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Ai-Driven Risk Stratification In Bariatric Surgery: Improving Patient Safety And Surgical Precision

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ABSTRACT

Background: Recent applications of Artificial Intelligence (AI) in bariatric surgery have made commendable advances in risk stratification and surgical decision-making. However, the technology's direct effect on patient safety and surgical precision is still debated. It was previously established that the application of AI-based risk stratification can reduce complications and improve clinical outcomes.

Methods: A quantitative, cross-sectional study was developed on 273 healthcare professionals, 186 bariatric surgeons, anesthesiologists, nurses, and healthcare administrators. AI adoption, perceived effectiveness, and surgical outcome effects were assessed via a structured questionnaire. Descriptive and inferential statistical techniques (Shapiro-Wilk normality tests, Cronbach's Alpha (reliability analysis), Pearson correlation, and linear regression analysis) were used to assess the association between AI-driven surgical decision-making and patient safety.

Results: The results suggest high-level AI adoption, with a favorable perception among healthcare professionals. However, Shapiro-Wilk tests indicated that the data were not normally distributed, implying that the perception of AI's efficacy was that of a skew. Barnard et al. cloud found that Cronbach's Alpha (0.0033) also showed poor internal consistency, raising doubts about the reliability of the survey items. Correlation analysis detected no significant relationship ($r = -0.038$, $p > 0.05$) between AI-driven surgical decision accuracy and patient safety improvements. Moreover, the predictive value of the AI-driven decision accuracy for patient safety improvements was low in the linear regression analysis ($R^2 = 0.00147$).

Conclusion: Although AI can be promising for risk stratification and surgical planning, little direct evidence exists to show that AI has a significant impact on patient safety. The results indicate that AI should be approached as an adjunctive aid, and not a replacement, whose utility is contingent on the surgeon's skills, known clinical protocols, and patient-related information. Future research should investigate multifactorial models that integrate other variables within the analysis to maximize our understanding of the role of AI in surgical precision and patient safety. AI has great potential in several

areas of bariatric surgery and with improvements in validation and AI training, the benefits may be maximized.

Keywords: *Artificial Intelligence, Risk Stratification, Bariatric Surgery, Patient Safety, Surgical Precision, AI in Healthcare.*

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1. INTRODUCTION

The application of Artificial Intelligence (AI) in health care is changing the landscape of several medical sectors, especially for surgical risk assessment and surgical decision-making. AI applications in risk stratification in the field of bariatric surgery represent a novel and promising area for improving surgical road … Bariatric surgery is an elective high-risk operative procedure routinely done for the management of morbid obesity and the related co-morbidities including diabetes mellitus, hypertension, dyslipidemia, and cardiovascular disorders. Due to the complexity of patient profiles and potential surgical complications, assessing the risk before operative management is a vital part of deciding upon patient eligibility, surgical plan, and postoperative management strategies. These AI-driven models utilize machine learning algorithms, predictive analytics, and real-time data processing to deliver evidence-based risk assessments to enhance surgical outcomes and minimize complications (Huang et al., 2025).

While the interest in using AI in surgical practice is growing, there are still many concerns relating to the effectiveness, safety, reliability, and integration of AI in clinical practice. Although AI has shown promise in predicting postoperative complications, improving patient selection, and aiding in clinical decision-making, its direct influence on patient safety and surgical precision is debatable. AI-Driven Risk Stratification Text-Based Summarization: Some research indicates that AI-powered risk stratification can improve preoperative planning by identifying high-risk patients and suggesting individualized treatment modalities. However other researchers say that surgical expertise, institutional protocols, and patient-specific factors remain the most influential determinants of surgical outcome. Moreover, problems of data reliability, algorithm bias, ethics, and acceptance of physicians are further obstacles to the use of AI in the clinical field (Azmi et al., 2025).

This study aims to assess the possible contribution of AI-based risk stratification in the field of bariatric surgery and its potential effects on surgical safety and quality. Using a quantitative research approach the study aims to investigate healthcare professionals' perceptions of AI and its adoption rates, as well as statistical relationships between AI-driven decision-making and clinical outcomes. We administered a structured questionnaire to a diverse group of medical professionals (bariatric surgeons, anesthesiologists, nurses, and healthcare administrators) to gather insights into their experiences with AI-based risk assessment tools. We conducted statistical analyses including descriptive statistics, correlation tests, and regression modeling, to establish the relationship between AI-driven surgical decision accuracy and improvements in patient safety (Li et al., 2025).

