

ASSESSING THE FREQUENCY OF DIFFICULT INTUBATION IN ADULT OBESE PATIENTS UNDERGOING GENERAL ANESTHESIA AT DISTRICT HEADQUARTERS HOSPITAL SWABI

Umair Ali¹, Mehar Ali², Mahad Wahab³, Shayan Habib⁴, Azmat Ullah⁵,
Muhammad Kamran Khan^{*6}

¹Faculty of Allied Health Science Superior University Lahore

²Working at Kulsom International Hospital Islamabad

³Faculty of Aman Ullah Khan Medical and Nursing Institute

⁴Seena Institute of Medical Sciences Swabi

⁵Faculty of Allied Health Science Superior University Lahore

⁶Sarhad University of Science and Information Technology Peshawar

¹umair.ali.sgd@superior.edu.pk, ²meharashfaq136@gmail.com, ³mahadwahab360gmail.com,
⁴shayanhabib50@gmail.com, ⁵azmat.ullah.sgd@superior.edu.pk, ⁶kamran.kamre@gmail.com

DOI: <http://doi.org/10.5281/zenodo.19395481>

Keywords

BMI (body mass index), sternomental distance, difficult intubation, thyromental distance, cormack – Lehane Classification, mallapatti score, obesity, general anesthesia.

Article History

Received: 31 January 2026

Accepted: 15 March 2026

Published: 31 March 2026

Copyright@Author

Corresponding Author: *

Muhammad Kamran Khan

Abstract

A prospective observational study was carried out at District Headquarter Hospital swabi, Pakistan. Total of 124 patients have participated in the study. Patients of both gender with age 18 and above years were included. An assessment of frequency of difficult intubation in obese patients was conducted using pre-formed questionnaire. Statistical package for social sciences version 22 were used for analysis of data. Descriptive statistics (frequencies, percentages and cross-tabulation) was applied to analyze the data. The study population comprised 124 adult patients, all classified as obese Based on the data, there was a high incidence of challenges with intubations in these obese cohort. This finding was caused by several factors which included some patients' obesity, as 29% of patients (36/124) were intubated after more than three attempts while 28.2% (35/124) had intubation that lasted over 10 minutes. In 34.7% (43/124) of cases, an airway adjunct was found to be necessary. These led to a worrisome situation whereby significantly a greater number of the obese participants encountered difficult or failed intubation. Other anatomical features of the airway also proved worthwhile in further analysis. A good number, however, had poor oropharyngeal visualization, as demonstrated by the distribution of Mallam Patti scores (Grade 2: 29%; Grade 3: 32.3%; Grade 4: 3.2%). A good number of these patients (34.7%) also had stern omental distance less than twelve centimeters which could be associated with difficult intubation. These observations were corroborated by Cormack-Lehane classification, whereby 41.9% of participants demonstrated Class II view. this was an indicator on which we predicted that difficulty was likely to be experienced in 48 %. These findings disagree with the predicted 48% frequency of difficult intubation. In this study, the observed rate of difficult intubation was lower at 29%. This trend is vertically shown in the accompanying bar graph on which the expected and the

actual frequency of the complication 'difficult intubation' has been plotted for all the 124 subjects. The decline in the observed rate has been as expected from the prediction. The purpose of the intubation was to maintain or secure the airway of the patient. Furthermore, this study included analysis of difficult intubation in obese patients among 124 subjects. Intubation challenges were of considerable concern during our analysis with 29% of the patients requiring more than 3 attempts, intubations exceeding 10 minutes were noted in 28.2% and airway adjuncts were required in 34.7% of the cases. As the authors state, a high rate of "atypical" anatomy was registered: unsatisfactory visualization of oropharynx, short stern omental distance, and Cormack-Lehane Classification II – III views were observed. However, the difficult intubation rate we observed 29% which is lower than our above predicted value of 48%.

INTRODUCTION:

The global rise in obesity has emerged as a major challenge in anesthetic practice, particularly in airway management. Obese patients are at increased risk of perioperative complications, including apnea and hypoxemia, which make tracheal intubation more technically demanding. The Body Mass Index (BMI) is commonly used to define obesity, with the World Health Organization classifying obesity as BMI ≥ 30 kg/m². However, in Asian populations, including India, a lower threshold of BMI ≥ 25 kg/m² is considered indicative of obesity due to associated health risks. Studies report that the incidence of difficult intubation among obese individuals ranges between 10–15%, compared to approximately 6.2% in non-obese individuals. Difficult airway management is a significant contributor to anesthesia-related morbidity and mortality, with nearly 30% of anesthesia-related deaths linked to intubation complications. Contributing factors include obstructive sleep apnea, Mallampati score >3 , male gender, and increased neck circumference (>40 cm) (Shailaja et al., 2014; De Jong et al., 2020).

