

RESEARCH ARTICLE

Obesity: is it an additional risk factor in analyzing surgical outcomes in the South Indian population?

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Keywords

Obesity • Surgery • Postoperative pain • BMI • Duration of surgery • Risk factor

Summary

Aim. This study aims to determine whether obesity impacts surgical outcomes among patients undergoing surgery at the Surgery Unit in a tertiary care hospital.

Methods. This is a retrospective study. Data were retrieved from the medical records of patients who underwent surgery at a tertiary care hospital. Patient demographics, co-morbidities, intra-operative and postoperative pain scores and complications, if occurring, were compiled for each patient. Patients were subdivided into four subsets based on their disease profile. Each subset was divided into two groups based on their body mass index (BMI). Preoperative BMI greater than or equal to 25 kg/m² was classified as obese.

Results. The study showed that there is a considerable increase in the duration of surgery in obese when compared to non-obese. 30 days readmission rate was higher among obese in all the subsets. We find that in the subset of non-infective conditions, post operative pain mean ranking score is greater among obese (128.8 vs 109.6).

Conclusions. In conclusion, the impact of obesity resulted in increased duration of surgery and post-operative pain. The association between obesity and surgical outcome shows the importance to further research to find a way to prevention of some of the complications of surgery that could occur in patients with high BMI.

Introduction

Obesity is considered the most serious lifestyle-generated ill health of the 21st century due to its morbidity and mortality [1]. Obesity has attained “epidemic” levels worldwide, threatening healthcare systems and economies in both developed and developing countries [2]. The key reasons for overweight and obesity appear to be the modern lifestyle comprising of inactivity and malnutrition [3]. Globally, nearly 2.8 million people die from overweight or obesity each year, and about 35.8 million (2.3%) of global Disability Adjusted Life Years (DALY) are attributed to overweight or obesity [4]. In India, obesity has affected over 135 million people [5]. Further, overweight and obesity prevalence among men and women has increased to twice in the last two decades from 1998-99 to 2015-16 [6]. According to the 2016 National Family Health Survey data, the national prevalence of overweight and obesity is 14.6 and 3.4%, respectively. The highest prevalence of these conditions was seen among those aged 35-54 years, in particular women living in urban areas at the national level [5].

Obesity is linked with an elevated risk for developing severe medical conditions, particularly hypertension, diabetes, cardiovascular disease, dyslipidemia, bronchial asthma, degenerative arthritis, and cancers [3, 7]. Obesity is also associated with a higher risk of several malignancies, notably colon and esophageal cancer [8]. Obesity is a modifiable risk factor associated with an increased need for

health care resources and morbidity throughout all surgical areas [9].

Obesity is related to higher postoperative complications and increased technical difficulty in patients undergoing surgery. The excess adipose tissue hinders sufficient exposure and direct visualization, which contributes to the complexity of the procedure, resulting in prolonged operative times and technical difficulties [10].

The body mass index (BMI) is an uncomplicated measure frequently used to measure adult overweight and obesity. BMI is defined as a “person’s weight in kilograms divided by the square of his height in meters (kg/m²)”. WHO classifies BMI as underweight (< 18.4 kg/m²), normal (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), obese class I (30-34.9 kg/m²), obese class II (35-39.9 kg/m²) and obese class III (> 40 kg/m²) [11]. The BMI offers the population-level measure of overweight and obesity, as it is similar for both the genders and for all ages of adults [4].

There is a paucity of data identifying the impact of obesity on postoperative complications. Previous studies have focused on a single surgical specialty and single disease condition. Our study centered on all the conditions in a large surgical group and divided into four subsets, namely, infectious, non-infectious, cancer, and superficial peripheral limb conditions. This study aims to determine whether obesity impacts surgical outcomes among patients undergoing surgery at the Surgery Unit in a tertiary care hospital.