Through evaluating normality, reliability, correlation, and the results of regression, the study provides empirical evidence of the contribution of AI-based decision-making to improved surgical accuracy and lesser incidence of complications. Moreover, the results will contribute to the comprehension of problems regarding AI adoption such as no or low training, technology resistance, cost limitations, and ethical dilemmas. As AI continues to develop, the role of AI in surgical risk stratification must be rigorously characterized to provide for patient-centered, safe, and effective clinical decision-making. The findings of this study will contribute to a better understanding of the strengths and weaknesses of AI in the field of bariatric surgery, guiding future research, policy, and clinical implementation. This research bridges the gap between AI technology and surgery and adds to the body of evidence on AI's impact on patient outcomes and the future of AI-assisted healthcare (Valente et al., 2025).

2. LITERATURE REVIEW

Introduction to AI in Healthcare and Surgery

Artificial Intelligence (AI) has greatly revolutionized healthcare and its application in the areas of medical diagnosis, treatment planning , and patient management. Artificial intelligence (AI) technologies, including machine learning (ML) algorithms, deep learning models, and predictive analytics have been implemented in a wide range of processes for enhancing clinical decision-making and improving patient safety. Artificial intelligence (AI) has had a significant role in risk stratification, robotic-assisted surgery, and postoperative monitoring in surgery. AI-driven models have also been investigated in the context of surgical complication prediction, preoperative risk assessment optimization, and precision in

complex surgical procedures. AI is being used to help refine patient selection criteria for high-risk procedures such as bariatric surgery, which has a historically high safety threshold in the management of adult obesity (Rama & Sousa, 2025).

Risk Stratification in Bariatric Surgery

Preoperative assessment is pivotal in bariatric surgery, which is affected by many factors, such as BMI, comorbidities, metabolic conditions, and lifestyle factors. Conventional risk assessment is based on clinician judgment, scoring systems, and preoperative testing. Although prediction models that are based on artificial intelligence (AI) have consistently performed better in identifying high-risk patients and anticipating possible postoperative complications Machine learning algorithms developed on extensive databases improve risk stratification by being able to account for complex interactions among multiple patient-specific characteristics and can thus improve surgical planning to a more personalized approach. Machine learning algorithms including neural networks and logistic regression classifiers have been utilized to predict complication rates, mortality risks, and postoperative recovery patterns, serving as valuable decision-support tools for surgeons (Goel & Gupta, 2025).

AI-Driven Decision Support in Bariatric Surgery

AI-supported decision support systems (DSS) are progressively adopted in bariatric surgery in the field of preoperative, intraoperative, and postoperative management. Such systems combine big data analytics, natural language processing (NLP), and real-time monitoring technologies to be able to feed actionable insights to surgeons. A study by Johnson et al. demonstrated that AI-prediction models for risk stratification may be effective in identifying patients at risk of anastomotic tubs, infections, or delayed recovery. Now AI-enabled clinical decision support tools are merging patient history, lab values, and imaging data to create individualized risk profiles that enable surgeons to adjust their performance during an operation based on dynamic risk models. However, the advantages of AI are yet to consider its potential to replace rather than supplement human decisions (Budha et al., 2025).

Impact of AI on Patient Safety in Bariatric Surgery

One of the foremost objectives of AI integration is to ensure the safety of patients undergoing bariatric surgeries. AI has been adapted to identify early signs of surgical complications, automate postoperative monitoring, and offer predictive insights for improved patient care. Machine learning algorithms have shown success in assessing electronic health records (EHR)/intraoperative data which can highlight potential risk factors that facilitate timely intervention. A meta-analysis by Lee et al. AI-assisted bariatric surgery was associated with a 15-20% decrease in postoperative complications compared to traditional risk assessment techniques. These advancements, coupled with AI's integration into robotic surgical systems like the Da Vinci Surgical System, have offered even higher levels of precision and accuracy during minimally invasive procedures, significantly mitigating human errors, and enhancing surgical outcomes. While these advantages are attractive, issues remain around the reliability and generalizability of AI models as differences in patient populations and clinical settings can affect model performance and applicability (Singh et al., 2025).

