



## A Retrospective Study on the Impact of Body Mass Index on Anesthesia-Related Complications

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### ABSTRACT:

**Background:** Body Mass Index (BMI) is a determining factor of the anesthetic care and the perioperative outcome. The physiological response to anesthesia is altered by obesity and under nutrition and exposes them to complications.

**Aim:** To determine the relationship between BMI and intraoperative and postoperative complications with anesthesia.

**Methodology:** The article is retrospective observational research that was carried out at the Department of Anaesthesiology, Gouri Devi institute of medical sciences and hospital, Durgapur, over a period of one year. The patient records studied were 120. Based on BMI, the patients were categorized into underweight, normal, overweight, and obese patients. The data were analyzed using the descriptive statistics and the chi-square tests.

**Results:** The normal BMI patients were 41.7, overweight (25), obese (20), and underweight (13.3). Airway complications (20%), difficult intubation (18%), and postoperative respiratory complications (22%), were significantly more common in obese patients. Intraoperative hypotension was more in underweight patients (15%).

**Conclusion:** BMI is a significant predisposing risk factor of complications of anesthesia. Airway and respiratory complications are the risk of obese patients and hemodynamic instability is the risk of underweight patients.

**Keywords:** BMI, Anesthesia complications, Obesity, Airway management, Perioperative risk.

## 1. Introduction

BMI is an anthropometric measure that is commonly used to measure the health condition and nutritional status of an individual. BMI is calculated as kilograms of weight divided by the square of height in meters ( $\text{kg}/\text{m}^2$ ) and is a simple and effective measure of classifying people into underweight, normal weight, overweight, and obese based on standardized

measures. In clinical practice, especially in anesthesiology, BMI has become an important part of the preoperative examination. Not only does it reflect body composition but also is a proxy of physiological reserve and metabolic status. BMI changes have a great impact on the various organ systems, such as respiratory, cardiovascular, and endocrine systems, which

changes the way the patient responds to the anesthetic agents and predisposes the patient to perioperative complications. Consequently, BMI is currently being seen as an important predictor of perioperative risk stratification and anesthetic planning.

Both underweight and obese extremes of BMI present unique and clinically relevant challenges to anesthetic care. The issue of obesity, specifically, has become a key global health issue and its prevalence has been steadily increasing among both developed and developing countries as a result of sedentary living, dietary habits and urbanization. In terms of anesthetics, obese patients come with a pool of physiological changes that make it difficult to manage the obese during the perioperative period. They comprise decreased functional residual capacity, diminished lung compliance, augmented oxygen use, and ventilation-perfusion imbalance all of which causes gas exchange to be impaired. It, therefore, increases the risk of respiratory complications in obese patients during peri-operative phases which include; hypoxemia, atelectasis, and challenging ventilation. Moreover, management of airways in obese patients is usually not easy because the anatomy of the obese patients makes them more prone to difficult intubation and airway blockage, with an obese neck circumference, as well as fat deposition in the pharyngeal area and limited mobility of the neck.

In addition to the breathing difficulties, obesity has a huge influence on cardiovascular physiology. Higher adiposity causes high cardiac output, hypertension in the body, and structural changes in the heart, thus making the body prone to perioperative hemodynamic instability. Additionally, metabolic syndrome, obstructive sleep apnea and diabetes mellitus are comorbid conditions that tend to be associated with obesity and make the treatment of anesthesia more difficult. Another important concern is the problem of drug distribution, metabolism, and clearance in the case of obese patients where the excessive fat mass affects the pharmacokinetic and pharmacodynamic

processes. This may cause a more lasting effect of the drugs, slowing of anesthesia and more likelihood of underdosing and drug build-up. All this leads to more intraoperative and postoperative complications of obese patients, which necessitate a careful preoperative planning and intraoperative care.

The other high-risk group regarding anesthetic practice that is not usually the focus of clinical studies, though, is underweight patients. Such individuals are normally defined by minimal physiological reserves, muscle atrophy and possible micronutrient deficiencies that affect their ability to overcome surgical stress. Underweight patients are particularly vulnerable to intraoperative hypotension due to the decrease in the volume of circulating blood and the deprivation of cardiovascular compensatory mechanisms.

