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Postoperative ileus and associated factors in patients following major abdominal surgery in Ethiopia: a prospective cohort study

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Abstract

Background Postoperative ileus is a complication of abdominal surgery, resulting in significant morbidity and patient discomfort, dissatisfaction, and great economic burden. However, clinical studies regarding POI are very limited in Ethiopia and other Sub-Saharan countries. The main objective of this study is to assess the incidence and associated factors of postoperative ileus among adult patients who underwent abdominal surgery at hospitals in Northwest Ethiopia.

Methods and materials A multicenter hospital-based prospective cohort study was conducted on patients who underwent major abdominal surgeries at specialized hospitals in Bahir Dar from November 20, 2023, to January 20, 2024. A total of 252 were selected by consecutive sampling techniques and included in the final analysis. Data were collected using EpidData version n4.6 and analyzed by STATA version 17. Bivariable and multivariable binary logistic regression were fitted to identify the explanatory variables.

Results The incidence of postoperative ileus at hospitals in Bahir Dar was 16.27% (95% CI: 12.19%, 21.38%). Age > 60 years (adjusted odds ratio (AOR) = 3.81, 95% CI: 1.41, 10.33), BMI < 18.5 kg/m^2 (AOR = 11.54, 95% CI: 67.55), and intestinal surgery (AOR = 3.27, 95% CI: 1.01, 11.77) were significantly associated with postoperative ileus. On the other hand, being female was associated with a decreased likelihood of postoperative ileus (AOR = 61%, AOR = 0.39, 95% CI: 0.15, 0.97).

Conclusion Postoperative ileus among patients who underwent major abdominal surgery in Bahir Dar was comparable with global reports. Old age, low body mass index, and intestinal surgeries were significant determinant factors for postoperative ileus. Being female is associated with a decreased likelihood of postoperative ileus.

Keywords Postoperative ileus, Morbidity, Abdominal surgery, Ethiopia

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Background

Postoperative ileus (POI) is a temporary impairment of gastrointestinal motility after surgical intervention due to nonmechanical causes and is characterized by abdominal distention, lack of bowel sounds, accumulation of gas and fluids in the bowel, and delayed passage of flatus and defecation that prevents sufficient oral intake [1, 2]. This unwanted postoperative clinical condition has been shown to increase perioperative morbidity such as. Pneumonia, prolonged wound healing, and elevated risk of anastomotic leak and sepsis, in return, these morbidities increase the length of a hospital, 30-day readmission, and mortality [3–5]. Moreover, POI has a significant financial impact, with a 66.3% increase in total hospital costs if patients develop POI [5].

According to a report from the United States of America, approximately half of patients who underwent major abdominal surgery had developed paralytic ileus postoperatively [6]. The incidence of postoperative ileus after colorectal surgery ranges from 10 to 30% [4], while 13.5% of patients who underwent surgery for colorectal cancer develop postoperative ileus [7]. Among patients who underwent gynecologic surgery, orthopedics surgery, and open cardiac surgery, the incidence of POI is reported to be 9.2% [8], 2.1% [9], and 0.88% [10], respectively. Variability in definitions and diagnostic criteria across studies contributes to a variable incidence range of POI in the literature.

Despite existing ambiguity in the clinical definition, identifying risk factors for POI is difficult. Published data frequently reported male gender, advanced age, and major blood loss as factors associated with a higher risk of POI reported numerous risk several published data difficult [11, 12]. Furthermore, higher body mass index, American Society of Anesthesiologists physical status score, and Clavien–Dindo scale were significant predictors for POI [11, 13, 14]. Surgical duration, perioperative opioid use, and type of surgery are also important determinant factors for POI [15–18].

Clinical studies regarding POI are very limited in Ethiopia and other Sub-Saharan countries, which render the implementation of evidence-based practice to tackle this significant problem. Therefore, this study aimed to assess the incidence and associated factors of POI among patients who underwent major abdominal surgeries at Tibebe Gihon Specialized Hospital (TGSH) and Felege Hiwot Comprehensive Specialized Hospital (FHCSH), Bahir Dar, Northwest Ethiopia.

Methods and materials

Study design, period, and setting

A multicenter hospital-based prospective cohort study was conducted from November 20, 2023, to January 20, 2024, at the surgical wards of TGSH and FHCSH, Bahir Dar, Ethiopia.