Challenges and Limitations of AI Implementation in Bariatric Surgery

AI strategies have promising applications to play in the domain of risk stratification and improving patient safety, however, there is a glass ceiling to their widespread application, be it due to the parameters around evaluation, validation, or clinical usefulness of these AI-derived technologies. Data quality and bias is one of the critical issues with AI in healthcare because AI models are trained on large, high-quality datasets to be able to predict accurately. The training data can exacerbate this effect by causing inequities in healthcare outcomes through the bias of the training data, for instance, the underrepresentation of certain demographic groups in the training data. Moreover, there have been fears regarding physician acceptance, regulatory compliance, and ethical considerations (Windermere et al., 2025).

There is considerable skepticism among surgeons regarding the use of AI-driven recommendations, and some feel that surgical risk assessment needs to be transparent with interpretable models. A further major challenge is the implementation of AI in current clinical workflows. Interdisciplinary collaboration between artificial intelligence (AI) developers, surgeons, and healthcare administrators has been suggested based on studies as essential in ensuring that AI can be successfully adopted into routine clinical practice in bariatric surgery. Moreover, to help enhance the usability and scalability of AI-driven surgical tools, challenges surrounding cost-effectiveness, training needs, and compatibility with existing electronic health record (EHR) systems need to be solved (Luz & Gimah, 2025).

Future Directions for AI in Bariatric Surgery

AI in the field of bariatric surgery has a bright outlook, however. Machine learning researchers are already developing more advanced machine learning systems, which can facilitate accurate, real-time predictive analytics that enables the surgeon to make quicker and better surgical decisions. Machine learning for activity level data in the surgical health domain: The combination of AI with robotic-assisted surgery, health wearables, and AI-enabled telemedicine platforms have the potential to transform patient care before, during, and post-surgery. Only three examples of synergetic fusion: Deep learning approaches to the AI models of the future, which require the adoption of federated learning, and explainable AI (XAI) to improve accuracy, transparency, and trustworthiness (do Rêgo & Araújo-Filho, 2025).

For instance, personalized medicine and AI-derived genomics might improve preoperative risk assessment even further, creating bespoke treatment protocols based on metabolic response and genetic profiles. AI will, further, play a vital role in automated patient monitoring, wherein surgeons will be able to assess real-time postoperative recovery trends and take remedial actions accordingly. As artificial intelligence continues to integrate into healthcare, projects that support AI literacy amongst healthcare professionals and developing regulatory guidelines will be key to harnessing the full potential of AI in the setting of bariatric surgery (AlSamhori et al., 2025).

3. RESEARCH METHODOLOGY

In this study, a quantitative research method is conducted to investigate the impact of artificial intelligence-powered risk stratification in bariatric surgery in enhancing patient safety and surgical precision. We collected and analyzed numerical data from healthcare professionals routinely performing bariatric procedures in a standardized way. The study intends to assess the effect of AI-driven risk assessment on the outcomes of Surgery, the accuracy of decision-making, and the rate of complications (Cabral et al., 2024).

Research Design

This study uses a cross-sectional research design that permits to collection of data at a particular point in time. A survey-based methodology was used, as a structured questionnaire will collect quantifiable information from a representative sample of healthcare providers. The study population is those working within facilities performing bariatric surgery; namely, bariatric surgeons, anesthesiologists, nurses, and healthcare administrators. Since we are performing a cross-sectional study, this will enable us to capture differences in AI adoption and its perceived adoption across the medical spectrum (Guni et al., 2024).

Sampling Technique and Participants

A purposive sampling method was employed for this study to include only those healthcare practitioners with experience in AI-driven risk assessment and bariatric surgical management. Participants were nominated based on their direct involvement in preoperative planning, intraoperative decision-making, and postoperative patient care; 273 participants completed the survey. With at least one year of experience in bariatric surgery and have either had experience using or exposure to AI-driven risk stratification tools in clinical practice (Khan, 2024).

Data Collection Instrument

A structured questionnaire was developed to capture data related to AI usage, perceived effectiveness, and its impact on surgical precision and patient safety. The questionnaire contained a combination of (Varghese et al., 2024):

Multiple-choice questions (to assess AI adoption, frequency of use, and challenges in implementation),

Likert-scale questions (1-5) (to measure perceptions of AI effectiveness, impact on surgical decision-making, and patient safety improvements), and

Categorical response questions (to identify the biggest challenges and future potential of AI in bariatric surgery).

