Assessment of Gastrointestinal Outcomes among Intermittent Enterally Fed Critically Ill Patients

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Abstract

Background: Enteral feeding or enteral nutrition is the preferable route and utilized commonly for nutritional support in critically ill patients. **Aim of the study:** This study aimed to assess the gastrointestinal outcomes among intermittent enterally fed critically ill patients. **Design:** Descriptive exploratory research design was utilized. **Setting:** The study was carried out in General Intensive Care Unit at El Fayoum University Hospital. **Subjects:** a purposive sample of 110 critically ill patients who met the inclusion criteria. **Data collection tools**: Data were obtained through two main tools; patients' assessment tool and gastrointestinal outcomes assessment tool. **Results:** The main results revealed that the mean age of the studied patients was 66.92±12.6 years, while 24.55% of the studied subjects had abdominal distension. Meanwhile, 100.00 % of the studied subjects hadn't vomiting and the mean score of gastric residual volume for them was 12.82±4.59 ml. Also, 70.00% of them had normal intra-abdominal pressure with the mean score of intra-abdominal pressure was 9.58± 3.43 mmHg. Meanwhile, 55.55 % of the studied subjects had mild constipation. Also, there was highly statistically positive correlation between intra-abdominal pressure and abdominal distension (r= 0.625 & P.value <0.001). **Conclusion**: about one fourth of the studied subjects had abdominal distension, none of them had vomiting, the mean score of gastric residual volume (GRV) for the studied patients was 12.82±4.59 ml, more than two thirds of them had normal intra-abdominal pressure and more than half of the studied subjects had mild constipation with highly statistically positive correlation between body mass index and intra-abdominal pressure. **Recommendations:** On-going and regular in-service educational programs about assessment of gastrointestinal outcomes among enterally fed critically ill patients and how to measure gastric residual volume and intra-abdominal pressure. The study should be replicated on large sample and in different geographical settings in order to generalize the results.

Key words: critically ill patients, enteral nutrition, gastrointestinal outcomes, gastric residual volume, intra-abdominal pressure.

Introduction

Critically ill patients are at increased risk for malnutrition because of metabolic disturbances experienced during critical illness and impaired delivery of nutrients. Malnutrition is a common problem which occurs in more than 40% of critically ill patients. Malnutrition leads to increased rates of infection, delayed wound healing, bacteria growth in the digestive system, a loss of nutrients via the stool, a loss of respiratory muscle mass, sepsis, increased length of hospital stay, increased mortality rate, and increased treatment costs. Therefore, it is essential to support the nutritional needs of these patients **(Komen et al., 2020; Oshvandi et al., 2020)**.

Enteral feeding or enteral nutrition is the preferable route and utilized commonly for nutritional support in critically ill patients. Enteral nutrition has been demonstrated to maintain the function of the gastrointestinal tract, improve wound healing, and reduce complication rates and length of stay in the intensive care unit. According to American

Society for Parenteral and Enteral Nutrition, enteral nutrition is liquid nutrition given through a tube and delivered directly into the stomach or small bowel. This liquid nutrition contains protein, carbohydrates (sugar), fats, vitamins, and minerals that are needed when a patient is unable to attain an adequate oral intake **(Komen et al., 2020)**.

Despite evidence based information from different studies regarding several benefits of enteral nutrition, multiple potential complications can occur. These complications are divided into three categories as mechanical, gastrointestinal and metabolic. The most common complications are thought to be related to gastrointestinal functions. Gastrointestinal complications include diarrhea, nausea, vomiting, abdominal distention, aspiration, high gastric residual volume, constipation, and elevated intra-abdominal pressure **(Gönderen et al., 2022)**.

During enteral nutrition, critical care nurses routinely place feeding tube, administering of feeding, prevent and detect complications associated with this form of therapy, obtaining weight measurements, vital signs, and laboratory data and providing enteral tube care throughout the duration of nutrition support therapies. Critical care nurses should elevate the head of the bed during feeding and check gastric residual before each feeding. The nurse obtains more objective signs of feeding tolerance through abdominal examinations. Also, the nurse monitors and records volume and frequency of both urine and stool **(Adam et al., 2020; Morsy et al., 2021)**.