Methods

This is a retrospective study. The study was conducted after attaining approval from the Institutional Ethics Committee (IEC: 113/2020). Permission was taken from the Medical Record Department (MRD) to access patient data. The physical and electronic medical records of all patients older than 18 years who underwent surgery from January 2019 to October 2019 in a single unit of the department of surgery of a medical college and a tertiary care hospital, were analyzed. Patients with missing height, weight or BMI measurement, and those who had secondary surgery at the same site were excluded from the study. A total number of 549 patients were admitted in the surgery unit during the year 2019 and complete enumeration of these patients was done.

Data collected for each patient included the socio-demographic profile, (patient age, gender, place of residence and BMI), previous comorbidities (history of hypertension, diabetes, cerebrovascular disease, chronic obstructive pulmonary disease, congestive heart failure, coronary artery disease, and hyperlipidemia), intraoperative variables (operative procedure type, duration of the procedure, anesthesia given, and analgesic given). The outcomes studied included length of hospital stay, 30-day readmission rates, and pre and postoperative pain scoring. Pain scores were documented using numerical rating scale from 0 to 10 first on the day of admission and first postoperative day. The pain score 0 suggests no pain, 1-3 mild pain, 4-6 moderate pain and 7-10 severe pain.

The surgery unit catered operative treatment to a plethora of illnesses. The pathophysiology and natural course of these diseases varied widely. It was therefore found prudent to analyze the outcome variables separately for the different types of illnesses. The patients were divided into four subsets. Patients with conditions such as abscess, gangrene, ulcer, and cellulitis were grouped into infectious diseases subset. Rectal disease, elective appendectomy, gall bladder disease, hernia and trauma were grouped as non-infectious diseases subset. All organ cancer patients were grouped together as cancer subset. Patients with superficial limb conditions which included varicose veins, skin grafting were grouped together as peripheral disease subset.

The preoperative body mass index was utilized to categorize the patients of these four subsets into two groups. For analysis, underweight and normal were considered as non-obese. These formed the control group (BMI ≤ 24.9 kg/m²) Overweight and obese were classified under obese and formed the case group (BMI ≥ 25 kg/m²).

STATISTICAL ANALYSIS

Descriptive statistics of categorical variables focused on frequencies and proportions. Independent samples T-test was carried out to compare mean and presented as Mean and SD. Mann Whitney U test was used to compare the continuous variable. Pearson’s Chi-square test was performed to identify differences between the

two categorical variables. SPSS 20.0 software was used to carry out statistical analysis, with the significance level being P < 0.05.

Results

A total number of 549 patients were admitted in the surgery unit. Out of 549 patients, 37 records were incomplete and hence were excluded. Five-hundred and twelve patients’ data were analyzed for this study.

248 (48.4%) were overweight or obese. 264 (51.6%) were classified as controls (Tab. I) The mean age of the patients in both the groups together was 48 ± 13 years. The mean age of the participants in non-obese and obese group is 48.6 ± 11 and 48.6 ± 12 respectively.

The mean height of participants was 159 ± 14 cm and mean weight was 69 ± 13 kg. The mean height and weight among the non-obese control group was 161.4 ± 12 cm and 55.4 ± 11 kg and that among obese was 157.1 ± 10 cm and 73.17 ± 11 kg. Among the participants 10% were underweight, 41.6% were normal, 32% of them were overweight and 16.4% were obese. Non-obese control group had a mean BMI of 20.9 kg/m² and it was 29.02 kg/m² among the obese case group. Among the total participants, 288 (56.25%) were male and 224 (43.75%) were female. A total of 125 (43.4%) were obese among males and 123 (54.9%) females were obese. Among the total participants, 257 (50.1%) had comorbidity, of which 134 (52%) were in obese group and 123 (48%) in non-obese control group. Out of 512 participants, a total of 152 (29.69%) patients had diabetes and 122 (23.83%) had hypertension. Among the 152 patients with diabetes, 74 (48.7%) were obese, and among the 122 hypertensive patients, 68 (55.7%) were obese (Tab. I).

