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Influence of a checklist-based management model on postoperative complication rates and hospitalization time after metabolic and bariatric surgery

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KEY WORDS

checklist management protocol, length of hospital stay, metabolic and bariatric surgery, postoperative complications

ABSTRACT

INTRODUCTION Metabolic and bariatric surgery (MBS) is associated with various postoperative complications and extended hospital stays. Standardized management protocols may enhance patient outcomes.
AIM This study aimed to evaluate the impact of a checklist-based management protocol on postoperative recovery, length of hospital stay (LOS), and complication rates in patients undergoing laparoscopic MBS.
MATERIALS AND METHODS A retrospective analysis was conducted on 209 patients who underwent laparoscopic MBS between December 2021 and December 2022. The patients were divided into 2 groups based on the perioperative management protocol used. The observational group (n = 112) received checklist-based management, while the control group (n = 97) received standard care. Primary outcomes included LOS, time to first flatus, and time to first mobilization. Secondary outcomes comprised postoperative complications classified according to the Clavien–Dindo scale, postoperative nausea and vomiting (PONV), and analgesic consumption. Health literacy and self-efficacy were assessed using the Newest Vital Sign (NVS) questionnaire and the Self-Rated Abilities for Health Practices (SRAHP) scale.
RESULTS The observational group demonstrated shorter median (interquartile range) LOS (4 [4–5] vs 6 [5–7] d; $P < 0.001$), earlier mean (SD) first flatus (36.76 [10.23] vs 48.32 [12.62] h), and shorter mean time to first mobilization (12.58 [4.68] vs 18.5 [6.29] h), as compared with the control group. The total complication rate was lower in the observational group (4.46% vs 16.49%; $P = 0.004$), and this cohort also showed lower incidence of PONV and reduced analgesic consumption in comparison with the controls. There were no intergroup differences in the NVS or SRAHP scores before application of the checklist-based management, but postmanagement, the observational group scored higher.
CONCLUSIONS Checklist-based perioperative management was associated with improved postoperative recovery, reduced complications, as well as enhanced health literacy and self-efficacy in the patients undergoing MBS.

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INTRODUCTION Obesity and related metabolic diseases have become a major global problem, seriously threatening human health. It is an important risk factor for multiple chronic diseases, including type 2 diabetes mellitus (T2DM), cardiovascular disease, and nonalcoholic fatty liver disease.[1] The prevalence of obesity continues to increase dramatically worldwide, impeding progress in reducing cardiovascular disease incidence rates.[2] Metabolic and bariatric surgery (MBS) is widely recognized as the most effective and durable evidence-based treatment for obesity currently available.[3] However, patients undergoing MBS have high rates of postoperative complications, making effective perioperative management crucial for improving outcomes. Studies

TABLE 1 Checklist-based perioperative management protocol for metabolic and bariatric surgery patients

Stage	Domain	Checklist item	Responsible staff
Preoperative	Patient preparation	• Completing admission and providing education manual[a]; • Documenting preoperative examination results	Bariatric nurse coordinator
	Clinical assessment	• Completing laboratory tests and communicating surgical plan; • Providing education on the procedure and obtaining informed consent[a];	Metabolic surgeon and bariatric nurse coordinator
	Optimization	• Nutritional preparation: 6-h fast, carbohydrate drink 2 h preoperatively; • Psychological counseling and family support[a]	Bariatric nurse coordinator
Intraoperative	Safety and monitoring	• Verifying patient identity, surgical site, and prophylactic antibiotics; • Monitoring vital signs at 15-min intervals; • Ensuring hemodynamic stability before transfer to the ward	Surgical team and OR nurse
Postoperative	POD 0	• Administering antibiotics, antiemetics, and multimodal analgesia; • Respiratory care: airway management and oxygen monitoring; • Early mobilization: sitting within 4–6 h, ambulation ≥3 times; • Monitoring for complications (bleeding, leak, respiratory distress)	Metabolic surgeon and bariatric nurse coordinator
	POD 1–3	• Continuing medications and advancing oral intake; • Progressive ambulation 4–6 times daily; • Venous thromboembolism prophylaxis and wound inspection; • Health literacy and self-efficacy education[a]	Metabolic surgeon and bariatric nurse coordinator
	POD 4–5 (discharge)	• Performing contrast examination if indicated; • Discharge education: diet, physical activity, medications, warning signs[a]	Metabolic surgeon and bariatric nurse coordinator
Postdischarge	Follow-up	• Weekly telephone/WeChat follow-up (first month)[a]; • Monthly follow-up thereafter; • Enrolling in a support group[a]	Bariatric nurse coordinator

a Checklist items directly addressing patient education

Abbreviations: OR, operating room; POD, postoperative day

have found that obesity is associated with higher rates of infection, venous thromboembolism, and renal failure.[4-6] Current clinical management still faces challenges, such as low standardization and delayed risk identification, urgently requiring an establishment of scientifically effective management models.