Significance of the study

Nutritional status tends to deteriorate during hospitalization unless appropriate nutritional support is started early and continually reassessed. According to a study conducted in the adult medical intensive care unit of a university hospital in Turkey by **Kahraman et al. (2020)** entitled "Complications Developing in Intensive Care Patients Receiving Enteral Feeding and Nursing Interventions", the incidence of abdominal distension was 28.8 %, high gastric residual volumes was 13.4 %, constipation was 17.3 % and vomiting was 1.9 %. These complications usually interfere with the achievement of adequate nutrition support. According to a study published in Egypt by **Mohammed and Othman, (2018)** entitled "Effect of Gravity Feeding Versus Bolus Feeding Technique on Gastrointestinal Disturbance among Stroke Patients", the incidence rate of constipation was 40% and then vomiting was 33%.

Through clinical experience at many intensive care units, it has been observed that many critically ill patients are receiving nutritional support through enteral feeding and experienced a lot of gastrointestinal outcomes that make a strong effect on progression or compromising of their health status. Consequently, assessment and identification of patient's gastrointestinal outcomes will construct a database about this problem, which would be beneficial for health care professionals in different ways: first, it could improve quality of patient care; second, it could support the important role of the critical care nurse related to the care of patients using enteral feeding; third, it might generate an attention and motivation for further researches in this area.

Aim of the study:

This study aimed to assess the gastrointestinal outcomes among intermittent enterally fed critically ill patients.

Research question:

The current study answered the following question:

- What are the gastrointestinal outcomes among intermittent enterally fed critically ill patients?

Subjects and Methods

The study was portrayed under the four main designs as follows:

I. Technical design.
II. Operational design.
III. Administrative design.
IV. Statistical design.

I. Technical design:

The technical design includes research design, setting, subjects and tools for data collection.

Research Design: Descriptive exploratory research design was utilized for the conduction of this study.

Setting of the Study: This study was conducted at the General Intensive Care Unit (ICU) at El Fayoum University Hospital, El Fayoum, Egypt. This ICU located at 2nd floor in the hospital with total capacity of 36 beds, 20 ventilators, 36 monitors and 5 emergency carts, it were distributed in 11 rooms, ICU also contains three rooms for medications and supplies storage.

Research Subjects: A Purposive sample of 110 critically ill patients who met the inclusion criteria at previously mentioned setting.

Inclusion criteria: The inclusion criteria of the current study included adult patients from both gender >20 years old, patients with newly inserted nasogastric tube for intermittent enteral feeding, patients who have indwelling urinary catheter for measuring intra-abdominal pressure and hemodynamically stable.

Exclusion criteria: The exclusion criteria of the current study included patients receiving prokinetic medications as metoclopramide (reglan) and cisapride (propulsid), patients with hepatic impairment and patients who was receiving radiotherapy or chemotherapy.

Tools for data collection:

Two main tools were used for data collection:

Tool (I): Patients' assessment tool :

This tool was adapted from **(Abdelhafez & Abd Elnaeem, 2019; Narmadha & Priyanka, 2019; El-Feky & Ali, 2020; Morsy et al., 2021)** and modified by the researcher to suite the study aim. This tool is consisted of three parts:

- **Part (I): Demographic data:**

It was concerned with patient's demographic data such as age, gender, level of education, residence and occupation.

- **Part (II): Clinical data:**

It was concerned with patient's clinical data such as reason for ICU admission, past medical history, surgical history, allergic history, family history, current medications, weight, height, body mass index (BMI) and physiological parameters; vital signs (as heart rate, respiratory rate, blood pressure and temperature), oxygen saturation(Spo2), level of consciousness and fluid intake and output.

Body mass index (BMI): It was calculated by dividing the patient's weight in kilograms by the square of height in meters (kg/m2). Body Mass Index is interpreted using standard weight categories for adults 20 years and older.

❖ **Scoring system:**

- Underweight: <18.5
- Normal: 18.5-24.9
- Overweight: 25- 29.9
- Obesity class I: 30-34.9
- Obesity class II: 35-39.9
- Obesity class III: ≥40

Glasgow Coma Scale: It was used to assess the level of consciousness. The scale assesses patients' responsiveness through eye-opening, motor, and verbal responses.

❖ **Scoring system:**

- Mild impairment: 13-15
- Moderate impairment: 9-12

- Severe impairment: 3-8

- **Part (III): Enteral feeding data:**

It was concerned with enteral feeding related data such as type of feeding, amount of feeding (per meal and per day), and number of feeding (per day).