Among the 512 patients, 95 (18.56%) had an infective condition, 236 (46.09%) were admitted with a non-infective condition, 25 (4.88%) had cancer and 156 (30.47%) had other conditions (Tab. I). Further analysis was done for these four subsets.

Independent samples T-test was carried out to compare the mean of the duration of surgery, a total length of hospital permanence, pre, and post-operative pain scores. We saw an increase in the mean duration of surgery

Tab. I. Demographic profile of the participants.

	N = 512	Non-obese (control)	Overweight & obese (cases)
Male	288	163 (56.6%)	125 (43.4%)
Female	224	101 (45.1%)	123 (54.9%)
Infective	95	49 (51.6%)	46 (48.4%)
Non infective	236	115 (49.0%)	121 (51.0%)
Cancer	25	14 (54.2%)	11 (45.8%)
Other condition	156	86 (55.1%)	70 (44.9%)
Presence of comorbidity	257	123 (48.0%)	134 (52.0%)
Presence of diabetes	152	78 (51.3%)	74 (48.7%)
Presence of hypertension	122	54 (44.3%)	68 (55.7%)
Total	512	264 (51.6%)	248 (48.4%)

Tab. II. Distribution of surgical risk among the patient with obesity and non-obese.

		Non-obese (control)	Overweight & obese (cases)	P-value
30-days readmission, n (%)	Infective	8 (17.5%)	18 (37.8%)	0.040
	Non-infective	10 (8.5%)	10 (9.8%)	0.824
	Cancer	4 (30.8%)	3 (27.3%)	1.000
	Others	4 (4.7%)	5 (7.1%)	0.516
The total length of stay at hospital, (days)		6.74 ± 6.3	7.1 ± 6.01	0.490
Duration of surgery, (hours)		1.2 ± 1.0	2.0 ± 1.6	0.027
Pre-operative pain score		1.6 ± 1.5	1.4 ± 1.5	0.136
Post-operative pain score		1.9 ± 1.4	2.2 ± 1.4	0.017

Tab. III. Comparison of obesity with the duration of surgery, the total length of hospital permanence, pre and post-operative pain scores among the different groups of condition (P-value).

Variables (in P-value)	Duration of surgery	The total length of stay at the hospital	Preoperative pain	Postoperative pain
Infective	0.049	1.000	0.631	0.203
Non-Infective	0.140	0.274	0.206	0.025
Cancer	0.796	0.561	0.149	0.336
Others	0.704	0.999	0.848	0.256

from 1.2 ± 1.0 to 2.0 ± 1.6 hours among obese with a statistically significant difference ($p = 0.017$). The mean length of hospital stay was comparable between both the groups (6.7 vs 7.1 days). There was an increase in the mean postoperative pain score among obese 1.9 ± 1.4 vs 2.2 ± 1.4 respectively, which was statistically significant ($P = 0.017$) (Tab. II).

We evaluated the relations of obesity with the duration of surgery, the total length of hospital permanence, pre and post-operative pain scores among the different subsets using the Mann Whitney U test. Both groups had a comparable level of the duration of surgery. However, for the infective subset, the duration of surgery was greater in the obese group. The result was statistically significant ($p = 0.049$) (Tab. III). The value of the mean ranking indicated that the obese group had significantly more duration of surgery (33.08 minutes) than the non-obese control group (24.53 minutes) in this subset.

The post-operative pain was greater among the obese group in the non-infective subset. The result was statistically significant $P = 0.025$ (Tab. III). The mean ranking score indicated that the obese group experienced significantly more postoperative pain (128.89) than the non-obese control group (109.63).

A Chi-square test was performed to calculate the 30 days readmission. The study showed that 30 days readmission rate among the obese in the infective condition subset was 37.8%. There was a significant difference in the parameters of 30 days readmission rate between non-obese patients and those who are obese in this subset. ($P = 0.040$) (Tab. II). The other subsets showed a difference in 30 days readmission rate among obese, but no statistically significant difference was seen between the two groups (Tab. II).