Normal BMI patients on the other hand, are likely to exhibit more stable physiological responses, higher drug tolerance and lower complication rate during anesthesia. This stresses the importance of being in optimal nutritional states to develop better perioperative outcomes. However, in the contemporary world, where obesity is intertwined with undernourishment, anesthesiologists increasingly have to cope with the patients that fall into the wide BMI range. Each of these categories has various difficulties, which demand specific anesthetic approaches that justify the importance of the BMI as a key aspect to consider during the perioperative process.

With this in mind, BMI has become an important and a practical instrument in preoperative examination and risk evaluation. The relationship between BMI and complications linked to anesthesia is a complex issue that needs to be well understood in order to maximize perioperative care, improve patient safety, and minimize the morbidity and mortality linked to surgical operations. Although some evidence is there, more context-related data, especially in tertiary care, is required to further comprehend the trend of complications among various BMI groups. Thus, the current research will assess the

effects of BMI on intraoperative and postoperative anesthesia-related complications of patients undergoing surgical operations in a tertiary care hospital and, therefore, will help in enhancing clinical decision-making and patient outcomes.

## 2. Methodology

### 2.1. Study Design

The current study was intended to be a retrospective observational study to determine the relationship between BMI and anesthesia-related complications in surgical patients. To identify the patterns, risk factors, and outcomes of changes in BMI in the perioperative context, a retrospective methodology was selected to conduct a systematic analysis of the previously recorded clinical data within a specific time frame to be able to identify patterns, risk factors, and outcomes.

### 2.2. Study Area

The study was carried out in the department of anaesthesiology in the Gouri devi institute of medical sciences and hospital, Durgapur, West Bengal, India.

### 2.3. Study Duration

The research was conducted in one year.

### 2.4. Study Participants

#### ➤ Inclusion Criteria

- Patients aged between 18 and 65 years
- Patients who underwent elective or emergency surgical procedures under anesthesia (general, spinal, or epidural)
- Patients with complete and well-documented medical records, including preoperative, intraoperative, and postoperative details

#### ➤ Exclusion Criteria

- Patients with incomplete or missing clinical data
- Pediatric patients (below 18 years of age)
- Patients classified as American Society of Anesthesiologists (ASA) Physical

Status Grade IV and above, due to the high likelihood of confounding severe systemic illness

- Patients with known severe systemic or metabolic disorders that could independently influence perioperative outcomes

### 2.5. Sample Size

The study selected 120 records of the patients that met the inclusion and exclusion criteria. The sample size was deemed to be sufficient to cover a wide range of BMI groups and related anesthesia outcomes in the study group.

### 2.6. Procedure

The medical records department of the hospital was used to retrieve the data through a structured data collection format to allow uniformity and accuracy. All patients were measured on the basis of standard formula (weight in kilograms/squares of height in meters) to determine his/her BMI, which was further divided into categories in accordance with the World Health Organization (WHO) categorization to underweight (less than 18.5 kg/Ethical permission to carry out the study was granted by the Institutional Ethics Committee of the hospital and all data were anonymized to protect patient privacy prior to data collection.

### 2.7. Statistical Analysis

The data collected were actually entered into the SPSS version 22.0 (IBM, USA) where it was to be analyzed. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population by giving mean and standard deviation of the continuous variables, frequency and percentage of the categorical variables. The relationship between the BMI groups and complications related to anesthesia was tested using the chi-square-test. Where the necessity arose, comparisons were made among different groups to ascertain statistically significant differences. The p-value of less than 0.05 was considered to be statistically significant, which implied that the

variables were significantly related to one another.