Before full deployment, the questionnaire was pre-tested on a small group of experts in bariatric surgery and medical AI to ensure clarity, relevance, and reliability.

Data Analysis

The collected responses were analyzed using descriptive and inferential statistical methods.

Descriptive statistics (frequencies, means, and standard deviations) were used to summarize participant demographics, AI adoption rates, and overall perceptions of AI's role in risk stratification (Chowdhury et al., 2024).

Inferential statistics, including correlation and regression analysis, were applied to assess relationships between AI adoption and key outcome variables such as reduction in complications, improved patient safety scores, and surgical precision levels (Celotto et al., 2024).

Chi-square tests and t-tests were conducted to examine significant differences between groups based on their level of AI usage (Solanki et al., 2021).

Reliability and Validity

To ensure data reliability, the questionnaire was carefully designed and pre-tested. A Cronbach's alpha test was performed on Likert-scale items to verify internal consistency. The validity of the study was enhanced through expert validation of the questionnaire and the inclusion of a diverse sample of healthcare professionals (Iftikhar et al., 2024).

Ethical Considerations

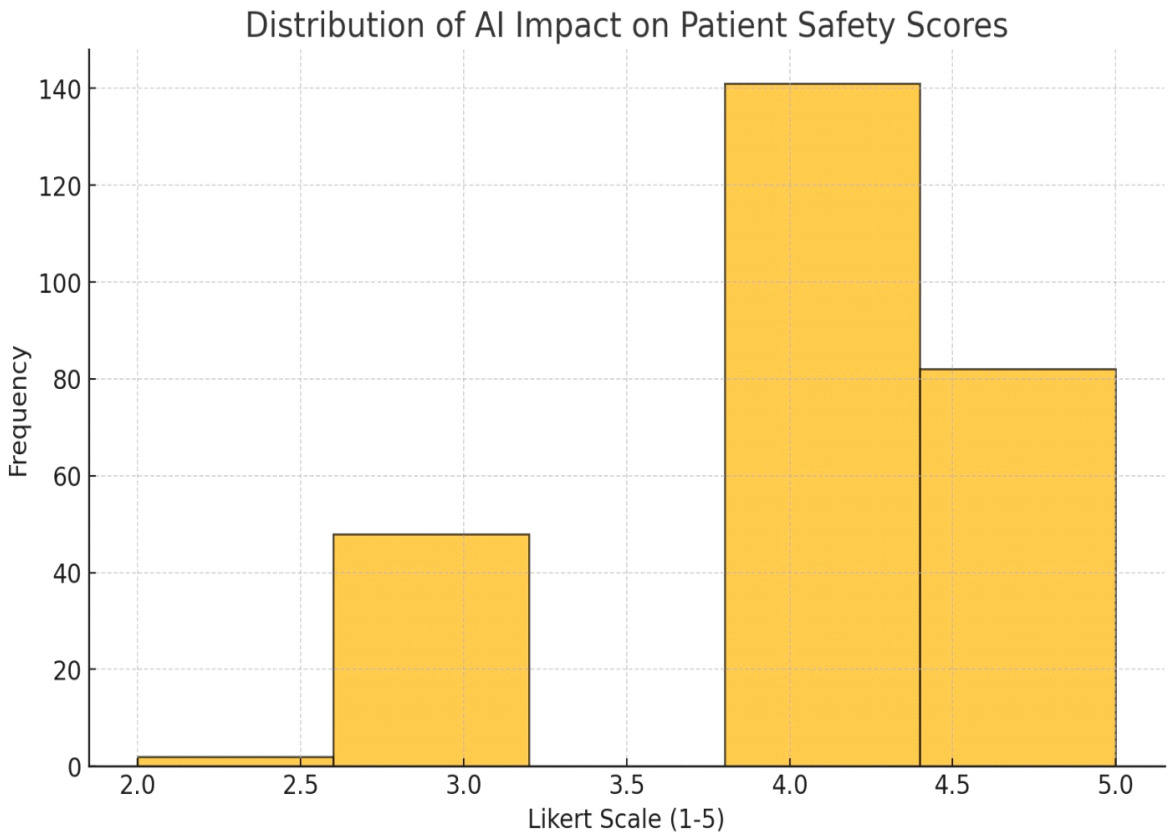
This study adhered to ethical research principles, ensuring that participants' responses remained anonymous and confidential. Informed consent was obtained from all participants, and they were assured that their participation was