Checklist-based management, as a systematic quality improvement tool, has been widely applied in clinical practice. The World Health Organization (WHO) Surgical Safety Checklist has demonstrated beneficial impacts on various patient and team outcomes.[7] Surgical checklists are associated with increased detection of potential safety hazards, fewer surgical complications, and improved communication among operating staff.[8] Implementation of the WHO Surgical Safety Checklist significantly reduces perioperative mortality and complication rates.[9] In bariatric surgery, pre- and intraoperative checklists are commonly used as safety tools to standardize care and identify high-risk patients.[10] However, research on postoperative checklist management models in MBS is relatively scarce.

AIM This study investigated the impact of a checklist management model on postoperative complications and length of hospital stay (LOS) in 209 MBS patients. By establishing standardized postoperative protocols, we aimed to improve nursing quality, reduce complication rates, and develop an optimized perioperative care approach with a comprehensive clinical value. The findings provide evidence-based support for establishing a scientific and standardized nursing system for MBS, demonstrating significant clinical applicability.

MATERIALS AND METHODS **Study design** This retrospective cohort study was conducted at the Fourth Affiliated Hospital of China Medical University, a tertiary care center specializing in MBS. The study analyzed consecutive patients who underwent MBS between December 2021 and December 2022. All procedures were conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of The Fourth Affiliated Hospital of China Medical University (2025053632289), and the requirement for informed consent was waived due to the retrospective nature of the study and the use of de-identified data.

Patient selection and group allocation A total of 209 patients undergoing MBS were included in the analysis. The patients were allocated into 2 groups based on the perioperative management protocol that was in effect at the time of their surgery. The observational group (n = 112) underwent surgery between July and December 2022 and received structured checklist-based management, and the control group (n = 97) underwent surgery between December 2021 and June 2022, following standard perioperative care protocols.

Inclusion criteria comprised: 1) body mass index (BMI) below 27.5 kg/m^2 and fulfillment of the 2019 Chinese Guidelines for Surgical Treatment of Obesity and Type 2 Diabetes[11,12]; 2) age of 18 years or older; 3) primary bariatric / metabolic procedure performed laparoscopically; and 4) complete medical records available for analysis. Exclusion criteria encompassed: 1) severe cardiac disease or active malignancy; 2) significant hepatic, renal, pulmonary, or cardiac dysfunction; 3) transfer to another facility or incomplete follow-up; 4) psychiatric illness or current sedative therapy precluding reliable assessment; 5) revisional or emergency bariatric procedures or conversion to open surgery; and 6) incomplete medical records or missing key outcome data.

Perioperative management protocols Observational group The patients in the observational group received care under a newly-implemented checklist--based management protocol. A multidisciplinary team led by a senior bariatric head nurse and co-managed by a dedicated metabolic surgeon was established. It included 5 certified bariatric nurses, 1 clinical dietitian, and 1 rehabilitation therapist. Within 24 hours of admission, the team had a bedside conference to review the patient's chart and operative plan, translate these into perioperative objectives, and allocate specific tasks to individual team members. Drawing from the Guidelines for Perioperative Care in Bariatric Surgery (Enhanced Recovery After Surgery [ERAS] Society Recommendations)[13,14] and Clinical Practice Guidelines for the Perioperative Nutrition, Metabolic, and Nonsurgical Support of Patients Undergoing Bariatric Procedures,[15] we tailored perioperative goals to each patient, and created a checklist whose items were individually assigned to the team members, ensuring precise and efficient execution. The checklist (**TABLE 1**) comprised standardized items organized into pre-, intra-, and postoperative phases. The multidisciplinary team conducted formal reviews every 72 hours to examine adherence, identify gaps in the preceding care cycle, and refine the protocol.