The investigation was conducted in two tertiary hospitals in Bahir Dar, Northwest Ethiopia. Both hospitals, affiliated with Bahir Dar University College of Medicine and Health Science, offer clinical and academic services, have more than 400 beds, and treat patients from Amhara, Oromia, and Benishangul Gumuz. Senior general and gastrointestinal subspecialist surgeons undertake all elective and emergency abdominal procedures. Basic and advanced laboratory and radiological tests are available for abdominal surgery patients.

This study was conducted in line with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Eligibility criteria

All adult patients (age 15+) who underwent major abdominal surgery from November 20, 2023, to January 20, 2024, were eligible for this study. Patients who were intentionally nil per os due to planned reentry to the abdomen, on total parenteral feeding postoperatively, and mechanical ventilation during postoperative period were excluded from the study.

Sample size determination and sampling procedure

The sample size was determined using a single population proportion formula based on the following assumptions: an estimated incidence of POI among patients undergoing abdominal surgery from a previous study in Kenya 10.7% ($p = 0.107$) [14], 95% confidence level, and a margin error to be 4% ($d = 0.04$). The final sample was calculated by adding 10% contingency was 252.

The calculated total sample size ($n = 252$) was divided into each hospital. A consecutive sampling method was used to choose the needed number of participants from all patients who underwent abdominal surgery in the study period from November 20, 2023, to January 20, 2024.

Data collection tool and procedure

The data was collected using a pre-tested checklist, which the principal investigator prepares after reviewing different literature findings of other similar studies.

The data extraction checklist was prepared in English according to the objectives of the study. Then, it was translated to Amharic for data collection and then back to English for analysis. Data was collected by Two BSc surgical nurses under the supervision of two surgical residents at the surgical ward of TGSH and FHCSH using a data collection sheet. The sociodemographic, clinical, and surgical factors were collected from the patient's medical record on the first postoperative day. The outcome variable was collected on the fourth postoperative

day. Study subjects discharged before the fourth postoperative day were considered not to have POI.

Data quality assurance

To ensure data quality, a pre-test was conducted on 5% of the calculated sample size (12 study subjects) at Addis Alem Hospital, and corrections were made accordingly. Training on the study objective of reviewing the documents per the data extraction format and collecting outcomes was given to data collectors and the supervisor for one day before data collection. The principal investigator, with another supervisor, supervised the overall process. The filled format was checked daily by the principal investigator and the supervisor for completeness.

Source of bias and minimizing strategy

The severity/invasiveness of surgical procedures was a potential source of bias in this study. Thus, we enrolled patients following major abdominal surgery based on commonly agreed definitions. Patients discharged before the POI assessment (fourth postoperative day) might be another source of bias. To overcome this, we explained to patients about suggestive symptoms of POI and instructed patients to have an emergency visit if they had the symptoms.

Bias due to the data collection tool was minimized by pre-testing the tool before the actual data collection. To avoid interviewer bias, we standardized the data collection tool, and training was given to the data collectors. At the analysis stage, confounder bias was minimized by conducting a multivariable analysis.

Variables

The primary outcome for this study was POI (yes/no), which was defined according to a systematic review and meta-analysis by *Vather R* et al. [19]. The independent variables were **Sociodemographic** (age, sex, residence, educational status, occupation), **Clinical factors** (body mass index (BMI), perioperative narcotic use, history of previous abdominal surgery, presence of abdominal contamination, ASA physical score, presence of hemodynamic instability, smoking history, Clavien–Dindo score, type of medical illness, estimated blood loss, types of anesthesia, blood transfusion, time of initiation of feeding), and **Surgical factors (**duration of surgery, urgency of surgery, type of surgery).

Operational definitions

Major abdominal surgery was defined as an intra-peritoneal operation with no primary involvement of the thorax, involving either luminal resection and/or resection of a solid organ associated with the gastrointestinal tract [20, 21].

Postoperative ileus was defined as when patients have two or more of the following five criteria met on or after the fourth postoperative day without improvement: [1] nausea and vomiting; [2] inability to tolerate oral diet intake for at least 24 h; [3] absence of flatus for 24 h; [4] abdominal distension; and [5] radiological evidence of ileus [19].