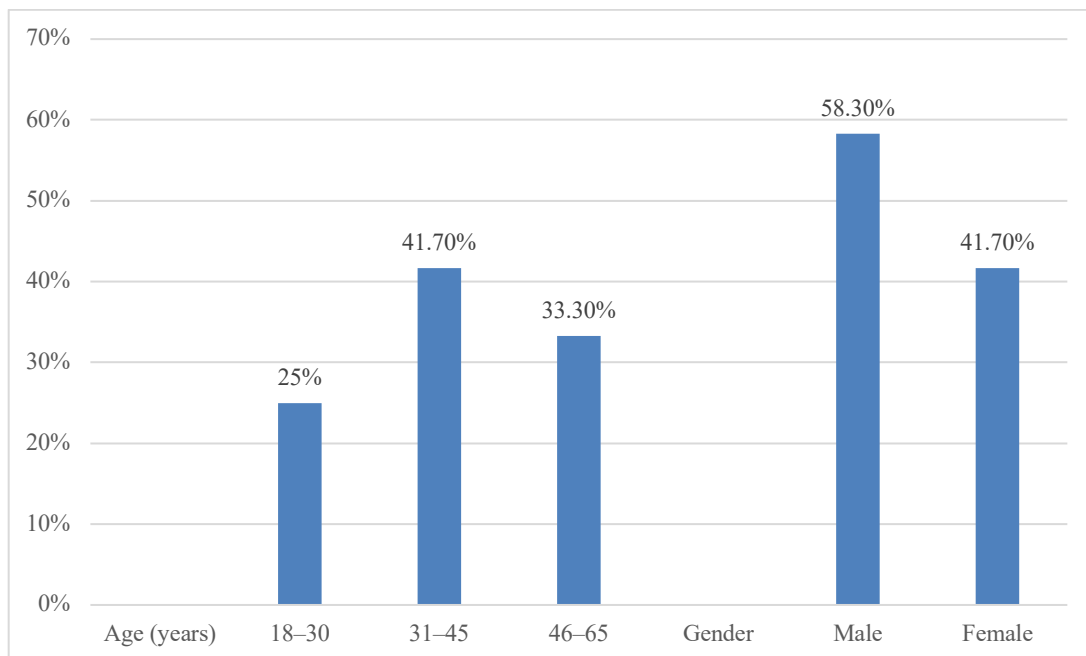
### 3. Result

Total of 120 patients were analysed in the present study to determine the relationship between BMI and anesthesia-related complications in a tertiary care environment. An overall evaluation was conducted to investigate the effects of differences in BMI on perioperative outcomes, intraoperative and postoperative events. The main parameters

included in the analysis were demographic factors, distribution of patients among BMI groups, and the nature of anesthesia provided. Secondly, a specific focus was directed at the identification and comparison of the incidence of the intraoperative complications, including hypotension, difficult intubation and airway problems, and the postoperative complications, including respiratory complications, delayed recovery and nausea/vomiting across the different BMI groups.

**Table 1: Demographic Characteristics of Patients (n = 120)**

| Parameter   | F  | %     |
|-------------|----|-------|
| Age (years) |    |       |
| 18–30       | 30 | 25%   |
| 31–45       | 50 | 41.7% |
| 46–65       | 40 | 33.3% |
| Gender      |    |       |
| Male        | 70 | 58.3% |
| Female      | 50 | 41.7% |



**Figure 1: Graphical presentation of Demographic Characteristics of Patients**

Table 1 provides the demographic data on the population of the study population with the majority of the patients being aged 31-45 years (41.7%), then 46-65 (33.3) and 18-30 (25) years old, demonstrating that middle-aged people