Control group The control group patients received standard perioperative care that was routinely practiced at our institution prior to the checklist protocol. After admission, baseline indicators were measured, and the patients were briefed on disease origins, symptoms, treatment modalities, the planned operation, and surgical precautions. Instructions for preoperative fasting and fluid restriction were delivered 1 day prior to surgery. The participants were transferred to the operating room 3 hours before the procedure. Postoperatively, the patients were assisted with early mobilization, prescribed antibiotics and additional medications, and placed on individualized hydration regimens. Vital sign monitoring, pain management, and antiemetic therapy followed the standard institutional protocol. Post-surgery education was provided on the day preceding discharge, supplemented by monthly telephone follow-up.

Outcome measures Demographic and clinical characteristics Demographic data, including sex, age, body weight, and BMI, were extracted from the electronic medical records. Clinical information on comorbidities, such as T2DM, hypertension, dyslipidemia, obstructive sleep apnea, and fatty liver disease, was collected. Surgical characteristics, including the type of bariatric procedure performed (laparoscopic sleeve gastrectomy or laparoscopic Roux-en-Y gastric bypass), American Society of Anesthesiologists (ASA) physical status classification, operative time measured from skin incision to closure, and estimated intraoperative blood loss were recorded by the anesthesiology team.

Postoperative complications Postoperative complications, understood as evaluation of all surgery--related adverse events occurring from the patient's return to the ward after surgery until discharge, were closely monitored. All complications were classified according to the Clavien–Dindo grading system: grade I (deviation from normal course without pharmacologic treatment), grade II (requiring pharmacologic treatment), and grade III (requiring surgical, endoscopic, or radiological intervention). The postoperative complication rate was counted using the patient-unit method (where each patient is counted only once regardless of the number of complications). Complication rate (%) = (number of patients with complications / total number of observed cases) × 100.

Recovery outcomes LOS was defined as the total number of calendar days from the date of surgery to the date of discharge, calculated as discharge date minus surgery date.

Time to first flatus was defined as the interval in hours from the completion of surgery (skin closure) to the first documented passage of gas per rectum, as reported by the patient and recorded by the nursing staff.

Time to first mobilization was defined as the time in hours from the completion of surgery to the first instance of independent ambulation, documented as the patient walking for a minimum of 10 meters without physical assistance, as observed and recorded by the bedside nurse.

Postoperative nausea and vomiting (PONV) were defined as the occurrence of nausea, vomiting, or retching within 48 hours following surgery, requiring administration of rescue antiemetics beyond routine prophylaxis, as documented in the nursing records. PONV incidence was recorded as a binary outcome (present or absent).

Analgesic consumption was quantified as the total amount of opioid medications administered from the end of surgery until 48 hours postoperatively. All opioid medications were converted

TABLE 2 Demographic and clinical characteristics of the study population

Characteristic		Observational group (n = 112)	Control group (n = 97)	*P* value
Age, y		37.23 (9.14)	36.45 (8.72)	0.53
Sex	Men	52 (46.43)	42 (43.3)	0.7
	Women	60 (53.57)	55 (56.7)	
BMI, kg/m^2		39.12 (5.78)	38.67 (5.43)	0.57
Comorbidities	Type 2 diabetes mellitus	38 (33.93)	31 (31.96)	0.76
	Hypertension	54 (48.21)	45 (46.39)	0.79
	Dyslipidemia	41 (36.61)	38 (39.18)	0.7
	Obstructive sleep apnea	28 (25)	22 (22.68)	0.7
	Fatty liver disease	67 (59.82)	56 (57.73)	0.76
Surgical procedures	Laparoscopic sleeve gastrectomy	87 (77.68)	73 (75.26)	0.68
	Laparoscopic Roux-en-Y gastric bypass	25 (22.32)	24 (24.74)	
ASA class	I–II	65 (58.04)	58 (59.79)	0.89
	III	47 (41.96)	39 (40.21)	
Operative time, min		115.6 (23.2)	118.3 (24.7)	0.42
Estimated blood loss, ml		30 (20–45)	30 (20–50)	0.6

Data are presented as number (percentage) or mean (SD).