In the general population, the incidence of difficult intubation ranges from 0.1% to 13%, but this rate increases substantially in obese and morbidly obese individuals, who may experience up to a threefold higher risk. Epidemiological data from the United States show a marked increase in obesity prevalence from 30.5% in 2000 to 42.4% in 2018, with morbid obesity rising from 4.7% to 9.2%. These trends have led to an increased reliance on bariatric surgical interventions in

patients with BMI >35 kg/m² and associated comorbidities (Thota et al., 2022; Akin et al., 2024). In Pakistan, regional disparities exist, with obesity prevalence reported as 56% in Khyber Pakhtunkhwa, 29% in Balochistan, and 19% in Sindh (Satti, 2015).

Poor airway management can result in serious complications, including airway trauma, hypoxic brain injury, and death. Evidence suggests that advancements in airway management techniques, including the introduction of video laryngoscopy, have reduced the incidence of severe complications such as brain injury and mortality during general anesthesia. According to the Fourth National Audit Project, severe complications like death or brain damage occur in approximately 1 in 180,000 general anesthesia cases (Joffe et al., 2019). Despite these improvements, airway management in obese patients remains challenging.

Obesity contributes to anatomical and physiological changes that complicate airway management. These include reduced chest wall compliance, decreased functional residual capacity, increased oxygen consumption, and fat deposition around the upper airway, which collectively predispose patients to rapid desaturation during apnea. Additionally, supine positioning in morbidly obese patients further compromises respiratory mechanics, increasing the risk of hypoxia during intubation. Predictive airway assessment tools such as the Mallampati classification, thyromental distance, sternomental distance, and interincisor gap are commonly used; however, their predictive accuracy remains

limited, with success rates ranging from 22% to 62% (Siriussawakul et al., 2018).

Difficult intubation is defined as the inability to successfully place an endotracheal tube using conventional laryngoscopy. Common contributing factors include a short, thick neck, limited cervical mobility, large tongue, and obesity (Cierniak et al., 2016). In such cases, alternative airway devices have gained importance. The intubating laryngeal mask airway (ILMA) has emerged as a useful adjunct, allowing blind tracheal intubation and effective ventilation. Studies have demonstrated that ILMA offers comparable success rates to fiberoptic-guided techniques, with moderate intubation times, making it a viable alternative in difficult airway scenarios (Dhonneur et al., 2006; Siddiqui et al., 2022; Frappier et al., 2003).

Rationale

Obesity is an escalating public health concern globally and in Pakistan, significantly impacting perioperative care. Physiological alterations associated with obesity, such as decreased lung volumes, reduced neck mobility, and increased adipose tissue in the airway, contribute to difficult intubation. Failure to anticipate and manage these challenges can result in severe complications, including hypoxia, aspiration, airway trauma, cardiac arrest, and even mortality. Despite its clinical significance, limited local data exist regarding the frequency and predictors of difficult intubation in obese patients.

This study aims to evaluate the frequency of difficult intubation among obese patients undergoing general anesthesia at a tertiary care hospital. By identifying key predictive factors, the findings will assist in improving preoperative airway assessment, facilitating the availability of appropriate equipment, and enhancing staff preparedness. Ultimately, this will contribute to safer anesthetic practices, improved patient outcomes, and reduced perioperative complications in the obese population.

MATERIALS AND METHODS:

This section includes research study setting, study design duration of study, sampling technique,

sample size, data collection procedure, ethical consideration and data analyzing procedure.

STUDY SETTING AND STUDY POPULATION:

The targeted population of the current study was obese patients aged 18 and above, visiting at Operation Theater (OT) for general anesthesia of District Headquarter hospital Swabi.

STUDY DESIGN:

This is a Prospective Observational study to assess the frequency of difficult intubation in obese patients during general anesthesia in District Headquarter Hospital Swabi. The study lasted for six months (July 2024 to December 2024), and research data was collected in three months (October to December).

SAMPLE SIZE:

The sample size (n) was calculated using the OpenEpi website, assuming a population proportion (p) of 50% and a confidence interval of 5%. Based on these parameters, the required sample size was determined to be 384, rounded to 380.

Although the initial sample size was determined to be 380, data collection constraints during the six-month study period resulted in a final sample size of 124 participants.

While the achieved sample size is smaller than the initially calculated value, it remains sufficient to provide meaningful insights into the frequency of difficult intubation in the study population. The limitation posed by the reduced sample size is acknowledged, and the results should be interpreted cautiously, considering the potential impact on generalizability.

To evaluate the adequacy of the achieved sample size (124 participants), a post hoc power analysis was performed using the formula $[n = (Z\alpha + Z\beta)^2 / \text{Effect size}^2]$. The analysis revealed an estimated statistical power of approximately 97.5%, which exceeds the commonly accepted threshold of 80%. This indicates a high probability of detecting an actual effect with the given sample size, ensuring that the results remain statistically valid.