Tool (II) Gastrointestinal outcomes assessment tool:

This tool was adapted from **(Abdelhafez & Abd Elnaeem, 2019; Lynn, 2019; Cetinkaya et al., 2020; El-Feky & Ali, 2020; Foschi & Navarra, 2020; Rajkumar, 2020; Boling et al., 2021; Diab et al., 2021; Rebeiro et al., 2021; Perry et al., 2022)** and modified by the researcher to suite the study aim. It was used to assess the gastrointestinal outcomes as gastric residual volume, abdominal distension, vomiting, intra-abdominal pressure and constipation. **It was included five parts as following;**

Part (I): Gastric residual volume:

It was used to assess gastric residual volume for the studied patients before enteral feeding administration.

Part (II): Abdominal distension:

It was used to assess abdominal distension for the studied patients before enteral feeding administration. Abdominal distension was assessed by palpation of abdomen in terms of soft and tense or hard.

Part (III): Vomiting:

It was used to assess vomiting before and after enteral feeding administration throughout the day for the studied patients through frequency of vomiting episodes in terms of none, once/day and twice/day.

Part (IV): Intra-abdominal pressure:

It was used to assess intra-abdominal pressure for the studied patients before enteral feeding administration. Intra-abdominal pressure was measured by using intra-abdominal pressure measurement checklist (manometer technique).

❖ **Scoring system:**

- **0-12mmHg:** Normal intra-abdominal pressure.
- **13-15 mmHg:** Grade I Intra-Abdominal Hypertension.
- **16-20 mmHg:** Grade II Intra-Abdominal Hypertension.
- **21-25 mmHg:** Grade III Intra-Abdominal Hypertension.
- **>25 mmHg:** Grade IV Intra-Abdominal Hypertension.

Part (V): Constipation:

It was used to assess constipation for the studied patients. Criteria for assessment of constipation include; occurrence of constipation which was described in terms of yes / no based on frequency of defecation. The patient considered constipated if pass stool once in more than 3 days.

Constipation severity was assessed using modified constipation assessment scale (CAS); it was adapted from **(Abd-Elraheem et al., 2020)** and modified by the researcher to suite the study aim. It was used to delineate the severity of constipation. It included five parameters; abdominal distension or bloating, less frequent bowel movement, oozing liquid stool, smaller stool size, and inability to pass stool .

❖ **Scoring system:**

The score of the scale was graded from 0 to 2 degrees for each parameter; none (0), some (1), and Severe (2) with total score ranged from 0-10. The total score was obtained by summating the selected grade for each parameter. This score indicated the severity of constipation as following :

- **1-3:** mild constipation.
- **4-6:** moderate constipation.
- **7 or more:** severe constipation.

II. Operational design:

The operational design includes preparatory phase, validity and reliability, pilot study, ethical considerations and field of work.

Preparatory phase:

It included reviewing of the current and more recent relevant national and international literature reviews and theoretical knowledge of the various related aspects using books, articles, periodicals, magazines and internet in order to develop the data collection tools. The researcher received a training course about abdominal massage technique for one month in Academy of Chinese Medicine in Cairo Training and Human Resources Development to be qualified in applying the correct technique of abdominal massage.

Validity and reliability

Validity:

The tools were revised by a panel of seven experts from medical-surgical and critical care nursing academic staff, Ain shams university. The experts reviewed the tools for clarity, relevance, comprehensiveness, and simplicity and minor modifications were done accordingly. Face and content validity for tool I (patients' assessment tool) was 90% to 100% and for tool II (gastrointestinal outcomes assessment tool) was 71.4 % to 100%.

Tool Reliability:

Reliability of tools were tested statistically using Cronbach's Alpha coefficient test which revealed that tools of the study were reliable as indicated by the value for tool I (patients' assessment tool) was 0.824 and for tool II (gastrointestinal outcomes assessment tool) was 0.848.

Pilot study:

A pilot study was carried out on 10% (11 patients) of sample size to test feasibility of the research process, applicability, clarity and efficiency of the tools, as well as to estimate the time needed to conduct the study. The patients who were included in the pilot study were included to the sample because there was minor modifications were done after conducting pilot study.

Ethical Considerations:

The research approval was obtained from scientific research ethical committee in the faculty of nursing, Ain Shams University before initiating the study work. The researcher clarified the objectives and aim of the study to patients or their families included in the study before starting. The researcher assured maintaining anonymity and confidentiality of the subjects' data. Patients or their families were informed that they are allowed to choose to participate or not in the study and that they have the right to withdraw from the study at any time. Ethics, values, culture, and beliefs were respected.