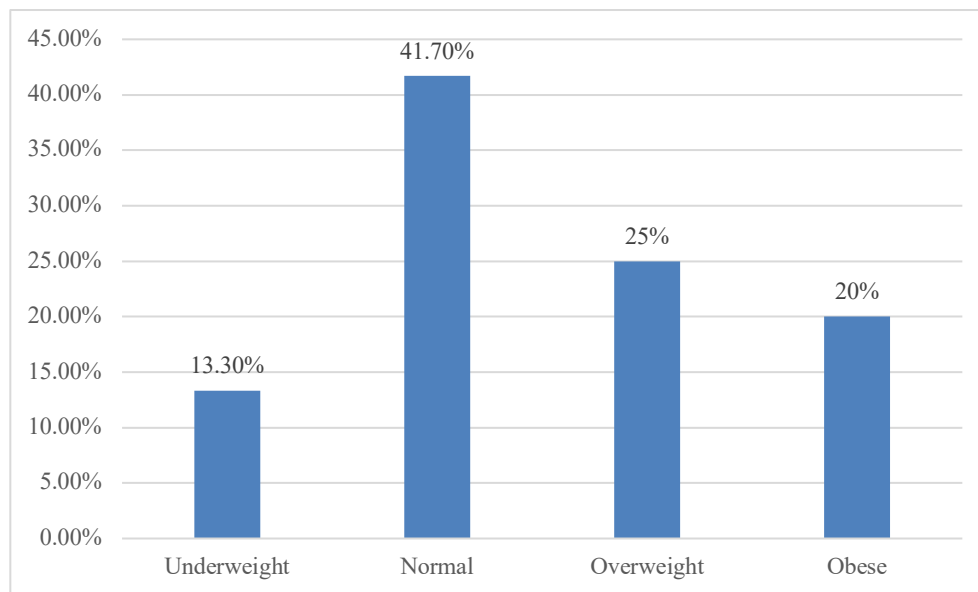
were the largest percentage of surgical cases. This implies that this age group is more likely to undergo surgery and other comorbidities. The distribution of gender was that male patients (58.3%) outnumbered the female patients

(41.7%), this means that males were a little overrepresented in the study population. Overall, the demographic perspective indicates the equal representation of adult patients, and this is a sufficient background that would be used to research the impacts of BMI on anesthesia-related complications. Gender distribution reflected those male patients

(58.3%), were overrepresented slightly above female patients (41.7%), and this indicates that males were overrepresented in the study population. Overall, the demographic perspective shows that the number of adult patients is equal, which is a sufficient background to examine the impact of BMI on anesthetic complications.

**Table 2: Distribution Based on BMI**

| BMI Category | F  | %     |
|--------------|----|-------|
| Underweight  | 16 | 13.3% |
| Normal       | 50 | 41.7% |
| Overweight   | 30 | 25%   |
| Obese        | 24 | 20%   |



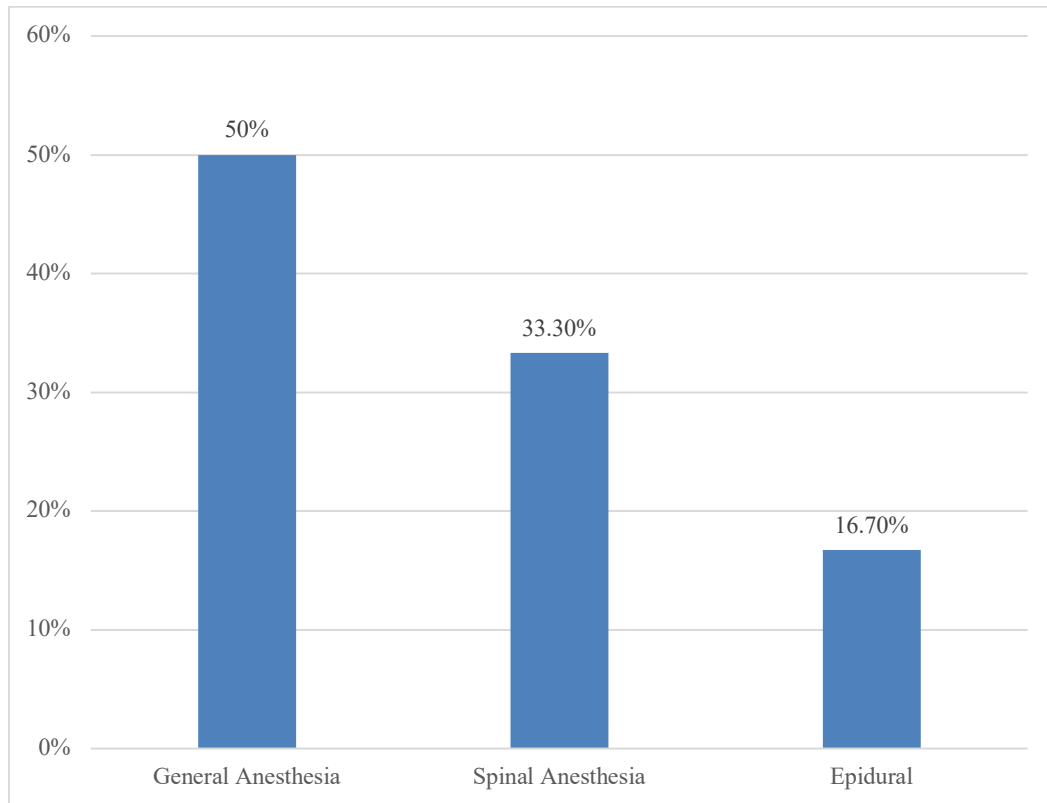
**Figure 2: Graphical presentation of Distribution Based on BMI**