INCLUSION AND EXCLUSION CRITERIA:

This study included adult patients aged 18 years and above with BMI ≥ 30 kg/m² undergoing planned non-emergency surgeries who provided informed consent and were classified as ASA Grade I or II, with all intubations performed exclusively by trained anesthesiologists; patients were excluded if they were under 18 years of age, had BMI < 30 kg/m², required emergency surgery, did not provide informed consent, were classified as ASA Grade III or IV, or if intubation was to be performed by a trainee medical officer or technician.

DATA COLLECTION PROCEDURE:

After getting approval from institutional research committee, Head of Seena Institute of medical sciences Swabi and head of research ethical committee DHQ hospital Swabi, data was collected from OT department. A questionnaire was used for data collection.

STATISTICAL ANALYSIS:

Data were analyzed using descriptive statistics, such as frequencies and percentages, via the Statistical Package for the Social Sciences (SPSS). This approach was used to summarize patient demographics and variables relevant to difficult intubation, including age, BMI, Mallampati score, and pre-existing conditions. The overall frequency of difficult intubation was also calculated using this method.

RESULTS:

The study population comprised 124 adult patients, all classified as obese. Based on the data, there was a high incidence of challenges with intubations in these obese cohort. This finding was caused by several factors which included some patients' obesity, as 29% of patients (36/124) were intubated after more than three attempts while 28.2% (35/124) had intubation that lasted over 10 minutes. In 34.7% (43/124) of cases, an airway adjunct was found to be necessary. These led to a worrisome situation whereby significantly more number of the obese participants encountered difficult or failed intubation. Other anatomical features of the airway also proved worthwhile in further analysis. A good number, however, had poor oropharyngeal visualization, as demonstrated by the distribution of Mallampatti scores (Grade 2: 29%; Grade 3: 32.3%; Grade 4: 3.2%). A good number of these patients (34.7%) also had sternomental distance less than twelve centimeters which could be associated with difficult intubation. These observations were corroborated by Cormack-Lehane classification, whereby 41.9% of participants demonstrated Class II view. This was an indicator on which we predicted that difficulty was likely to be experienced in 48%. These findings disagree with the predicted 48% frequency of difficult intubation. In this study, the observed rate of difficult intubation was lower at 29%. This trend is vertically shown in the accompanying bar graph on which the expected and the actual frequency of the complication 'difficult intubation' has been plotted for all the 126 subjects. The decline in the observed rate has been as expected from the prediction.

TABLE 1: CONSOLIDATED DATA

Category	Details
Age	Age range: 18-68. Majority: 30-50 years.
Gender	Male: 56.5% (70), Female: 43.5% (54)
BMI Category	Obese I: 53.2% (66), Obese II: 41.1% (51), Obese III: 5.6% (7)
Mallampatti Score	Grade 1: 34.7% (43), Grade 2: 29% (36), Grade 3: 32.3% (40), Grade 4: 3.2% (4)
Sternomenl Distance	<12 cm: 56.5% (70), 12-14 cm: 3.2% (4), >12 cm: 34.7% (43), >14 cm: 5.6% (7)

Cormack-Lehane Class	Class I: 30.6% (38), Class II: 41.9% (52), Class III: 22.6% (28), Class IV: 4.8% (6)
Difficult Intubation	Difficult: 48.4% (60), Not Difficult: 51.6% (64)
More Than Three Attempts Required	Yes: 29% (36), No: 71% (88)
Intubation Time >10 mins	Yes: 28.2% (35), No: 71.8% (89)
Airway Adjunct Used	Yes: 34.7% (43), No: 65.3% (81)

The above 1 provides a summary of demographic and clinical characteristics of the study participants.

AGE

The participants' ages ranged from 18 to 68. A significant portion of the study group was aged between 30 and 50. This age distribution highlights a middle-aged demographic, a population likely to face increased health risks and challenges in airway management.

GENDER

Male participants comprised 56.5% (70 individuals) of the total sample, while females accounted for 43.5% (54). This indicates a slightly higher representation of males in the study population, which may provide insights into potential gender-related differences in intubation outcomes.

BMI CATEGORY

- i. **Obese I (BMI 30–34.9)** was found to account for 53.2% of the sample, comprising 66 participants.
 - ii. **Obese II (BMI 35–39.9)** represented 41.1% of the sample, with 51 participants falling into this category.
 - iii. **Obese III (BMI ≥ 40)** accounted for 5.6% of the sample, consisting of 7 participants.
- This distribution underscores the predominance of moderately obese individuals in the study while reflecting the smaller subset of severely obese participants.

MALLAMPATTI SCORE

- i. **Grade 1** was observed in 34.7% of participants (43 individuals), indicating relatively easy intubation conditions.