Field work:

The actual work of this study started and completed within four months from beginning of January to the end of April (2022). Data were collected by the researcher three days per week, at morning and afternoon shifts in the previous mentioned setting.

Researcher followed the Ministry of Health and Population's protocol to minimize the risk of transmissions of coronavirus which included wearing personal protective equipment especially well fitted masks, hand hygiene, cough etiquette (sneezing or coughing into a tissue or a bent elbow), avoiding touching eyes, nose and mouth with contaminated hands, maintain a distance of at least one meter away from others and getting vaccinated.

All newly admitted patients who having nasogastric tube for intermittent enteral feeding were assessed by the researcher for meeting the

inclusion criteria to be enrolled in the current study. The aim of the study explained for the patients or their families who agreed to participate in this study prior to data collection after obtaining a written consent.

The studied patients' demographic data, clinical data and enteral feeding related data were obtained by the researcher from the patients and patient's medical record using Tool (I) patients' assessment tool. It took about 15-20 min to be fulfilled for each patient**.**

The gastrointestinal outcomes were assessed by the researcher using Tool (II) gastrointestinal outcomes assessment tool. It took about 30-35 min to be fulfilled for each patient**.**

Abdominal distension was assessed by the researcher before enteral feeding administration by light and deep palpations. The distension was considered present when the abdomen was tense or hard. **Vomiting** as a gastrointestinal outcome was assessed through its frequency. **Gastric residual volume** was assessed by the researcher before enteral feeding administration using gastric residual volume measurement checklist. **Intra-abdominal pressure (IAP)** was measured by the researcher before enteral feeding administration using intra-abdominal pressure measurement checklist (manometer technique). Each IAP value was obtained by manometer (cmH2O) and recalculated in millimeter mercury using the conversion factor (1 cmH2O = 0.74 mmHg)**. Occurrence of constipation** as a gastrointestinal outcome was assessed through frequency of defecation. The patient considered constipated if pass stool once in more than 3 days and constipation severity was assessed by using modified constipation assessment scale.

III. Administrative design

An official approval with a written letter, clarifying the purpose and setting of the study obtained from the dean of the Faculty of Nursing, Ain Shams University. Another approval obtained from the director of El Fayoum University Hospital. The title and aim of the study were explained.

IV. Statistical design

The collected data organized, categorized, tabulated and statistically analyzed using the statistical package for social science using SPSS program version 20. Quantitative data were presented as mean and standard deviation (SD). Qualitative data were presented as frequencies and percentages (%). Correlation between variables was evaluated using Pearson's correlation coefficient (r).

Results:

Table (1): reveals that, 49.09% of the studied patients their age were equal or more than 70 years with mean age 66.92±12.6 years. In relation to gender, 70.90 % of the studied subjects were males. Concerning level of education, 31.82 % of them can't read and write. As regards residence, 56.36 % of the studied subjects were lived in rural areas. Regarding occupation, 89.09 % of them were retired or not working

Table (2): shows that, 74.55 % of the studied subjects had respiratory disorders as a reason for ICU admission. Concerning past medical history, 66.36 % of the studied subjects had past history for hypertension. In relation to current medications, 100.00% of the studied subjects received antibiotics and proton pump inhibitor. Regarding body mass index, 40.91% of the studied subjects were overweight.

Table (3): reveals that, 24.55% of the studied subjects had hard or tense abdomen. Meanwhile, 100.00 % of the studied subjects hadn't vomiting and the mean score of gastric residual volume for them was 12.82±4.59 ml.

Table (4): reveals that, 70.00% of the studied subjects had normal intra-abdominal pressure. As well as, the mean scores of intra-abdominal pressure for them was 9.58±3.43 mmHg. Meanwhile, 55.55 % of the studied subjects had mild constipation.

Table (5): shows that, there was highly statistically positive correlation between body mass index and intra-abdominal pressure as a gastrointestinal outcome (r =0.448 & P.value

<0.001). Meanwhile, there was statistically negative correlation between body mass index and constipation as a gastrointestinal outcome (r = -0.196 & P.value= 0.040).

Table (6): reveals that, there was statistically positive correlation between abdominal distension and gastric residual volume (r =0.200 & P.value =0.037). Meanwhile, there was highly statistically positive correlation between intra-abdominal pressure and abdominal distension (r = 0.625 & P.value <0.001). Also, there was statistically negative correlation between constipation and abdominal distension (r = -0.214 & P.value= 0.025).