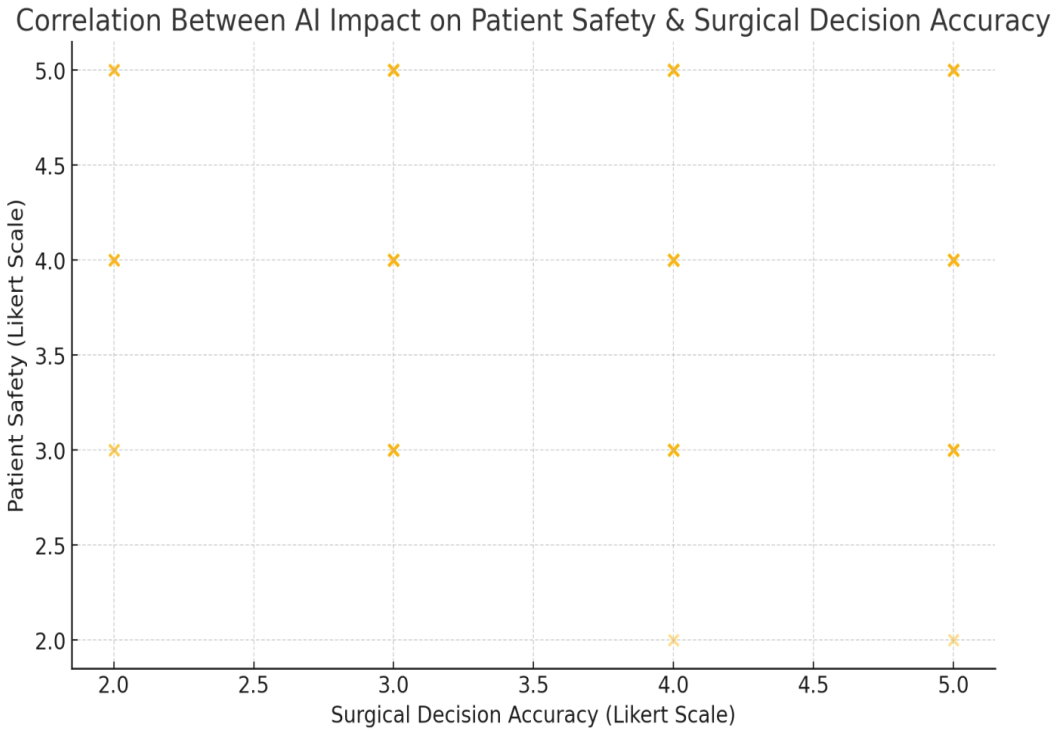
voluntary and that they could withdraw at any time (Joo, 2024).