Data management and analysis

Data was checked manually, entered into EpiData version 4.6, and exported to STATA version 17 for further analysis.

Descriptive statistics were used to summarize the study variables. Binary logistic regression analysis was performed to identify factors associated with postoperative ileus, and variables with a p-value less than 0.2 were entered into the multivariable binary logistic regression model. A p-value of less than 0.05 was used to determine statistically significant associations of factors with the outcome variable. The Hosmer-Lemeshow goodness-of-fit checked the model's assumption with a p-value of 0.44.

Results

Cohort profile

Two hundred sixty-two patients who underwent abdominal surgery between November 20, 2023, and January 20, 2024, were selected consecutively. After recruitment, ten (3.82%) patients were found to be undergoing minor abdominal surgeries, and then 252 (96.18%) patients were included in the final analysis.

Sociodemographic characteristics of study subjects

Approximately 114 (45.24%) of individuals aged 15 to 30 years. About 67.86% of the whole sample consisted of male subjects, and more than 30% of study subjects were illiterate in their educational background. More than half (52.38%) of patients reside in rural areas, while most (41.27%) study subjects are farmers by occupation. (Table 1)

Clinical characteristics of the study subjects

Of 252 abdominal surgical patients, more than 83.73% of study subjects had a BMI within the normal range. Among 252 surgical patients, 207 (82.14%) had no history of perioperative narcotic use, 33 (13.10%) subjects had previous abdominal surgery, and 29 (11.51%) patients who underwent abdominal surgery had abdominal contamination. Of all study subjects, 236 (93.65%) exhibited ASA physical status I/II, and 198 (78.57%) had no comorbidity. Nearly one-third (32.14%) of study subjects had Clavien–Dindo score of I/II, and 247 (98.02%) patients had no smoking history. Most abdominal surgeries were performed under general anesthesia, while more than 6% [16] of patients had intraoperative hemodynamic

Table 1 Sociodemographic characteristics of patients who underwent major abdominal surgery at hospitals in Bahir Dar, Ethiopia

Variable	Category	Frequency	Percentage
Age (years)	15–30	114	45.24
	31–45	33	13.10
	46–60	52	20.63
	> 60	53	21.03
Sex	Male	171	67.86
	Female	81	32.14
Educational background	Unable to read and write	81	32.14
	Read and write only	44	17.46
	Primary school	16	6.35
	Secondary school	46	18.25
	College/University	65	25.79
Residence	Urban	120	47.62
	Rural	132	52.38
Occupation	Government employee	36	14.29
	Housewife	21	8.33
	Merchant	39	15.48
	Farmer	104	41.27
	Student	41	16.27
	Other[#]	11	4.37

Non-government employee, Unemployed

instability. One-fourth (25%) of patients who underwent abdominal surgery had intraoperative blood loss of more than 500 milliliters, and 47 (18.65%) patients received blood transfusions. More than half (53.67%) of the study subject's feeding was initiated after 24 h. (Table 2)

Surgical characteristics of the study subjects

Regarding surgical factors, 140 (57.94%) had surgical duration of less than 120 min, 146 (57.94%) underwent emergency surgery, and 156 (61.90%) had surgery involving the intestine. (Table 3) Generalized peritonitis was the most frequent indication for abdominal surgery, followed by acute appendicitis and symptomatic cholelithiasis. (Fig. 1) The most common primary surgical procedure was appendectomy (16.27%), followed by cholecystectomy (13.89%), and bowel resection and anastomosis (13.49%). (Table 4) All patients underwent open-access surgery. No laparoscopic/minimally invasive procedure was recorded.

Incidence of clinical outcomes

Of 252 patients enrolled in this study, 41 developed POI. The overall incidence of POI among patients who underwent major abdominal surgery at selected hospitals in Bahir Dar was 16.27% (95% CI: 12.19%, 21.38%). (Fig. 2) Regarding the clinical symptom complex leading to the diagnosis of POI, 40 (16.87%) patients had nausea and vomiting, 35 (13.89%) patients had an inability to tolerate oral diet intake for at least 24 h, and 34 (13.49%) patients had an absence of flatus for 24 h. (Fig. 3) No readmission attributed to POI after discharge was recorded during the follow-up period.