- ii. **Grade 2** was recorded in 29% of participants (36 individuals).
- iii. **Grade 3** was identified in 32.3% of participants (40 individuals), suggesting moderate difficulty in intubation.
- iv. **Grade 4** was noted in 3.2% of participants (4 individuals), indicating severe difficulty in intubation.

The distribution shows that a significant proportion of participants fell into higher grades (3 and 4), reflecting potential challenges in airway management.

STERNOMENTAL DISTANCE

- A **sternomental distance of <12 cm** was observed in 56.5% (70 participants), suggesting a higher likelihood of intubation difficulty.
- **12–14 cm** was recorded in 3.2% (4 participants).
- A **distance >12 cm** was found in 34.7% (43 participants).
- **>14 cm** was noted in 5.6% (7 participants), which generally correlates with easier intubation.

This data highlights the anatomical variations that contribute to differences in intubation ease.

CORMACK-LEHANE CLASS

- i. **Class I** was observed in 30.6% of participants (38 individuals), indicating optimal visibility of the vocal cords.
- ii. **Class II** was recorded in 41.9% of participants (52 individuals), suggesting moderate visibility.
- iii. **Class III** was identified in 22.6% of participants (28 individuals), reflecting poor visibility.
- iv. **Class IV** was noted in 4.8% of participants (6 individuals), representing very challenging cases.

This distribution highlights the prevalence of intermediate and poor visibility in this study population, contributing to intubation difficulties.

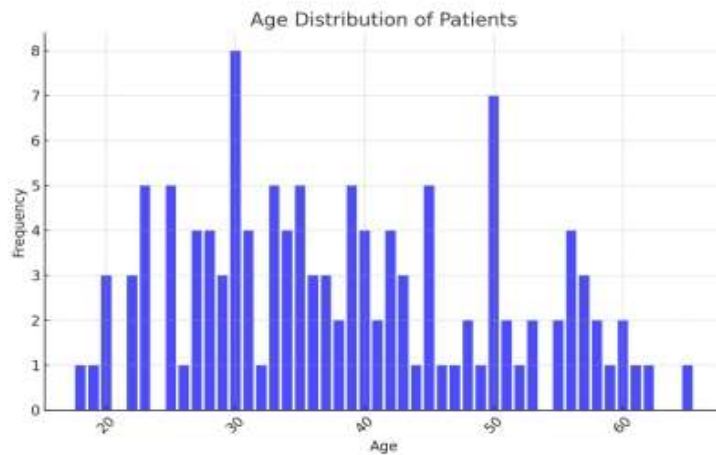
DIFFICULT INTUBATION

Anesthesiologists labeled 48.4% of cases (60 participants) as difficult, while 51.6% (64 participants) were classified as not difficult. This high proportion of difficult intubations underscores the complexity of managing airways in the studied population.

In 29% of cases (36 participants), more than three attempts were required to achieve intubation. Conversely, 71% of cases (88 participants) required fewer than three attempts. Repeated attempts highlight the challenges faced by anesthesiologists in some instances.

DATA ANALYSIS AND VISUALIZATION

AGE DISTRIBUTION



This bar chart shows the distribution of ages among patients. The age range is diverse, with

INTUBATION TIME >10 MINUTES

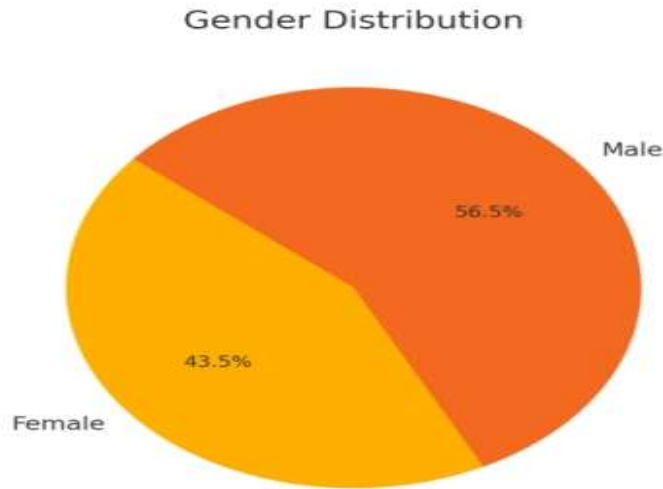
Prolonged intubation times exceeding 10 minutes were noted in 28.2% of cases (35 participants), while 71.8% (89 participants) had intubation completed within 10 minutes. Extended intubation times often reflect anatomical or procedural challenges.

AIRWAY ADJUNCT USED

An airway adjunct was required in 34.7% of cases (43 participants), while 65.3% (81 participants) did not require adjuncts. The use of adjuncts indicates the complexity and difficulty of certain intubations.

frequencies varying across the spectrum, indicating a broad demographic spread.