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index

TABLE 3 Postoperative recovery outcomes

Outcome	Observational group (n = 112)	Control group (n = 97)	*P* value
Length of hospital stay, d	4 (4–5)	6 (5–7)	<0.001
Time to first flatus, h	36.76 (10.23)	48.32 (12.64)	<0.001
Time to first mobilization, h	12.58 (4.68)	18.5 (6.29)	<0.001
Postoperative nausea and vomiting, n (%)	24 (21.43)	38 (39.18)	0.005
Analgesic consumption, mg	10 (6–16)	18 (12–26)	<0.001

Data are presented as mean (SD) or median (interquartile range) unless indicated otherwise.

to oral morphine milligram equivalents (MMEs) using standard conversion factors: intravenous morphine (× 3), oral oxycodone (× 1.5), intravenous fentanyl (× 0.1 per μg), and tramadol (× 0.1). Nonopioid analgesics (paracetamol, nonsteroidal anti-inflammatory drugs) were not included in the MME calculation, but were administered as part of multimodal analgesia protocols in both groups.

Health literacy and self-efficacy outcomes Health literacy was assessed using the Newest Vital Sign (NVS) questionnaire, a 6-question health literacy assessment tool based on reading a nutrition label. The instructions for scoring the NVS categorize patients into 3 groups, depending on the total number of questions answered correctly. Scores of 0–1 indicate a high likelihood of limited health literacy; scores of 2–3 correspond to the possibility of limited health literacy; and scores of 4–6 indicate adequate health literacy.[16] Health-related self-efficacy was assessed using the Self-Rated Abilities for Health Practices (SRAHP) scale, which measures an individual's confidence (self-efficacy) in their ability to perform health-promoting behaviors.[17] This 28-item instrument evaluates 4 key dimensions: nutrition, exercise, psychological well-being, and health responsibility. Each item is scored on a 5-point Likert scale (where 1 means "not at all confident" and 5 corresponds to "completely confident"), with total scores ranging from 28 to 140. Higher scores indicate greater self-efficacy in health practices.[14] NVS and SRAHP dimensions have demonstrated excellent reliability and validity in medical populations, with the Cronbach α = 0.8 (for health literacy) and 0.74 (for SRAHP dimensions).

Statistical analysis All figures were compiled in Excel (Microsoft, Redmond, Washington, United States) and processed using SPSS Statistics software, version 22.0 (IBM Corp., Armonk, New York, United States). Normality of the data was assessed using the Shapiro–Wilk test. Continuous variables are expressed as mean (SD) for normally distributed data or median with interquartile range (IQR) for non-normally distributed data. Categorical variables are presented as frequencies and percentages. Between-group comparisons for continuous variables were conducted

TABLE 4 Postoperative complications classified according to the Clavien–Dindo scale

Clavien–Dindo grade	Complication	Observational group (n = 112)	Control group (n = 97)	*P* value
Grade I	Seroma	2 (1.79)	4 (4.12)	0.42
	Transient fever	1 (0.89)	3 (3.09)	0.33
	Subtotal	3 (2.68)	7 (7.22)	0.12
Grade II	Wound infection	0	1 (1.03)	0.46
	Thromboembolism	1 (0.89)	2 (2.06)	0.6
	Bowel obstruction (conservative)	1 (0.89)	1 (1.03)	>0.99
	Subtotal	2 (1.79)	4 (4.12)	0.42
Grade IIIb	Intra-abdominal hemorrhage	0	3 (3.09)	0.1
	Anastomotic leak	0	1 (1.03)	0.46
	Bowel obstruction (surgical)	0	1 (1.03)	0.46
	Subtotal	0	5 (5.15)	0.02
Total (grade I–IIIb)	–	5 (4.46)	16 (16.49)	0.004
Total (grade II–IIIb)	–	2 (1.79)	9 (9.28)	0.02

Data are presented as number (percentage).