Factors associated with POI among abdominal surgical patients

After assessing the assumptions of logistic regression, the binary logistic regression model was fitted to identify significant predictors of POI among patients who underwent abdominal surgery. In multivariable binary logistic regression, covariates, age, sex, BMI, and nature of the surgery were significant predictors for POI among patients who underwent abdominal surgery.

The odds of developing POI after abdominal surgery among patients aged > 60 years was 3.81 (AOR = 3.81, 95% CI: 1.40, 10.35) times higher than those aged 15–30 years. On the other hand, being female is associated with a lower risk of POI by 61% (AOR = 0.39, 95% CI: 0.15, 0.97) compared with male patients. Those patients with a BMI < 18.5 kg/m² have an 11.54 (AOR = 11.54, 95% CI: 1.97, 67.55) times higher odds of developing POI following abdominal surgery than their counterparts. In addition, patients who underwent abdominal surgery involving the intestine had more than three times (AOR = 3.27, 95% CI: 1.01, 11.77) the increased risk of POI compared with those who did not involve the intestine. (Table 5)

Discussion

This study investigated the incidence and associated factors of POI among patients who underwent abdominal surgery in two selected hospitals in Bahir Dar, Northwest

Table 2 Clinical characteristics of patients who underwent major abdominal surgery at hospitals in Bahir Dar, Ethiopia

Variable	Category	Frequency	Percentage
BMI (kg/m^2)	< 18.5	13	5.16
	18.5–24.9	211	83.73
	> 25	28	11.11
Perioperative narcotic use	Yes	207	82.14
	No	45	17.86
History of previous abdominal surgery	Yes	33	13.10
	No	219	86.90
Presence of abdominal contamination	Yes	29	11.51
	No	223	88.49
ASA physical score	I/II	236	93.65
	≥III	16	6.35
Presence of hemodynamic instability	Yes	16	6.35
	No	236	93.65
Smoking history	Yes	5	1.98
	No	247	98.02
Clavien–Dindo score	No complication	101	40.08
	I/II	81	32.14
	≥III	70	27.78
Type of medical illness	None	198	78.57
	Hypertension	13	5.16
	DM	15	5.95
	Others	26	10.32
Estimated Blood loss (ml)	< 500	189	75.00
	≥ 500	63	25.00
Types of anesthesia	General anesthesia	242	96.03
	Spinal anesthesia	10	3.97
Blood transfusion	Yes	47	18.65
	No	205	81.35
Time of initiation of feeding	< 24 h	118	46.83
	≥ 24 h	134	53.17

Table 3 Surgical characteristics of patients who underwent major abdominal surgery at hospitals in Bahir Dar, Ethiopia

Variable	Category	Frequency	Percentage
Duration of surgery	< 120 min	146	57.94
	≥ 120 min	106	42.06
Urgency of surgery	Elective	106	42.06
	Emergency	146	57.94
Type of surgery	Intestinal	156	61.90
	Non-intestinal	96	38.10

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Ethiopia. POI following surgery is associated with increased morbidity and hospital costs. While previous research has identified several potential risk factors for POI after abdominal surgery, our study went a step further by analyzing sociodemographic, clinical, and surgical factors. Among possible factors contributing to POI, age, sex, BMI, and the nature of the surgery were significantly associated with POI after abdominal surgery.

In this study, the incidence of POI among patients who underwent major abdominal surgery in Bahir Dar, Ethiopia, was 16.27% (95% CI: 12.19%, 21.38%). Our results were consistent with studies conducted in Europe, where the incidence of POI was 15.4% [22], and Japan showed POI occurred in 13.5% of abdominal surgical patients [13]. The result of this study was lower than reports from Australia, where around 34.9% developed POI [23], and from the United States of America postoperative ileus increased between 2001 and 2011 by 29.7% [24]. This discrepancy might be due to differences in the study population since these studies included a high proportion of patients with colorectal cancer, in which this group of population has an increased risk of POI. On the contrary, our results were higher than a report from Kenya [14].