Discussion

At the outset, our study revealed that nearly half the patient population were either overweight or obese,

stressing the ever-increasing magnitude of the problem of obesity. In the female population, the obese patients were more than the non-obese individuals. More than half the obese patients suffered from comorbidities, indicating the spiraling of associated risks.

This retrospective study assessed the impact of obesity on surgical outcomes, pain scores, duration of surgery, and 30-day readmission rates between non-obese and obese patients. Our study results showed that there is a considerable increase in the duration of surgery in obese when compared to non-obese. Our results showed that the meantime of surgery in the obese group was increased by an average of 40 min compared to the non-obese group (80 vs 120 min, $P = 0.027$). Comparing the surgical procedures in different subsets, a statistically significant extension in the operating time (33.08 min in obese vs 24.53 min in non-obese, $p = 0.049$) was observed in cases with an infective condition. Similarly, a study by Kundu S et al. showed an increase in the mean of surgery time in the obese group by an average of 13 min compared to the control group. The extended operating time can be the effect of the challenging intraoperative conditions caused by internal and external obesity and the subsequent narrowing and lack of space, reduced visibility, and tiresome preparation with the need for surgical accuracy [3]. In a study by Hawn MT et al. it was seen that BMI was associated with operation time with a 7% mean increase in time for cholecystectomy, 16% for colectomy, and 20% for unilateral mastectomy procedures [12]. An increased risk of infection with longer operative times in orthopedic trauma and knee arthroplasty has been reported in a study by Colman et al. [13]. Increase in operating time affects the anesthetic drug requirement by the patient and its added complications. The drug delivery is more initially due to the higher weight of the patient and it is further increased by the prolonged time of surgery. The presence of co morbidities interferes with the pharmaco-kinetics of these intra operative

drugs too. The prolonged operative time thus has detrimental effects on the obese patient.

The mean length of stay in our study in the obese group (7.1 days) was more compared to the non-obese (6.7 days) which was not statistically significant (0.490). A previous study reported that the total hospital stay in the obese group was 9.64 days opposed to 4.93 days in the non-obese ($P = 0.001$) [3]. There has been no evidence for a prolonged length of stay for obese patients undergoing common general surgery [14, 15]. Hawn et al. do not find evidence of the prolonged length of stay for obese patients undergoing 3 common general surgery procedures (cholecystectomy, unilateral mastectomy, and colectomy) [12]. Underweight and obesity had greater lengths of stay compared to normal weight who had shorter lengths of stay [15]. Evidence from a previous study suggests that some surgeon-specific characteristics could constitute a substantial amount of variation in operating time and discharge decisions. Most of these factors are unobservable and hard to measure and could give rise to biased estimates of the impact of obesity on operating time and length of stay [12]. Comorbidities in obese patients are related with longer length of stay as observed in a study by Plancharde et al. [16]. Identifying the risks may assist in changing the operating plan to reduce any postoperative complications. While each day of stay represents a measurable cost increase and increased hospital utilization, the exact effect of the increase in length of stay on surgical outcome is unknown [14]. There is a need to take special precaution both pre and post-surgery among obese, to reduce the cost and length of stay at the hospital.

Our study demonstrated that obese patients (37.8%) had higher 30 days readmission rate than the non-obese (17.5%) among those suffering from infectious conditions ($P = 0.040$). A significant difference in both groups was seen ($P = 0.040$). Other conditions had a difference in 30 days readmission between the two groups which was not statistically significant. A study on predictors of readmission with heart failures revealed that Obesity (aOR = 0.84, 95% CI = 0.82-0.86) and Morbid Obesity (aOR = 0.83, 95% CI = 0.81-0.85) were independently associated with 30-day readmission rate. Readmission at 6 months was highest among Morbid-Obese followed by Non-Obese and Obese (51.1 vs 50.2 vs 49.1%, $P < 0.01$) [17]. However, in our study, we did not follow-up for readmission in 6 months. Further study showed that predictors of higher 30-day readmission among obese patients were associated with comorbidities like diabetes mellitus, atrial fibrillation, chronic kidney disease, liver disease, and peripheral vascular disease [17]. Particular focus needs to be taken on postoperative care for obese patients admitted with infectious condition to minimize the preventable complications and promote the quality of care. Interventions such as early mobilization, precautions for pressure ulcers must be included to reduce 30 days readmission rate [17].