Table 2 displays the distribution of patients based on BMI with the majority of them comprising of normal (41.7), overweight (25), obese (20), and underweight (13.3) patients. It is interesting to note that nearly 45 % of the patients were overweight or obese and that an excess weight of the body is a major load of surgical patients. In the meantime, the

underweight individuals show the presence of undernutrition. The extensive range of these BMI groups offers the opportunity to compare well the complications of anesthesia and promotes the importance of BMI as one of the most pertinent factors in the perioperative risk assessment.

**Table 3: Type of Anesthesia Administered**

| Type of Anesthesia | F  | %     |
|--------------------|----|-------|
| General Anesthesia | 60 | 50%   |
| Spinal Anesthesia  | 40 | 33.3% |
| Epidural           | 20 | 16.7% |



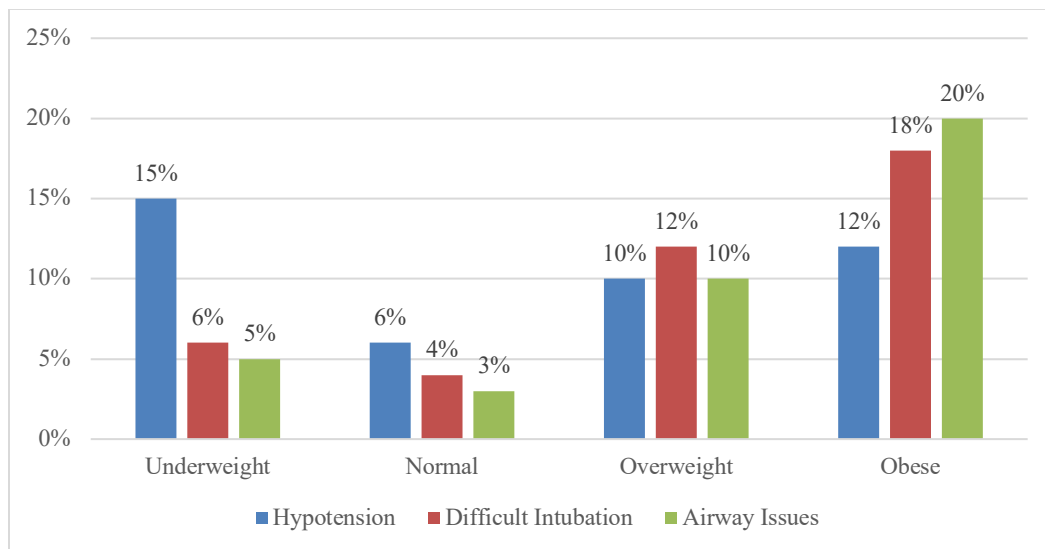
**Figure 3: Graphical presentation of Type of Anesthesia Administered**

Table 3 breaks down the types of anesthesia used in the research with the most commonly administered anesthesia being general anesthesia (50%), followed by spinal anesthesia (33.3) and epidural anesthesia (16.7). The prevalence of general anesthesia suggests that the proportion of surgery requiring airway restraint and deeper depths of anesthesia was

high. Meanwhile, the use of regional anesthesia techniques testifies to its clinical importance associated with avoiding the development of systemic complications and maintaining a rapid recovery. This kind of variation in the mode of anesthesia provides a holistic approach in determining the effect of BMI on the outcome of anesthesia.