GENDER DISTRIBUTION



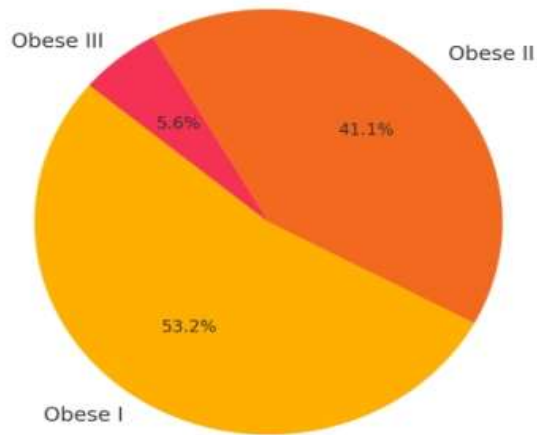
The pie chart depicts the gender distribution of the study participants. There is a higher

proportion of male participants (56.5%) compared to female participants (43.5%).

BMI CATEGORY DISTRIBUTION



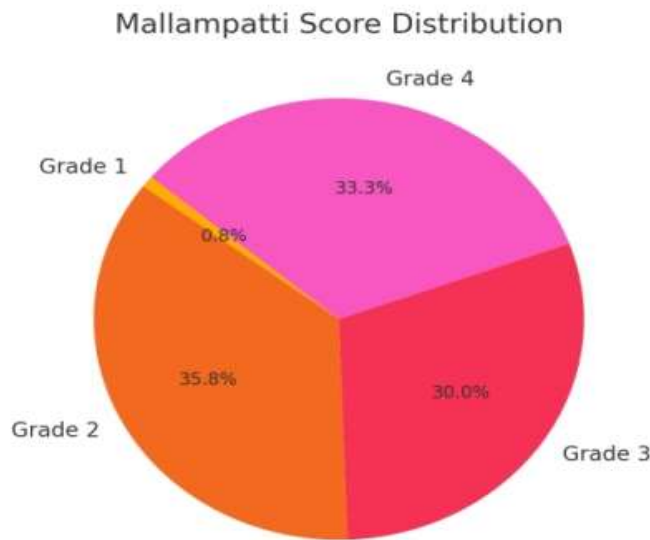
BMI Category Distribution



This pie chart illustrates the distribution of BMI categories among participants. The majority are classified as Obese I (53.2%), followed by Obese II

(41.1%), and a smaller proportion in Obese III (5.6%).

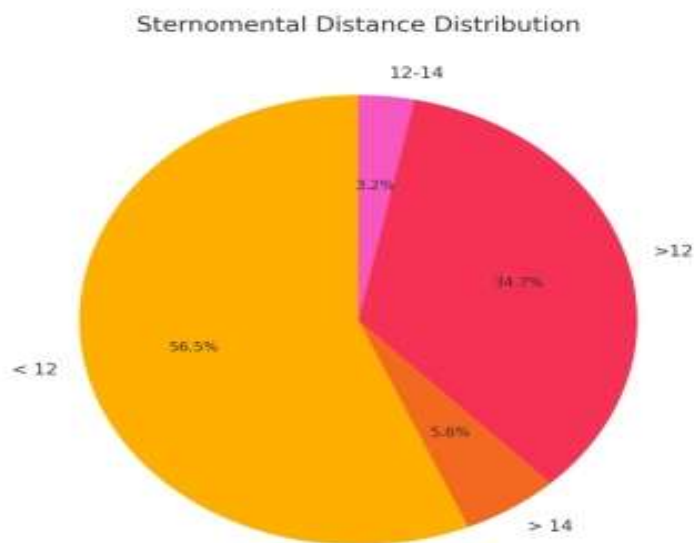
MALLAMPATTI SCORE DISTRIBUTION



This pie chart shows the distribution of Mallampatti scores, a measure used to predict the ease of intubation. The highest frequency is in

Grade 2 (34.7%), followed by Grade 3 (29.0%), with lower frequencies in Grades 1 and 4.

