)	140.4 (187.1)	114.8 (195.0)	0.017
In-hospital deaths, n (%)	53 (2.8)	2302 (2.4)	0.314
RR within 7 days	1.80	1.74	0.864
RR within 28 days	9.04	5.70	<0.001
Adjusted for age, IRSD, gender and CI			
LOS	1.71 (1.63–1.79)	1.00	<0.001
ICU hours	1.20 (1.06–1.35)	1.00	0.004
ICU admission rate	2.17 (1.95–2.42)	1.00	<0.001
In-hospital mortality	1.20 (0.91–1.58)	1.00	0.191
RR within 7 days	1.07 (0.76–1.50)	1.00	0.716
RR within 28 days	1.46 (1.26–1.71)	1.00	<0.001
Elective	Severely obese	Non-severely obese	p value
Number of subjects	810	23,889	
Gender, % male	44.3	49.7	0.002
Age, years (SD)	51.8 (13.8)	56.1 (17.8)	<0.001
Charlson index (SD)	0.97 (1.84)	0.92 (1.91)	0.447
LOS days (SD)	4.61 (7.91)	4.11 (7.11)	0.051
ICU admission rate, %	14.2	10.2	<0.001
ICU hours (SD)	45.3 (60.0)	61.6 (130.9)	0.183
In-hospital mortality, n (%)	3 (0.4)	79 (0.3)	0.847
RR within 7 days	1.23	1.51	0.530
RR within 28 days	6.05	4.34	0.020
Adjusted for age, IRSD, gender and CI			
LOS	1.10 (1.02–1.18)	1.00	0.011
ICU hours	0.73 (0.60–0.88)	1.00	0.001
ICU admission rate	1.51 (1.25–1.82)	1.00	<0.001
In-hospital mortality	1.56 (0.49–4.95)	1.00	0.439
RR within 7 days	0.83 (0.44–1.55)	1.00	0.563
RR within 28 days	1.41 (1.06–1.88)	1.00	0.019

SD: standard deviation; LOS: length of stay; ICU: intensive care unit; IRSD: Index of Relative Socio-Economic Disadvantage; CI: Charlson index; RR: read-mission rate. The same patients represented in Table 1 but divided according to the nature of the admission. Data are presented as means (SD) or odds ratios (95% confidence intervals). p values are expressed following a t-test or chi-square test as appropriate. Poisson or negative binomial regression was used for the multivariate analysis.

admitted as an emergency, the complexity of illness was similar between the severely obese and non-severely obese elective groups. The duration of ICU admission was shorter in the severely obese elective patient than their non-severely obese controls, whereas ICU stay was longer in the severely obese emergency patient compared to their non-severely obese controls (Table 3).

Discussion

Hospital-wide, severe obesity conveys no significantly greater mortality risk. Severely obese patients have a two-fold higher likelihood of ICU admission, are likely to stay in

hospital 50% longer and have an over 40% greater risk of readmission to hospital within 28 days of discharge. Following emergency admission, severely obese patients are likely to stay longer in the ICU than non-severely obese patients, whereas the reverse is true following elective admission. All these outcomes occur despite the severely obese cohort being younger than their non-severely obese control group. Of note, the complexity of illness, assessed by a Charlson index, and the socio-economic disadvantage, assessed by the IRSD, were each significantly greater in the severely obese group than in the non-severely obese controls. For Charlson index at least, these differences were of significance both clinically and statistically. The adverse

outcomes noted in the severely obese group were still of significance after appropriate adjustment for known associates of obesity and known associates of poor medical outcomes such as Charlson index and IRSD. More elective surgery occurred in the severely obese group than in the non-severely obese. Specific characteristics of the severely obese patients or their admission outcomes were dependent upon the elective or emergency nature of the admission as discussed below.

In our study, adjustment for all patients' complexity of acute illness (Charlson index) and for socio-demographic differences (IRSD) did not remove the difference in LOS (nor in ICU admission risk or hospital readmission risk). This implies an effect of obesity independent of any obvious influence of the complex medical associations and co-morbidities of obesity.[1] Electively admitted severely obese patients were unlikely to have an increased Charlson index when compared to the non-severely obese, electively admitted patients. This suggests that more complex severely obese patients were less likely to be admitted electively; possibly having been excluded during screening. The LOS in the hospital for a severely obese patient following elective admission was only slightly longer than that of a non-severely obese elective patient, possibly reflecting either a bias to the selection of these patients, better planned resources for inpatient care of the severely obese, more efficient discharge planning or all three.