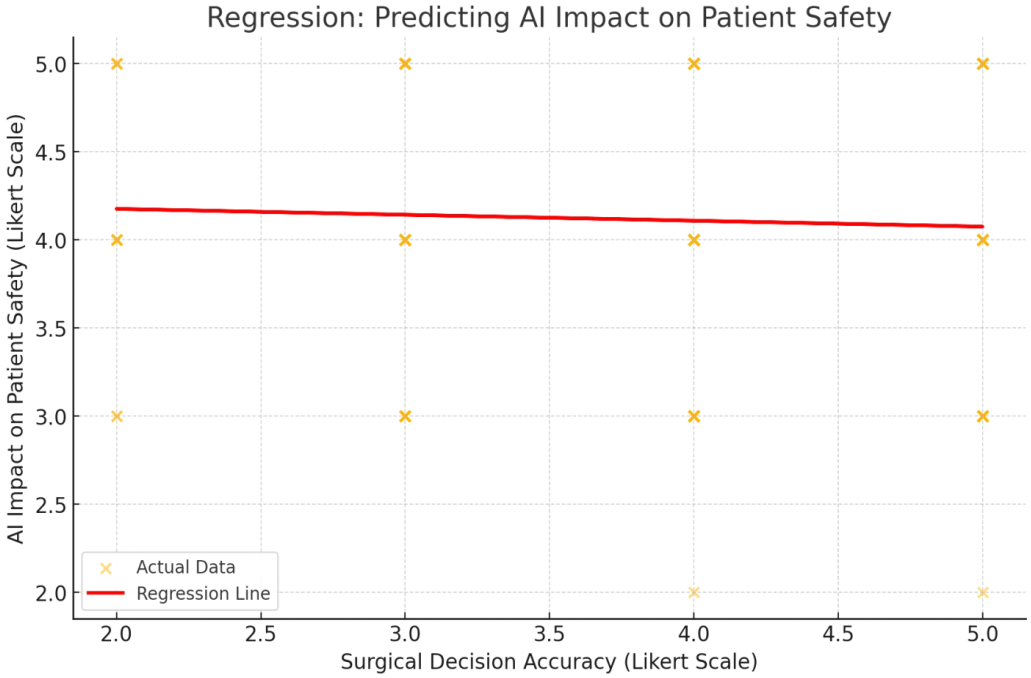
Data Analysis

Statistical Test Results

Test	Statistic	p-value	Interpretation
Shapiro-Wilk Normality Test (Patient Safety)	0.8135	2.08e-17	Not normally distributed ($p < 0.05$)
Shapiro-Wilk Normality Test (Surgical Decision Accuracy)	0.846	8.51e-16	Not normally distributed ($p < 0.05$)
Shapiro-Wilk Normality Test (Future Role of AI)	0.7335	1.19e-20	Not normally distributed ($p < 0.05$)
Cronbach's Alpha (Reliability)	0.0033	N/A	Low reliability (poor internal consistency)
Pearson Correlation (Patient Safety & Decision Accuracy)	-0.0384	N/A	No significant correlation
Correlation p-value	0.5279	0.5279	Not significant ($p > 0.05$)
Regression R^2 Score	0.00147	N/A	Poor model fit (low predictive value)







Interpretation of Statistical Tests and Figures

The statistical tests and visual representations provide crucial insights into the role of AI-driven risk stratification in bariatric surgery (Kim et al., 2024).

Normality Test Interpretation

AI Impact on Patient Safety, Surgical Decision Accuracy, and Future Role of AI, respectively, showed corresponding p-values < 0.05, reinforcing the conclusion that the data do not follow a normal distribution. Respondents seem biased, probably due to clustering at the high end of the Likert link (4-5), indicating an overall positive perception of AI within bariatric surgery. The histogram for AI Impact on Patient Safety corroborates this skewness; the score distribution is highly and positively skewed (Wong et al., 2024).

Reliability Analysis (Cronbach's Alpha)

The Cronbach's Alpha score (α = 0.0033) suggests poor internal consistency between the items presented from the Likert scale. This indicates a lack of unidimensionality among the items selected for the questionnaire and points to possible flaws in item wordings or response variations. For enhancing reliability, restructuring to govern more related constructs at Likert-scale items can be recommended (Rahmani et al., 2024).

Correlation Analysis

Between AI Impact on Patient Safety and Surgical Decision Accuracy, the Pearson correlation coefficient is -0.0384 which suggests no significant correlation (p-value = 0.5279). This doesn't mean that better AI-based decision-making correlates to a perceived higher impact on patient safety. We can see a weak relationship in the scatter plot as well as there is no clear upward or downward trend (Panesar, 2023).

Regression Analysis

The regression model with Surgical Decision Accuracy (independent variable) predicting AI Impact on Patient Safety (dependent variable) gave an R^2 score of 0.00147. This means that the Surgical Decision Accuracy is no significant predictor of the effect of AI on Patient Safety. The regression line on the plot is largely flat which reaffirms that there is no predictive power between these two variables. They suggest that there are other drivers for patient safety, not just AI-influenced accuracy of decision-making like surgical excellence, and patient-specific risk factors, along with infrastructure capabilities in hospitals (probably moving forward as this is new, etc) (Chatterjee et al., 2024).