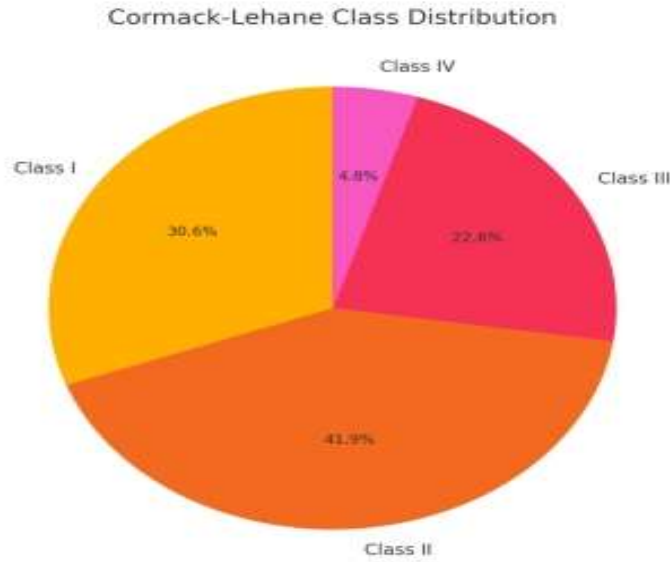
STERNOMENTAL DISTANCE DISTRIBUTION



STERNOMENTAL DISTANCE DISTRIBUTION:

- < 12: 70 occurrences (56.45%)
- > 14: 7 occurrences (5.65%)
- >12: 43 occurrences (34.68%)
- 12-14: 4 occurrences (3.23%)

CORMACK-LEHANE CLASS DISTRIBUTION



CORMACK-LEHANE CLASS DISTRIBUTION:

- Class I: 38 occurrences (30.65%)
- Class II: 52 occurrences (41.94%)
- Class III: 28 occurrences (22.58%)
- Class IV: 6 occurrences (4.84%)

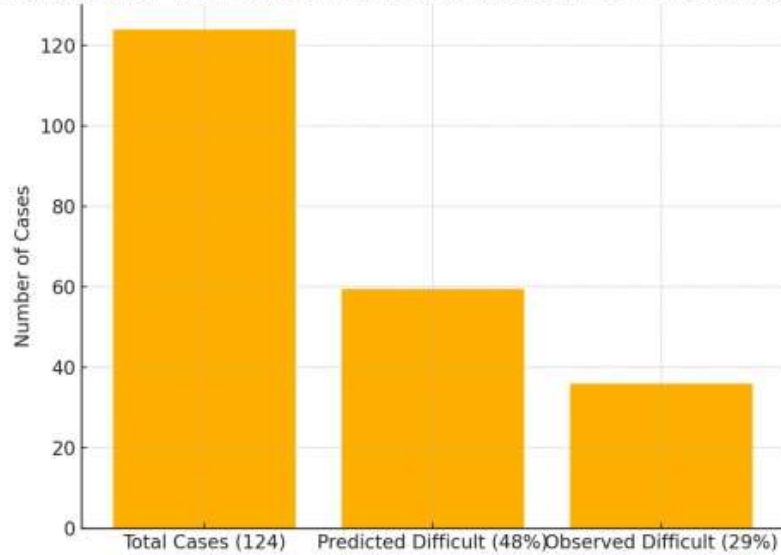
**COMPARISON OF PREDICTED VS OBSERVED DIFFICULT INTUBATIONS
BAR CHART WITH COMPARISON**

The bar chart shows the following:

- Total cases: 124.
- Predicted difficult intubations: 48% (59.52 cases).
- Observed difficult intubations: 29% (36 cases).

This provides a clear representation of how predictions compare to observed data.

Distribution of Total Cases, Predicted and Observed Difficult Intubation:



The graph shows the ratio of predicted difficult intubation to the actual difficult intubation. It includes some bar graphs and data from all 124 participant subjects. These subjects yielded an estimated difficult intubation rate of 48% or 59.52 cases approximately. For this study though, the combined factors set were rather low as it involved intubation lasting more than 10 minutes, three or more than three attempts of tackling with the intubation or the use of an airway adjunct. It was quite evident that 29% was notable, as that equated to a total of around 36 cases. This further showcases the gray areas of predictive modeling and emphasizes on the fact of not relying on a single model with regard to the complication of difficult intubation events. There is an expected further scope of improvement to increase the predictive reliability.

DISCUSSION:

This study included 124 obese adult patients. A substantial number experienced difficult intubations, evidenced by prolonged procedures (28.2%, 35/124 >10 minutes), multiple attempts (29%, 36/124 >3 attempts), and the need for airway adjuncts (34.7%, 43/124). These findings

suggest a high incidence of challenging or failed intubations in this obese cohort. Airway anatomical characteristics further illuminated the difficulties. A considerable proportion exhibited poor oropharyngeal visualization (Mallampati grades 2-4, totaling 93.5%), and a significant number (34.7%) had a sternomental distance less than 12 cm, factors associated with intubation difficulty. This was confirmed by Cormack-Lehane classification, with 41.9% of participants showing a Class II view. These anatomical features contributed to a predicted 48% difficult intubation rate. However, the actual observed rate of difficult intubation (29%) was lower than predicted, as illustrated in the accompanying bar graph comparing predicted versus observed frequencies across all 124 participants. This discrepancy warrants further consideration.