TABLE 5 Health literacy and self-efficacy before and after perioperative management

Assessment scale	Time point		Observational group (n = 112)	Control group (n = 97)	*P* value
NVS	Before		2 (1–3)	2 (1–3)	0.8
	After		4 (4–6)	3 (2–4)	<0.001[a]
SRAHP	Psychological well-being	Before	19.23 (3.67)	18.67 (3.42)	0.26
		After	23.89 (2.34)	21.34 (2.89)	<0.001[a]
	Exercise	Before	20.12 (4.45)	19.45 (4.21)	0.27
		After	26.45 (3.12	23.12 (3.67)	<0.001[a]
	Nutrition	Before	11.67 (2.67)	11.23 (2.45)	0.22
		After	15.34 (1.89)	13.67 (2.12)	<0.001[a]
	Health responsibility	Before	21.02 (3.94)	20.34 (3.78)	0.21
		After	26.78 (2.87)	24.12 (3.23)	<0.001[a]

Data are presented as mean (SD) or median (interquartile range).

a $P < 0.05$ in comparison with before intervention within the same group

Abbreviations: NVS, Newest Vital Sign; SRAHP, Self-Rated Abilities for Health Practices

using the independent *t* test for normally distributed data and the Mann–Whitney test for non-normally distributed data. Within-group comparisons of pre- and postmanagement scores were performed using the paired *t* test for normally distributed data and the Wilcoxon signed-rank test for non-normally distributed data. For categorical outcomes, the comparisons were made using the χ^2 test or the Fisher exact test. A 2-tailed *P* value below 0.05 was considered significant for all analyses.

RESULTS **Study population characteristics** Baseline characteristics of the groups are presented in **TABLE 2**. No significant intergroup differences were observed in demographic variables (age, sex, body weight, and BMI), comorbidities (T2DM, hypertension, dyslipidemia, obstructive sleep apnea, fatty liver disease, and a family history of diabetes), or surgical characteristics (procedure type, ASA classification, operative time, and estimated blood loss), indicating comparable baseline status of the 2 groups.

Recovery outcomes Postoperative recovery indicators are presented in **TABLE 3**. The observational group demonstrated shorter LOS than the control group ($P < 0.001$). Time to first flatus ($P < 0.001$) and time to first mobilization ($P < 0.001$) were also markedly reduced in the observational group, as compared with the control group, indicating enhanced early postoperative recovery with the checklist-based protocol. The incidence of PONV was lower in the observational group than in the controls (21.43% vs 39.18%; $P = 0.005$). Additionally, median (IQR) postoperative analgesic consumption was reduced in the observational group (18 [12–26] vs 10 [6–16] mg of morphine equivalent; $P < 0.001$).

Postoperative complications The incidence and distribution of postoperative complications are presented in **TABLE 4**. Total complication rate (grade I–IIIb) was 4.46% in the observational and 16.49% in the control groups ($P = 0.004$), while grade II–IIIb complication rates were 1.79% and 9.28%, respectively ($P = 0.02$). Grade I complications (seroma and transient fever) occurred in 3 patients from the observational group (2.68%) and 7 controls (7.22%; $P = 0.12$). Grade II complications requiring pharmacologic treatment, including wound infection, thromboembolism, and conservatively managed bowel obstruction, occurred in 2 patients from the observational group (1.79%) and 4 controls (4.12%; $P = 0.42$). No grade IIIb complications (including intra-abdominal hemorrhage, anastomotic leak, and surgically treated bowel obstruction) requiring surgical intervention under general anesthesia occurred in the observational group, whereas in the control cohort, 5 patients (5.15%) experienced such complications ($P = 0.02$).

Health literacy and health practice self-efficacy The effects of the management on health literacy and health practice self-efficacy are shown in **TABLE 5**. At baseline, no differences were observed between the groups in terms of NVS scores or any dimensions of SRAHP subscales (all $P > 0.05$). Following the management, both groups demonstrated improvements in all measured outcomes, as compared with baseline values (all $P < 0.05$). However, the observational group achieved higher scores than the control group across all measures. The NVS scores increased to a median (IQR) of 4 (1–3) in the observational and 3 (2–4) in the control groups ($P < 0.001$). For SRAHP subscales, the observational group showed superior improvements in psychological well-being, exercise, nutrition, and health responsibility than the control cohort (all $P < 0.001$).