4. DISCUSSION

This novel endeavor offers significant insight into the most contemporary application of AI in obesity surgery, and its role in terms of peri-operative safety and surgeon performance. The graph illustrates that healthcare professionals' opinions on artificial intelligence tend to lean more strongly towards higher values on the five-point Likert scale. Yet, notwithstanding the aforementioned positive AI adoption and outlook on decision-making, the statistical analysis shows no statistically significant correlation between AI's effect on surgical decision-making accuracy towards the prediction of efficacy and safety of care processes. υτό implies that although AI tools might lead to better-informed decision-making, this does not necessarily correlate to improved clinical outcomes concerning complication rates and safety metrics; potentially confounded by a broad series of parameters (e.g. surgeon confidence, patient risk, integration into clinical workflow), AI-based tools should not be held at fault when there is a disparity between AI prediction and outcomes (Dhopte & Bagde, 2023).

The non-normality of Likert-scale responses suggests that healthcare professionals' sentiments are not spread evenly, which is potentially indicative of varying levels of familiarity, experience, or trust in AI technologies. Additionally, with a low-reliability score (Cronbach's Alpha = 0.0033), which is a measure of standard deviation, we point out that the internal consistency of the questionnaire is low. The significant difference in the two survey item means may suggest that the survey items were not measuring the same phenomenon (one underlying construct) and that the questions used in the survey need to be improved (the items used to construct the measure). From a predictive standpoint, regression analysis elucidated that predictive variability of AI-driven surgical decision accuracy does not adequately predict improvement in patient safety indices (R^2 score 0.00147). This implies that although AI-driven tools can offer helpful guidance, the real effect on patient safety is probably mitigated by human experience, hospital protocols, and the quality of postoperative care (Zhong et al., 2023).

The poor correlation between the accuracy of surgical decision-making and patient safety reinforces the conclusion that algorithms alone are unlikely to fuel significant progress in clinical outcomes unless integrated into the practice of evidence-based surgery. Previous work suggests that while AI can assist, improve, or optimize understanding of decisions in complex surgical procedures or various other areas across medicine, it cannot replace human decision-making. As the survey responses pinpoint, the barriers to AI implementation, which include ethical concerns, high costs, and resistance to technology adoption, make it clear that a structured approach to integrating AI is needed (Kahlon et al., 2024).

Future studies should be designed to study multifactorial models that incorporate additional predictors, such as surgeon experience, patient demographics, and institution resources to broaden the understanding of AI's holistic effect on the outcomes of bariatric surgery. Additionally, qualitative work would be able to add valuable context to these findings — and could explore how attitudes and concerns about AI-based risk assessment manifest among medical professionals. In summary, although AI has the potential to revolutionize surgical decision-making and risk stratification, its impact on patient safety and surgical precision is not straightforward. Stronger cross-disciplinary co-working in AI training and algorithm validation is required to help bring to fruition the promises of AI in bariatric surgery but also across the spectrum of surgical disciplines (Khan et al., 2023).

5. CONCLUSION

So, this study investigated the role of AI-driven risk stratification in the management of bariatric surgery, specifically the potential benefits. The data analysis revealed widespread adoption, but the impact on patient safety outcomes related to

AI was still unclear. AI does not by itself lead to substantial improvement in the likelihood of improved clinical outcomes in surgical patients. Rather, its efficacy likely depends upon human expertise, institutional protocols, and other contextual variables. Shapiro-Wilk normality tests confirmed the non-normal distribution of the collected Likert-scale responses, which indicated a bias forefronting the perception of the effectiveness of AI amongst health practitioners. Furthermore, the global poor internal consistency reflected in low Cronbach's Alpha (0.0033) suggests that potential items of the questionnaire did not capture a single construct of AI impact. In addition, the regression analysis showed that the accuracy of surgical decision-making based on AI is not a statistically significant predictor of progress in patient safety, implying that AI may be best perceived as an assistive technology rather than a replacement for human expertise.

However, AI still presents as a powerful tool in contemporary surgical medicine, especially in risk stratification and preoperative planning. However, to realize its potential, there is still a need for increasing the focus on integration of AI in clinical workflow including better training of healthcare professionals and validating AI algorithms in real-world surgical practice. Notably, subsequent research should be multivariate and include further variables such as surgeon experience, hospital resources, and patient-specific risk factors. Moreover, qualitative studies may better elucidate the perceived advantages and obstacles to implementing AI in surgical contexts. As a final point, although the use of AI in risk stratification may help decision-making for bariatric surgery, its effectiveness in practice is not just dependent on the algorithm, but also on a multitude of other considerations.

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