Shailaja et al. (2014) compared ease of intubation in obese and lean patients using the intubation difficulty scale and found significant differences between the two groups. De Jong et al. (2020) emphasized the importance of understanding how to ventilate obese patients in the ICU, highlighting the unique physiological challenges these patients present. According to Thota et al.

(2022), the frequency of difficult intubation in the general population ranges from 0.1% to 13%, but this rate can be substantially higher in obese patients. Akin et al. (2024) used ultrasound to predict difficult airway in morbidly obese patients, demonstrating the utility of imaging techniques in preoperative assessment. Satti (2015) documented the health and economic consequences of overweight and obesity among adults in Pakistan, providing important regional context for this growing public health concern.

Joffe et al. (2019) conducted a closed claims analysis of difficult tracheal intubation management, revealing patterns in anesthesia-related complications that inform current practice. Hagberg et al. (2009) performed a retrospective analysis of airway management in obese patients at a teaching institution, identifying key risk factors that predict intubation difficulty. Magalhães et al. (2013) evaluated simple clinical predictors for preoperative diagnosis of difficult endotracheal intubation in obese patients, finding that straightforward assessment tools can effectively stratify risk. De Jong et al. (2015) specifically examined difficult intubation in obese patients across operating theatres and intensive care units, documenting incidence, risk factors, and complications in these settings.

El-Solh (2004) described the clinical approach to the critically ill, morbidly obese patient, outlining the physiological alterations that complicate airway management. Grassi et al. (2020) detailed the ventilatory mechanics in patients with obesity, explaining how reduced chest wall compliance and decreased functional residual capacity contribute to rapid desaturation. Sิริussawakul et al. (2018) assessed the predictive performance of a multivariable difficult intubation model for obese patients, finding that combining multiple assessment parameters improves prediction accuracy. Cierniak et al. (2016) investigated the degree of intubation difficulties and frequency of complications in obese patients at hospital emergency departments and intensive care units. Dhonneur et al. (2006) compared tracheal intubation techniques in morbidly obese patients using LMA CTrach™ versus direct laryngoscopy, demonstrating the value of alternative airway

devices. Siddiqui et al. (2022) evaluated the diagnostic accuracy of combined Mallampati and Wilson score to predict difficult intubation in obese patients, showing that composite scoring systems enhance predictive value. Frappier et al. (2003) described airway management using the intubating laryngeal mask airway for morbidly obese patients, establishing this technique as a viable alternative in difficult airway scenarios.

Juvin et al. (2003) demonstrated that difficult tracheal intubation is more common in obese than in lean patients, reporting a threefold increase in difficulty. Shaw et al. (2021) conducted a cross-sectional observational study of airway events in obese versus non-obese elective surgical patients, confirming higher complication rates in the obese population. Saasouh et al. (2018) found that the degree of obesity is not necessarily associated with more than one intubation attempt in their large center experience. Zoremba et al. (2009) compared intubation versus laryngeal mask airway in moderately obese adults, providing evidence for alternative airway strategies. Frat et al. (2008) conducted a prospective study on the impact of obesity in mechanically ventilated patients, documenting the physiological consequences of obesity in critical care settings.

This investigation looked into the rate of difficult intubation in a sample of 124 adult obese patients and found a rate of 29%. This value is appreciable, yet it is significantly less than our estimated figure of 48%, which is a cause for concern and needs to be investigated deeper. Our results endorse the fact that having a high body mass index places one at a potential risk for complicated intubation since it was revealed that 29% of the patients were heavily reliant on multiple intubation attempts, 28.2% experienced raised intubation duration and 34.7% required airway adjuncts. This is substantiated by research evidence that reports that intubation for the obese population is three times more demanding than in the general population and up to 14% of obese patients with no other comorbidities need multiple failed intubation attempts, and this rate further increases with the presence of other risk factors.

CONCLUSIONS:

The purpose of the intubation was to maintain or secure the airway of the patient. Furthermore, this study included analysis of difficult intubation in obese patients among 124 subjects. Intubation challenges were of considerable concern during our analysis with 29% of the patients requiring more than 3 attempts, intubations exceeding 10 minutes were noted in 28.2% and airway adjuncts were required in 34.7% of the cases. As the authors state, a high rate of “atypical” anatomy was registered: unsatisfactory visualization of oropharynx, short sternomental distance, and Cormack-Lehane Classification II – III views were observed. As per the authors, it is well known that obesity is a well recognized factor associated with difficult intubation. However, the difficult intubation rate we observed also 29% is lower than our above predicted value of 48%. This highlights the inadequacies of our model to predict the problem. There is clearly a need for better models which cater for multiple determinants apart from just obesity, in order to accurately calculate the odds of a difficult intubation. More work is needed in this area, both to establish these other variables and to enhance prediction of risk.