**Table 4: Intraoperative Complications by BMI**

| Complication         | Underweight | Normal | Overweight | Obese |
|----------------------|-------------|--------|------------|-------|
| Hypotension          | 15%         | 6%     | 10%        | 12%   |
| Difficult Intubation | 6%          | 4%     | 12%        | 18%   |
| Airway Issues        | 5%          | 3%     | 10%        | 20%   |

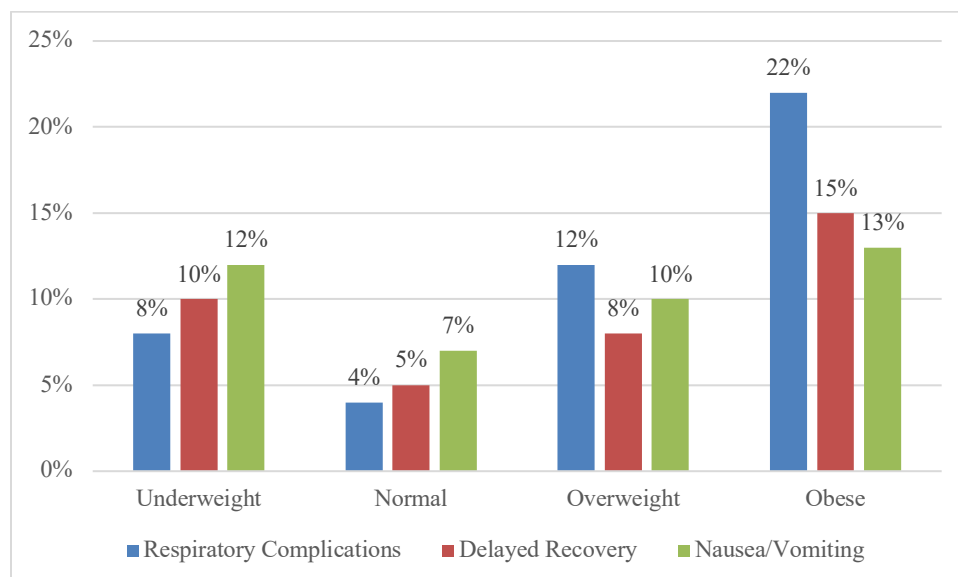


**Figure 4: Graphical presentation of Intraoperative Complications by BMI**

Table 4 shows the correlation between BMI and intraoperative complications and indicates that underweight patients experienced the highest prevalence of hypotension (15%), which can probably be explained by reduced physiological reserves and low blood circulation. On the other hand, the most frequent problem of challenging intubation (18%), airway complications (20%),

defined obese patients, which explains the challenges the airway management faces in this group of patients due to physiological and anatomical alterations. The rate of complications was moderate among the overweight patients, and the patient with normal BMI had the lowest rate of all intraoperative complications.

| Complication              | Underweight | Normal | Overweight | Obese |
|---------------------------|-------------|--------|------------|-------|
| Respiratory Complications | 8%          | 4%     | 12%        | 22%   |
| Delayed Recovery          | 10%         | 5%     | 8%         | 15%   |
| Nausea/Vomiting           | 12%         | 7%     | 10%        | 13%   |



**Figure 5: Graphical presentation of Postoperative Complications by BMI**

Table 5 observes the presence of postoperative complications according to BMI categories with the highest incidence observed in obese patients (22%), probably because of impaired pulmonary functioning and diminished oxygenation. They were also noted to have more delayed recovery (15%), which can be explained by the changes in drug metabolism, and the longer period of anesthetic influence. Patients with underweight showed greater delayed recovery (10%), nausea/vomiting (12%), which may be related to the change in pharmacokinetics and loss of physiological reserves. Conversely, patients with normal BMI had lowest complication rates, implying that they can tolerate anesthesia better and have better recovery outcomes, whereas overweight patients demonstrated intermediate risk.