Table (1): Frequency and percentage distribution of the studied patients according to their demographic characteristics (No=110).

Demographic data	No.	%
▪ <50-60	16	14.55%
▪ >60 - <70	40	36.36%
▪ ≥ 70	54	**49.09%**
▪ Mean ± SD (years)	**66.92 ±12.6**	
Gender:		
▪ Male	78	**70.90%**
▪ Female	32	29.09%
Level of education:		
▪ Can't read and write	35	**31.82%**
▪ Read & write	22	20.00%
▪ Basic primary education	6	5.45%
▪ Secondary education	18	16.36%
▪ University education	29	26.36%
Residence:		
▪ Rural	62	**56.36%**
▪ Urban	48	43.63%
Occupation:		
▪ No working / retired/ housewife	98	**89.09%**
▪ Governorate work	10	9.09%
▪ Private work	2	1.82%

Table (2): Frequency and percentage distribution of the studied patients according to their clinical data (No=110).

Clinical data	No.	%
Reason of ICU admission:		
▪ Respiratory disorders	82	**74.55%**
▪ Cardiac disorders	1	1.82%
▪ Renal disorders	16	14.55%
▪ Sepsis	8	7.27%
▪ Neurological disorders	81	73.63%
Past medical history:		
▪ Free medical history	1	1.82%
▪ Diabetes mellitus	41	37.27%
▪ Hypertension	73	**66.36%**
▪ Cardiac disorders	11	10.00%
▪ Neurological disorders	16	14.55%
Current medications:		
▪ Antibiotics	110	**100.00%**
▪ Proton pump inhibitor	110	**100.00%**
▪ Anticonvulsant	35	31.82%
▪ Corticosteroids	51	46.36%
Body mass index (BMI):		
▪ Normal	24	21.82%
▪ Overweight	45	**40.91%**
▪ Obesity class I	26	23.64%
▪ Obesity class II	15	13.64%

Table (3): Frequency and percentage distribution of the studied patients according to their gastrointestinal outcomes (abdominal distension, vomiting and gastric residual volume) (No=110).

Gastrointestinal outcomes	No.	%
Abdominal distension		
Palpation of abdomen:		
Soft (not distended)	83	75.45%
Hard/ tense(distended)	27	**24.55%**
Vomiting		
Frequency of vomiting episodes		
None	110	**100.00%**
Once/day	0	0.00%
Twice/day	0	0.00%
Gastric residual volume (GRV)		
(Mean± SD)	**12.82±4.59 ml**	

Table (4): Frequency and percentage distribution of the studied patients according to their gastrointestinal outcomes (intra-abdominal pressure and constipation) (No=110).

Gastrointestinal outcomes	No.	%
Intra-abdominal pressure		
0-12mmHg	77	**70.00%**
13-15 mmHg	24	21.82%
16-20 mmHg	9	8.18%
21-25 mmHg	0	0.00%
Mean+ SD	**9.58 ± 3.43**	
Constipation		
Constipation occurrence		
Yes	61	**55.55%**
No	49	44.55%
Constipation severity		
Mild	61	**55.55%**
Moderate	0	0.00%
Severe	0	0.00%

Table (5): Correlation between body mass index and gastrointestinal outcomes of the studied patients (No=110).

Gastrointestinal outcomes	Body mass index Pearson correlation coefficient (r)	P-Value
Abdominal distension	0.092	**0.342 NS**
Gastric residual volume	-0.154	**0.109 NS**
Intra-abdominal pressure	**0.448**	**<0.001 HS**
Constipation	**-0.196**	**0.040 S**

Non-Significant (NS) = P. > 0.05 **Significant (S) = P. < 0.05** **High significant (HS) = P. < 0.001**

Table (6): Correlation between gastrointestinal outcomes of the studied patients (No=110).