REFERENCES:

- Akin, S., Yildirim, M., Artaş, H., & Bolat, E. (2024). Predicting difficult airway in morbidly obese patients using ultrasound. *Turkish Journal of Medical Sciences*, 54(1), 262–274.
- Cierniak, M., Sobczak, R., Timler, D., Wiczorek, A., Borkowski, B., & Gaszyński, T. (2016). The degree of intubation difficulties and the frequency of complications in obese patients at the hospital emergency department and the intensive care unit: Case-control study. *Medicine*, 95(52).
- De Jong, A., Molinari, N., Pouzeratte, Y., Verzilli, D., Chanques, G., Jung, B., et al. (2015). Difficult intubation in obese patients: Incidence, risk factors, and complications in the operating theatre and in intensive care units. *British Journal of Anaesthesia*, 114(2), 297–306.
- De Jong, A., Wrigge, H., Hedenstierna, G., Gattinoni, L., Chiumello, D., Frat, J. P., et al. (2020). How to ventilate obese patients in the ICU. *Intensive Care Medicine*, 46(12), 2423–2435. <https://doi.org/10.1007/s00134-020-06286-x>
- Dhonneur, G., Ndoko, S. K., Yavchitz, A., Foucrier, A., Fessenmeyer, C., Pollian, C., et al. (2006). Tracheal intubation of morbidly obese patients: LMA CTrach™ vs direct laryngoscopy. *British Journal of Anaesthesia*, 97(5), 742–745.
- El-Solh, A. A. (2004). Clinical approach to the critically ill, morbidly obese patient. *American Journal of Respiratory and Critical Care Medicine*, 169(5), 557–561.
- Frappier, J., Guenoun, T., Journois, D., Philippe, H., Aka, E., Cadi, P., et al. (2003). Airway management using the intubating laryngeal mask airway for the morbidly obese patient. *Anesthesia & Analgesia*, 96(5), 1510–1515.
- Frat, J. P., Gissot, V., Ragot, S., Desachy, A., Runge, I., Lebert, C., et al. (2008). Impact of obesity in mechanically ventilated patients: A prospective study. *Intensive Care Medicine*, 34(11), 1991–1998.
- Grassi, L., Kacmarek, R., & Berra, L. (2020). Ventilatory mechanics in the patient with obesity. *Anesthesiology*, 132(5), 1246–1256.
- Joffe, A. M., Aziz, M. F., Posner, K. L., Duggan, L. V., Mincer, S. L., & Domino, K. B. (2019). Management of difficult tracheal intubation: A closed claims analysis. *Anesthesiology*, 131(4), 818–829.
- Juvin, P., Lavaut, E., Dupont, H., Lefevre, P., Demetriou, M., Dumoulin, J. L., et al. (2003). Difficult tracheal intubation is more common in obese than in lean patients. *Anesthesia & Analgesia*, 97(2), 595–600.

- Saasouh, W., Laffey, K., Turan, A., Avitsian, R., Zura, A., You, J., et al. (2018). Degree of obesity is not associated with more than one intubation attempt: A large centre experience. *British Journal of Anaesthesia*, 120(5), 1110-1116. <https://doi.org/10.1016/j.bja.2018.01.019>
- Satti, M. N. (2015). *Health and economic consequences of overweight and obesity among adults in Pakistan* (Population & Health Working Paper Series). Pakistan Institute of Development Economics. <http://www.pide.org.pk>
- Shailaja, S., Nichelle, S. M., Shetty, A. K., & Hegde, B. R. (2014). Comparing ease of intubation in obese and lean patients using intubation difficulty scale. *Anesthesia Essays and Researches*, 8(2), 168.
- Shaw, M., Waiting, J., Barraclough, L., Ting, K., Jeans, J., & Black, B. (2021). Airway events in obese vs. non-obese elective surgical patients: A cross-sectional observational study. *Anaesthesia*, 76(12), 1585-1592.
- Siddiqui, K. M., Hameed, F., & Ali, M. A. (2022). Diagnostic accuracy of combined Mallampati and Wilson score to predict difficult intubation in obese patients: A descriptive cross-sectional study. *Anesthesiology and Pain Medicine*, 11(6), 4-10.
- Siriussawakul, A., Maboonyanon, P., Kueprakone, S., Samankatiwat, S., Komoltri, C., & Thanakiattiwibun, C. (2018). Predictive performance of a multivariable difficult intubation model for obese patients. *PLoS One*, 13(8), 1-15.
- Thota, B., Jan, K. M., Oh, M. W., & Moon, T. S. (2022). Airway management in patients with obesity. *Saudi Journal of Anaesthesia*, 16(1), 76-81.
- Zoremba, M., Aust, H., Eberhart, L., Braunecker, S., & Wulf, H. (2009). Comparison between intubation and the laryngeal mask airway in moderately obese adults. *Acta Anaesthesiologica Scandinavica*, 53(4), 436-442.