DISCUSSION MBS is an effective treatment for obesity and related metabolic diseases. In recent years, with the continuous development and increase in the number of MBS surgeries performed, perioperative nursing management has received increasing attention. Choosing a perioperative management model with higher quality helps consolidate clinical treatment effects and provides patients with more comfortable and efficient perioperative care.[18] To further improve the quality of clinical management, setting specific nursing goals offers guidance for clinical management development, standardizes nursing workflows, and promotes early postoperative rehabilitation.[19] Recent expert consensus has also emphasized that a multidisciplinary approach with standardized protocols is essential in ensuring safer care for patients with severe obesity.[20]

This study found a lower incidence of complications in the observational group, as compared with the control group ($P < 0.05$). This suggests that implementing a checklist management model can effectively reduce postoperative complications and adverse events during clinical perioperative nursing, which aligns with earlier research.[21] According to Pinnock et al[22] and Li et al,[23] checklist management is characterized by logic, systematization, and standardization. By outlining perioperative nursing tasks, it helps prevent omissions in nursing procedures and ensures the achievement of various nursing objectives. Clinically, for patients undergoing MBS, checklist management specifies nursing workflows and the specific care tasks assigned to each team member at different perioperative stages. Detailed nursing arrangements and accountability at various postoperative intervals ensure proper implementation of tasks and reduce the risk of complications. Complications, such as hemorrhage and anastomotic leak, are primarily technique-dependent; however, a checklist may exert indirect effects through preoperative optimization, intraoperative safety verification, and early postoperative surveillance that enables prompt detection before minor issues progress to severe events. The observed reduction in grade IIIb complications (5.15% in the control vs 0% in the observation group) should be interpreted with caution given the small sample size. Similar findings have been reported in other newly established bariatric programs, where grade IIIb complications decreased from 7.69% to 0.97% over 3 years through careful planning and protocol adherence.[24] A nationwide survey also demonstrated that standardized care protocols were associated with improved compliance and outcomes in bariatric surgery.[25]

In our study, recovery outcomes in the observational group were superior to those of the control group, as the patients experienced shorter LOS, earlier time to first flatus, and earlier first ambulation ($P < 0.05$). These results align with those of Zhang et al,[26] who reported that average LOS and time to first flatus in the ERAS group was shorter than in the control cohort. The results showed that the application of a checklist management model can enhance postoperative rehabilitation efficiency and promote rapid recovery after surgery. In line with that, Guo et al[27] stated that metabolism following MBS can be effectively managed through a checklist management model, which allows for dynamic monitoring of metabolic reactions. The lower incidence of PONV and reduced analgesic consumption found in the observational group may reflect the benefits of protocolized antiemetic prophylaxis and early mobilization.

Additionally, the observational group scored significantly higher than the controls on the health-knowledge test and SRAHP. This suggests that checklist-driven management not only expands patient knowledge, but—more importantly—translates theory into observable and sustainable behavior, as the patients became more willing to monitor their blood glucose levels, adhere to dietary prescriptions, and mobilize early, thereby markedly enhancing self-efficacy. Preoperative sessions focused on surgical procedures and risk disclosure, day-of-surgery education emphasized anesthesia cooperation and early-mobilization scenario, and postoperative training centered on pain assessment, nutritional intake, and complication recognition. This staged information delivery may help patients construct a coherent knowledge–skill framework, thereby improving health literacy and self-efficacy.[28]

Limitations This study has several limitations that warrant consideration. As it is a single-center investigation, the findings may reflect institution-specific practices and patient characteristics, potentially limiting generalizability to other health care settings with different resources or patient populations. The relatively modest sample size, although adequate for detecting differences in complication rates, may have constrained the ability to perform subgroup analyses by procedure type, or to identify associations with less common adverse events. The absence of long-term follow-up prevents evaluation of whether the benefits of checklist management persist beyond the immediate postoperative period or influence outcomes, such as weight loss maintenance and metabolic disease control, at 1 year or beyond. Additionally, while the checklist encompassed multiple perioperative domains, granular analyses to determine which checklist components contributed most substantially to improved outcomes were not conducted. Future investigations employing multicenter designs with larger cohorts would strengthen the evidence base and enhance external validity of the findings. Extended follow-up studies are needed to assess the durability of improvements in patient self-efficacy and clinical outcomes. Exploring the relative impact of individual checklist elements through component analysis or factorial designs could inform more targeted and resource-efficient quality improvement strategies in bariatric surgery programs.

CONCLUSIONS This study suggests that checklist-based perioperative management is associated with shorter LOS, earlier functional recovery, reduced postoperative complications, and improved health literacy and self-efficacy among patients undergoing MBS. Prospective multicenter trials with larger sample sizes are needed to confirm these observations and assess the long-term durability of these benefits.

ARTICLE INFORMATION

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