The study showed that post-operative pain is higher among the obese group in the non-infective subset. The mean postoperative pain score between non-obese and obese increased from 1.9 ± 1.4 to 2.2 ± 1.4 respectively, which is statistically significant ($P = 0.017$). A study by Motaghedi et al. showed that there was no association between obesity and pain scores. It showed that the mean preoperative pain scores were comparable despite weight: normal weight, 3.4 ± 3.3 ; overweight, 2.9 ± 2.9 ; and obese and 2.9 ± 3.2 . Mean postoperative pain scores at rest and activity were similar regardless of weight [18].

There were several limitations to the study. While all variables were preoperatively, perioperatively and postoperatively registered, they were retrospectively evaluated and, as such, constrained by the shortcoming in retrospective analyses. Bias in the data can occur as it was pre documented and could not be verified with any source. There were no assessments of all the risk factors that lead to surgical outcomes. Further, only the patient's BMI was considered for measuring obesity. Other measures such as weight-for-height index, BMI, waist circumference (WC), waist-hip ratio (WHR), and body fat percentage estimated by skinfold thickness (ST) could not be considered as the study had to rely on the existing data. BMI measurement is independent of age, gender, bone structure, muscle mass or fat distribution. If the outcome varied due any of these parameter differences, it might have been missed due to the BMI measurements alone. Besides these limitations, this study provides a novel perspective into considering the appropriate disease treatment in the setting of obesity. Different operation procedures were considered in the study. Each procedure poses diverse operative challenges and is expected to have different complications. Hence subset analysis was performed. This was done to determine whether obesity played an important role in changing outcomes across all kinds of operations.

Based on this study, it would be prudent to bring about the following changes while treating our patients. In elective cases, it would be beneficial for patient to undergo a weight reduction regimen before the operative procedure so as to decrease operating time and postoperative pain. In emergency patients with operative treatment for infective conditions, it would be worthwhile to stringently monitor comorbidities to reduce duration of hospital stay and the risk of readmission due to complications. Further research regarding the postoperative health of obese individuals may be brought out more beneficially by a prospective study to determine the surgical outcomes among obese patients. Further studies could use other anthropometric measurements of obesity to evaluate whether certain single parameters (waist circumference or skin fold thickness) are more predictive of worse outcomes in obese individuals than other obesity measurements.

Conclusions

In conclusion, among the obese group, the impact of obesity was seen as increased duration of surgery and post-operative pain. A slight increase in the 30 days readmission among obese was seen in the infection subset. The differences in 30 days readmission, duration of surgery, and length of stay arise due to different complex conditions among the patients. This study concludes that we should have a higher sensitivity towards the pain management and towards the parameters monitoring the possibility of complications in obese individuals. It is necessary to take early decisions and actions to prevent further complications of surgery that could occur in obese patients. In this way, readmissions due to ensuing complications can be prevented. It is also necessary for the high-risk patients to receive an overview of their overall preoperative condition to ensure effective post-operative treatment and control of complications. As obesity rates increase worldwide and as comorbidities in them increase, the negative impact in postoperative outcomes may spiral in the ensuing years. It is of utmost importance therefore to establish safe, alternate and minimally invasive surgical techniques for operations associated with increased adiposity. In addition, it is not only important to establish protocols for postoperative pain alleviation in the obese but also to establish postoperative monitoring guidelines to detect post-operative complications in its very early stages thus preventing readmissions.

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Conflicts of interest statement

The authors declare no conflict of interest.

Authors' contributions

DK and VLK conceived the study, performed a search of the literature and, were responsible for data analysis and data acquisition; DK contributed to the preparation of the manuscript; DK and VLK revised critically and editing the manuscript; all authors read and approved the last version of the manuscript.

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