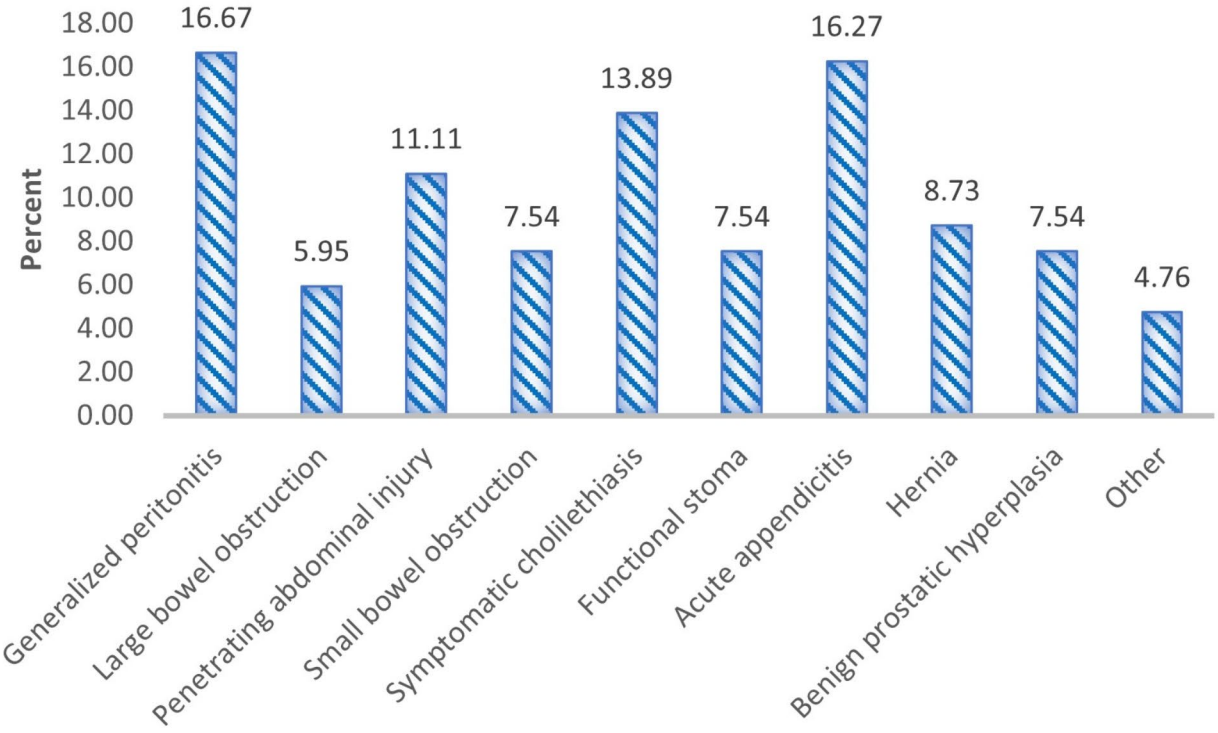

Fig. 1 Indications for major abdominal surgery at hospitals in Bahir Dar, Ethiopia. Other surgical indication includes obstructive jaundice, colorectal cancer, redundant sigmoid

Table 4 Surgical procedure mix among patients who underwent major abdominal surgery at hospitals in Bahir Dar, Ethiopia

Primary procedure	Frequency	Percentage
Laparotomy: solid organ repair	15	5.95
Laparotomy: hollow organ repair	24	9.52
Laparotomy: peritoneal lavage	31	12.30
Bowel resection and anastomosis	34	13.49
Cholecystectomy	35	13.89
Appendectomy	41	16.27
Stoma reversal	19	7.54
Open hernia repair	22	8.73
Trans vesical prostatectomy	19	7.54
Common-bile duct exploration	8	3.17
Whipple procedure	4	1.59

The possible explanation for this contradiction might be a difference in the study design and sample size.

Our study found that the incidence of POI after abdominal surgery increased with age > 60 years. This finding is in line with multiple studies, as age is reported to be an independent risk factor for POI [25, 26]. This link could be age-related changes in gastrointestinal functions, including digestion, absorption, motility, sphincter function, and immunity. These changes lead to decreased gastrointestinal tract function, which increases the risk of POI [27]. Furthermore, age-related alterations to the gastrointestinal tract also led to loss of adaptability to stress, such as surgery on the gastrointestinal system, increasing elderly susceptibility to POI. In addition, advanced age is associated with diminished gene expression and synthesis and catalytic activity of neuronal nitric oxide synthase; this increases delayed colonic transit, which has a negative effect on the gastrointestinal system [28].