There was an increased likelihood of admission to the ICU of those patients identified as severely obese. Once morbidly obese patients (BMI > 40 kg/m^2) are admitted to ICU, they have greater co-morbidity and mortality, a longer stay in ICU, longer ventilated hours and a longer whole of hospital stay.[19,20] At least some of these differences have been attributed to the impact of obesity on the respiratory system, respiratory tract infection being a common principal diagnosis in hospital inpatients. In our study, an analysis of the emergency admission groups did support previous work in this area, in particular an increase in the rate of ICU admissions in the severely obese and in the LOS of a severely obese patient in the ICU. Electively admitted severely obese patients were still admitted to ICU at a greater rate than non-severely obese elective patients but, once admitted to ICU, their LOS in that unit was reduced. This finding supports the presence of an obesity 'paradox'[4,21] in our elective patients. Additional processes introduced to manage obese elective patients[5,6] or greater prevalence of pre-existing optimal medical therapy[6] may be responsible. Others have shown an increase in ICU mortality if obese[19] but we did not have sufficient deaths within the ICU to warrant a similar analysis.

We did not see a significant increase in in-hospital mortality in our severely obese inpatient population as a whole and this supports previous findings both in more restricted, specialised inpatient groups and in similar large general inpatient populations.[1,6] Reports of increased mortality risk for obese patients in the community[9,14] are not reflected in our data, possibly in part due to more intensive and supportive care offered to these obese inpatients, as seen elsewhere in patients receiving a percutaneous coronary intervention for coronary artery disease.[6] Analysis of our data according to the emergency or elective nature of admission did not produce any useful additional information concerning inpatient mortality.

Compared to the non-severely obese, the admission and readmission rates of the severely obese in our population are much higher than have been reported elsewhere[11,12] possibly because our obese population is heavier than those previously studied in this regard. Obesity in the Australian community lies at about 25%[22] yet we have only identified fewer than 3% of patients admitted to hospital as being obese – a similar inpatient percentage to that labelled elsewhere as having a BMI greater than 40 kg/m^2 or 'morbid obesity'.[1] The readmission rate at 7 days in the severely obese patients was not increased, and this suggests that there was no increase in flaws in discharge planning for obese patients compared to plans for non-severely obese patients. A longer LOS should allow more time for appropriate discharge planning. In fact, concerns about care following discharge might in part explain the prolonged LOS in the obese.[6] Readmission to hospital for any reason within 28 days of discharge was elevated in both electively and emergency-admitted severely obese patients compared to the non-severely obese controls. This increased readmission rate within 4 weeks of discharge suggested greater morbidity in the obese[3] despite adjustment for the patient age, Charlson index and IRSD. Obesity itself remains an independent factor in the greater use of hospital facilities by the obese patient.

The limitations of our study include its retrospective nature and the lack of accurate anthropometric data (e.g. BMI or fat mass index[23]) for all hospital inpatients. Our prevalence suggests we are only mapping the characteristics and outcomes of the most obviously obese inpatients and missing out on about 90% of the inpatients with a BMI over 30 kg/m^2.

The reasons for these poorer outcomes require further study and we must develop and trial strategies to improve them. The dissimilarity in outcomes for severely obese patients following emergency admission as distinct from an elective admission offers some initial areas for research. Interventions such as bariatric surgery can lower weight significantly and should not only reduce the risk of an originally obese individual being admitted to hospital but also reduce their risk of developing these poor outcomes during any hospital admission.[24] Other more immediate and less drastic interventions could be trialled such as widespread availability of appropriate mobility aids for obese patients and additional allied health resources such as physiotherapy and pharmacy.

Severely obese hospital inpatients stay longer in hospital, are more likely to require admission to the ICU and, once discharged from hospital, are more likely to be readmitted than other patients with equivalent disease complexity who are of similar age, gender and IRSD. These unfortunate yet

predictable adverse outcomes for the severely obese patient are less pronounced in elective admissions than in emergency admissions. These outcomes represent an increased load upon our staff, a requirement for specialist equipment, larger patient rooms and other resources beyond the number of obese patients in hospital.[25,26] Over and above any economic impact of obesity on the use of hospital resources, these findings should inform clinicians and their patients about the preventable and possibly under-recognised associations of obesity in hospital inpatients. Upon admission or discharge of severely obese hospital inpatients, health care plans should be even more carefully laid than usual.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Ethical approval

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