#### 4. Discussion

The current retrospective research was carried out to determine the influence of BMI in anesthesia-related complications in patients undergoing surgery. The results are categorical on the fact that BMI is a significant risk factor in perioperative conditions, both underweight and overweight patients are more prone to develop certain intraoperative and postoperative complications as compared to those with normal BMI.

In the research, the obese patients displayed a much higher case of airway related complications such as hard intubation and airway blockage. The findings are in line with the already published literature that states that obesity is linked to the anatomical and physiological developments that make it difficult to manage the airways. Enhanced fat loading in the pharyngeal and neck areas, decreased neck range, and increased obstructive sleep apnea are causes of the difficulty in obtaining airway security. Furthermore, obese patients are predisposed to perioperative hypoxia and postoperative respiratory complications due to reduced lung compliance, functional residual capacity and ventilation-perfusion mismatch. These physiological considerations are upheld by the observed

increased rate of respiratory complications (22) in the current study in obese patients.

Moreover, delayed recovery and airway problems during the course of surgery were also more prevalent among obese patients. The effects of changed pharmacokinetics and pharmacodynamics of anesthetic agents among obese patients are significant factors in such outcomes. Enhanced fat tissue influences distribution and excretion of lipophilic drugs, resulting in extended effects of drugs and delayed appearance out of anesthesia. These results underscore the importance of cautious dosing and monitoring of drugs among obese individuals to prevent negative effects.

Conversely, intraoperative hypotension and slow recovery was more common in underweight patients in this study. This may be due to lower physiological reserves, lower muscle mass, and nutritional deficiencies which are usually observed in underweight people. Such patients are more susceptible to hypotension in anesthesia due to lower circulating blood volume and compromised cardiovascular compensatory mechanisms. As well, diminished protein binding and changes in the metabolism of drugs can lead to exaggerated reactions to anesthetic drugs, which helps in hemodynamic instability and delayed recovery.

The findings of the present research indicate that normal weight patients experience the lowest intraoperative and postoperative complication rates as well. It means that those individuals who have an ideal BMI have a more positive physiological balance and, therefore, their cardiovascular and respiratory responses to anesthesia are more consistent. These results justify the importance of a normal BMI that would improve the perioperative results.

The other significant finding of this study is that the rate of complications in normal, overweight and obese groups is gradually increasing. The intermediate risk levels of overweight patients revealed that even moderate weight gain can affect the outcomes of anesthesia. This brings

out the continuum of risk of increasing BMI instead of a threshold effect.

Findings of this study highlight the clinical relevance of BMI to preoperative risk assessment as a simple yet effective tool. Adding BMI to the workflow of pre-anesthetic assessment can assist anesthesiologists to detect high-risk patients and apply necessary measures including advanced airway planning, comorbid condition optimization, careful choice of drugs, and more precise postoperative check.

### Conclusion

The present research article validates the fact that BMI is a good predictor of anesthesia-related complications with underweight and obese patients having more perioperative risks but with different trends in clinical patterns. It was also discovered that obese patients were susceptible to airway issues, including tough intubation and postoperative respiratory troubles, primarily due to alterations in respiratory mechanics, an augmentation in adipose tissue prevalence, and a reduction in pulmonary compliance whereas underweight patients were more inclined to the intraoperative hypotension and delayed recuperation, and is a more consistent physiological response to anesthesia. These findings support the necessity of incorporating the measurement of BMI in the routine pre-anesthetic screening into the risk-based stratification and patient-centered perioperative care process. Personalizing the practice of anesthesia, logicity of drug dosage, and strict intraoperative and postoperative regulation based on BMI can significantly enhance the safety of patients and the results of the surgery.