In this study, low BMI increased the likelihood of POI after abdominal surgery. This finding agrees with a study by S Fujiyoshi et al. at Hokkaido University Hospital, Japan [29]. Patients with low BMI could explain the association between low BMI and POI as malnutrition, which impacts all organ systems, including gastrointestinal, negatively. This group of patients might be deficient in metabolic nutrients to keep the digestive system

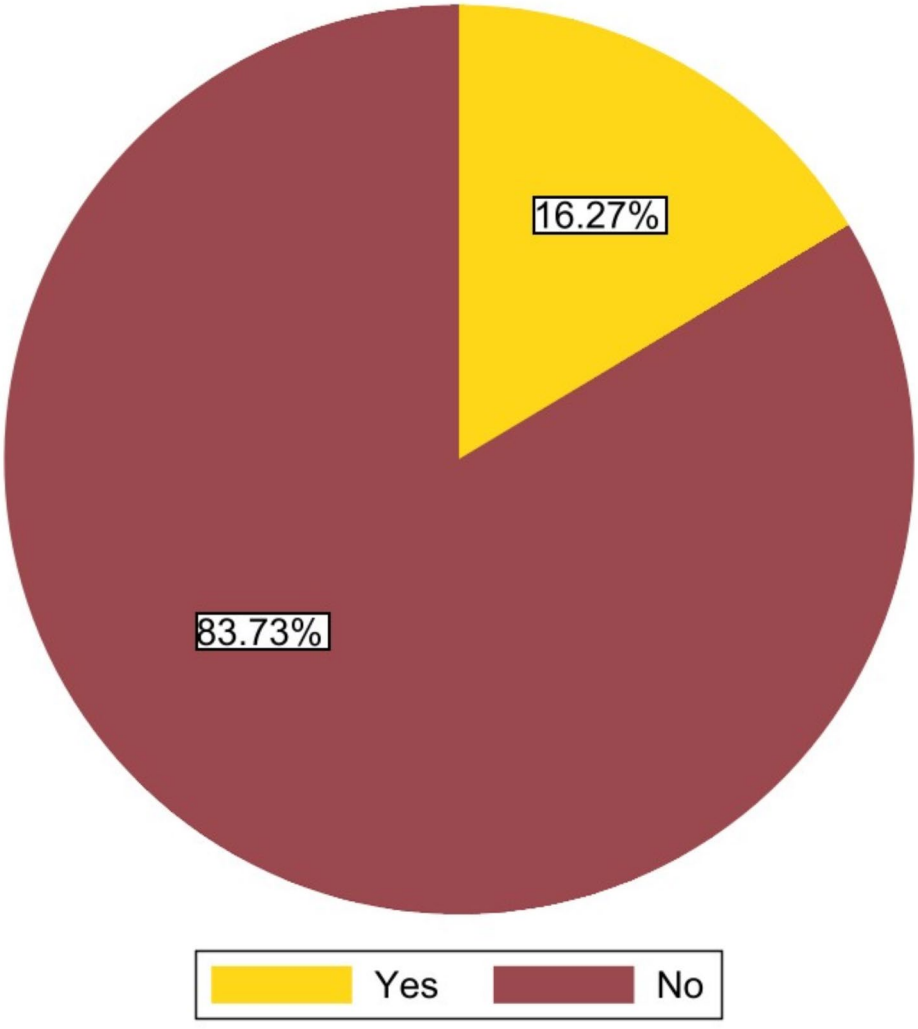

Fig. 2 Incidence of postoperative ileus among patients who underwent major abdominal surgery at hospitals in Bahir Dar, Ethiopia

functional, leading to delayed gastric emptying time and increasing the chance of POI [30]. Moreover, patients with a low BMI have a higher risk of severe complications such as infection and sepsis, increasing the postoperative risk of paralytic ileus [31].

The result of our study is that patients who underwent intestinal surgery have an increased risk of POI. This result is consistent with studies done in the United Kingdom [32]and Italy [33]. The possible reason might be that patients who underwent intestinal surgery will have an interruption of the gastrointestinal continuity or manipulation of the bowel. In addition, excessive small bowel manipulation, prolonged nasogastric catheter use, and systemic inflammation have been shown to retard bowel motility [34]. This finding aligns with a study conducted on elective colorectal patients, where the effects of estrogen and progesterone on the gastrointestinal tract elucidate the protective effect of being female for POI [35]. However, a systematic review and meta-analysis found no significant difference between sex and POI among patients undergoing gastrointestinal surgeries [36]. The existing controversy in the literature regarding the link between sex and POI necessitates further studies.

Recently, strategies to prevent POI have been proposed and tested. The primary approach to minimize the risk of POI is incorporating the Enhanced Recovery after Surgery (ERAS) protocols into clinical practice [37, 38]. Studies demonstrated that employing ERAS protocols effectively reduces the incidence of POI [39, 40]. The utilization of minimally invasive surgical approaches is also recommended to decrease the risk of POI, but the high cost of minimally invasive surgical machines limits the applicability of this strategy in low-income countries [41].

As a limitation of this study, due to the unavailability of investigation for patients who underwent abdominal surgery, albumin, and electrolytes were not assessed as a potential predictor of POI. In addition, using a

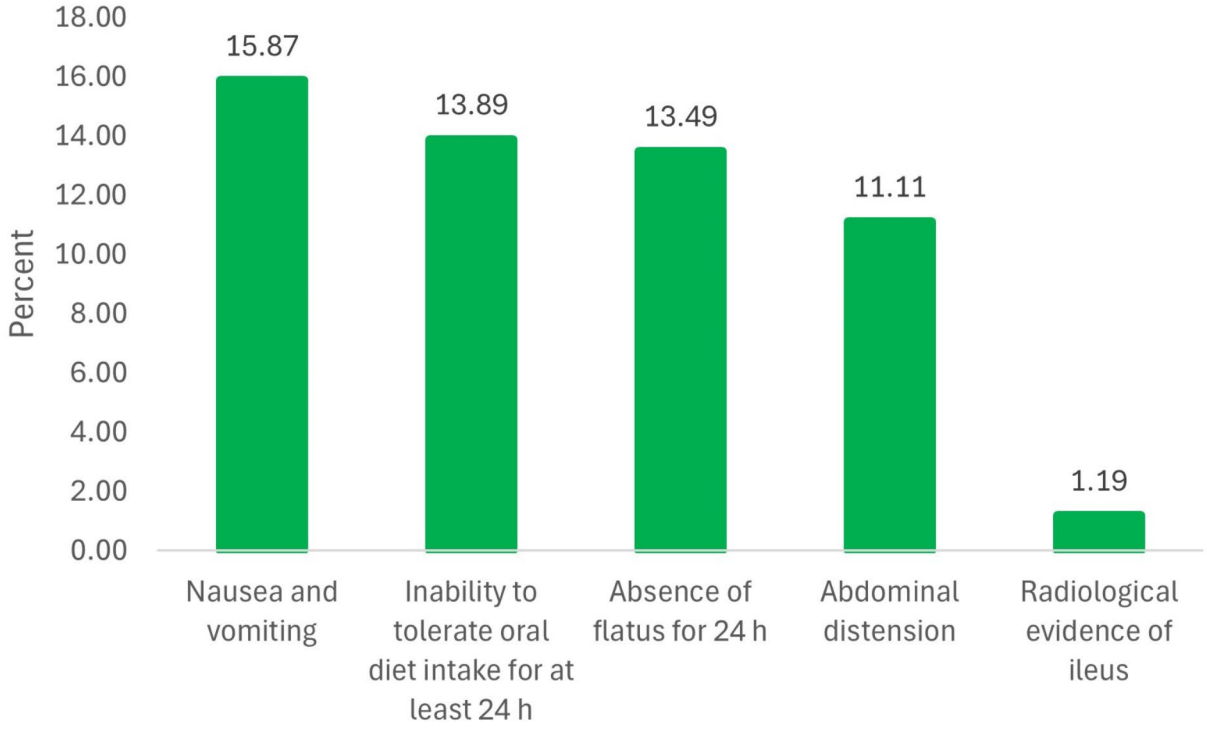

Fig. 3 Clinical symptom complex to diagnosis POI among patients who underwent major abdominal surgery at hospitals in Bahir Dar, Ethiopia