### References

- Egan B, Racowsky C, Hornstein MD, Martin R, Tsen LC. Anesthetic impact of body mass index in patients undergoing assisted reproductive technologies. *J Clin Anesth.* 2008;20(5):356–63.
- McKay RE, Malhotra A, Cakmakkaya OS, Hall KT, McKay WR, Apfel CC. Effect of increased body mass index and anaesthetic duration on recovery of protective airway reflexes after sevoflurane vs desflurane. *Br J Anaesth.* 2010;104(2):175–82.
- Suemitsu R, Sakoguchi T, Morikawa K, Yamaguchi M, Tanaka H, Takeo S. Effect of body mass index on perioperative complications in thoracic surgery. *Asian Cardiovasc Thorac Ann.* 2008;16(6):463–7.
- Ray DE, Matchett SC, Baker K, Wasser T, Young MJ. The effect of body mass index on patient outcomes in a medical ICU. *Chest.* 2005;127(6):2125–31.
- Mullen JT, Davenport DL, Hutter MM, Hosokawa PW, Henderson WG, Khuri SF, et al. Impact of body mass index on perioperative outcomes in patients undergoing major intra-abdominal cancer surgery. *Ann Surg Oncol.* 2008;15(8):2164–72.
- Davenport DL, Xenos ES, Hosokawa P, Radford J, Henderson WG, Endean ED. The influence of body mass index on vascular surgery 30-day morbidity and mortality. *J Vasc Surg.* 2009;49(1):140–7.
- Vricella LK, Louis JM, Mercer BM, Bolden N. Impact of morbid obesity on epidural anesthesia complications in labor. *Am J Obstet Gynecol.* 2011;205(4):370.e1–6.
- Vricella LK, Louis JM, Mercer BM, Bolden N. Anesthesia complications during scheduled cesarean delivery for morbidly obese women. *Am J Obstet Gynecol.* 2010;203(3):276.e1–5.
- Machado LS. Cesarean section in morbidly obese parturients: practical implications and complications. *N Am J Med Sci.* 2012;4(1):13–8.
- Dave A, Maru L, Daksha S, Natu N. Weight does matter: a study of effect of obesity on pregnancy and its outcome. *J South Asian Fed Obstet Gynaecol.* 2013;5(3):107–10.
- Whitty RJ, Maxwell CV, Carvalho JCA. Complications of neuraxial anesthesia in an extreme morbidly obese patient for cesarean section. *Int J Obstet Anesth.* 2007;16(2):139–44.
- Chau-In W, Hintong T, Rodanant O, Lekprasert V, Punjasawadwong Y,

- Charuluxananan S, et al. Anesthesia-related complications of caesarean delivery in Thailand: 16,697 cases from the Thai Anaesthesia Incidents Study. *Med J Med Assoc Thai.* 2010;93(11):1274–83.
13. Hall LF, Neubert AG. Obesity and pregnancy. *Obstet Gynecol Surv.* 2005;60(4):253–60.
14. Hawkins JL, Chang J, Palmer SK, Gibbs CP, Callaghan WM. Anesthesia-related maternal mortality in the United States: 1979–2002. *Obstet Gynecol.* 2011;117(1):69–74.
15. Bloom SL, Spong CY, Weiner SJ, Landon MB, Rouse DJ, Varner MW, et al. Complications of anesthesia for cesarean delivery. *Obstet Gynecol.* 2005;106(2):281–7.
16. Domi R, Laho H. Anesthetic challenges in the obese patient. *J Anesth.* 2012;26(5):758–65.
17. Galliano D, Bellver J. Female obesity: short- and long-term consequences on the offspring. *Gynecol Endocrinol.* 2013;29(7):626–31.
18. Casati A, Putzu M. Anesthesia in the obese patient: pharmacokinetic considerations. *J Clin Anesth.* 2005;17(2):134–45.
19. Soens MA, Birnbach DJ, Ranasinghe JS, van Zundert A. Obstetric anesthesia for the obese and morbidly obese patient: an ounce of prevention is worth more than a pound of treatment. *Acta Anaesthesiol Scand.* 2008;52(1):6–19.
20. Binks A, Pyke M. Anaesthesia in the obese patient. *Anaesth Intensive Care Med.* 2008;9(7):299–302.