Table 5 Multivariable logistic regression analysis results for identifying factors associated with POI at hospitals in Bahir Dar, Ethiopia

Variable	Category	POI		COR (95% CI)	AOR (95% CI)
		Yes	No		
Age (years)	15–30	12	98	1	1
	31–45	8	24	2.72 (1.00, 7.39)	2.21 (0.74, 6.74)
	46–60	5	47	0.86 (0.28, 2.60)	0.83 (0.25, 2.77)
	> 60	16	41	3.18 (1.38, 7.32)	3.83 (1.40, 10.35)*
Sex	Male	28	143	1	1
	Female	13	68	0.97 (0.47, 2.00)	0.39 (0.15, 0.97)*
BMI (kg/m^2)	< 18.5	5	8	4.66 (1.34, 16.18)	11.54 (1.97, 67.55)**
	18.5–24.9	32	179	1	1
	> 25	4	24	0.89 (0.29, 2.74)	2.27 (0.60, 8.54)
Perioperative narcotic use	Yes	4	41	0.44(0.15, 1.32)	0.36 (0.10, 1.33)
	No	37	17	1	1
History of previous abdominal surgery	Yes	8	25	1.79 (0.74, 4.31)	1.63 (0.55, 4.82)
	No	33	185	1	1
Presence of abdominal contamination	Yes	13	17	5.62 (2.44, 12.93)	4.16 (0.55, 11.19)
	No	28	194	1	1
Clavien–Dindo score	No complication/I/II	28	142	1	1
	> II	13	69	0.95 (0.46, 1.95)	0.93 (0.39, 2.23)
Time of initiation of feeding	< 24 h	8	111	1	1
	≥ 24 h	33	100	4.57 (2.02, 10.37)	3.36 (0.81, 11.24)
Urgency of surgery	Elective	18	88	1	
	Emergency	23	123	0.91 (0.46, 1.79)	1.06 (0.58, 1.82)
Type of surgery	Intestinal	34	121	3.61 (1.53, 8.52)	3.27 (1.01, 11.77)*
	Non-intestinal	7	90	1	1

COR = Crude Odds Ratio, AOR = Adjusted Odds Ratio, **=*p*-value < 0.001, *=*p*-value < 0.05

non-probabilistic sampling technique might introduce sampling bias, which might affect the generalizability of this study.

Conclusion

In this cohort, we found that the incidence of POI among patients who underwent major abdominal surgery at the two governmental hospitals in Bahir Dar was comparable with global reports. Old age, low BMI, and surgeries that involve the intestine were associated with a higher chance of developing POI. Female patients who underwent major abdominal surgery have a lower chance of POI.

Target-specific intervention for patients with the identified risk factors by implementing ERAS protocols at the two hospitals is recommended to decrease the burden of POI.

Abbreviations

ERAS	Enhanced Recovery After Surgery
FHCSH	Felege Hiwot Comprehensive Specialized Hospital
NPO	Nil per os
POI	Postoperative ileus
ASA	American Society of Anesthesiologist
AOR	Adjusted Odds Ratio
TGSH	Tibebe Ghion Specialized Hospital

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Author contributions

FC Animaw: Took part in conceptualization, methodology, formal analysis, investigation, resources, data curation, writing - original manuscript draft, writing – review & editing, visualization. MB Asresie: Took part in methodology, formal analysis, investigation, writing – review & editing, visualization. AS Endeshaw: Took part in conceptualization, methodology, writing - original manuscript draft, writing – review & editing. All authors approved the final draft of the manuscript.

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Data availability

The data generated during and analyzed during this study are available from the corresponding request upon a reasonable request.

Declarations

Ethical approval and consent to participate

The protocol to conduct this study was approved by the Institutional Review Board (IRB) of the College of Medicine and Health Science, Bahir Dar University (Protocol number: 818/2023). Tibebe Ghion Specialized Hospital and Felege Hiwot Compressive Specialized Hospital granted permission to conduct this study. Prior to data collection, written informed consent was obtained from all study subjects. Confidentiality was maintained at all levels of the study. All methods were carried out in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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