Gastrointestinal outcomes		Gastric residual volume	Abdominal distension	Intra-abdominal pressure
Abdominal distension	r	0.200		
	P-value	**0.037 S**		
Intra-abdominal pressure	r	0.113	0.625	
	P-value	**0.238 NS**	**<0.001 HS**	
Constipation	r	0.008	-0.214	-0.078
	P-value	**0.938 NS**	**0.025 S**	**0.416 NS**

Non-Significant (NS) = P. > 0.05 **Significant (S) = P. < 0.05** **High significant (HS) = P. < 0.001**

Discussion:

Critically ill patients are prone to malnutrition because of their hyper metabolic condition. Enteral nutrition had been beneficial over parenteral nutrition as it maintains the intestinal alignment and function which prevents from bacterial translocation. However, it has been associated with various gastrointestinal complications/outcomes as, vomiting, abdominal distension, increased gastric residual volume and constipation ***(Afitasari & Hudiyawati, 2021).***

The current study is descriptive exploratory study aimed to assess the gastrointestinal outcomes among intermittent enterally fed critically ill patients. The current study answered the following question; what are the gastrointestinal outcomes among intermittent enterally fed critically ill patients?

Regarding studied patients' **demographic characteristics**, the current study revealed that, about half of the studied patients their age were equal or more than 70 years with mean age 66.92±12.6 years. This might be explained due to age is considered non-modifiable risk factor predisposing to several

types of chronic diseases and intensive care unit (ICU) admission. This finding was in agreement with ***Garcia, (2017)*** who conduct a study entitled " Enteral Nutrition in Critically Ill Patients " and found that the mean age in the studied patients was 61±15.3 years**.** While, this finding was contradicted with ***Abd El-Hafez et al., (2013)***, whose study title was "Effect of Intermittent Enteral Feeding Schedule on the Occurrence of Gastrointestinal Complications and Hospital Stay among Critically Ill Patients" and found that the mean age was 34.6 ±10.7 years in the control group. Regarding **gender**, more than two thirds of the studied subjects were males. This finding might be due to the natural of ICU admission as emergency, increased accidents and increased incidence of chronic diseases among male more than female patients. This explanation was supported by ***Hill et al., (2020*)** who concluded that males were predominated in ICU admissions as they are at higher risk of getting several types of chronic diseases. This finding agreed with ***Gönderen et al., (2022),*** whose study title was " Investigation of Gastrointestinal Complications in Patients Given Enteral Nutrition " and found more than half (53.7 %) were males.

Meanwhile, this finding was not in agreement with ***Morsy et al., (2021),*** whose study title was '' Tube Feeding-Associated Patients' Outcomes at Intensive Care Units, Cairo '' and found that about half of the studied subjects were female.

Concerning **level of education**, the present study showed that about one third of the studied subjects can't read and write. This result was in agreement with ***Abd-Elraheem et al, (2020),*** whose study title was " Effect of Implementing Murdoch Bowel Protocol on the occurrence of Constipation among Critically Ill Patients " and found that one third of the studied subjects can't read and write. Although, this finding disagreed with ***Mohamed et al., (2021),*** in a study entitled " Effect of Abdominal Massage on Gastrointestinal Function among Enterally Fed Critically Ill Patients" and found that more than two fifths of the control group had secondary level of education.

Regarding **residence**, the current study revealed that more than half of the studied subjects were lived in rural areas**.** This might be explained due to El Fayoum University Hospital is a governmental hospital that provide free outpatients and inpatients' services for patients who can't afford especially those from rural areas as well as this hospital is more accessible for them. This was in agreement with ***Diab et al., (2021),*** whose study title was " Effect of Abdominal Massage on Clinical Outcomes of Enterally Fed Mechanically Ventilated Patients " and found that more than half of the studied subjects were lived in rural areas**.**

In relation to **occupation**, the current study revealed that the majority of the studied subjects had no work or retired. This might be due to the majority of the studied subjects were old aged so, they were retired or they might be unable to work at this age group.

This finding was in agreement with ***Momenfar et al., (2018)*** who conduct a study entitled "Studying the Effect of Abdominal Massage on the Gastric Residual Volume in Patients Hospitalized in Intensive Care Units" and mentioned that more than two thirds of the control group were unemployed. While this was not in agreement with ***Diab et al., (2021),*** who found that more than two thirds of the studied subjects were working.

Regarding **clinical data**, the current study revealed that about three fourths of the studied subjects had respiratory disorders as a reason for ICU admission. This result was in the same line with ***Kahraman et al., (2020),*** in a study titled "Complications Developing in Intensive Care Patients Receiving Enteral Feeding and Nursing Interventions" and reported that about half of the studied patients had disorders of the respiratory system as a diagnosis leading to hospitalization. In addition, this finding was congruent with ***Morsy et al., (2021)*** who found the majority of the studied sample had central nervous system problems (92.2%) as a medical diagnosis.

Concerning **past medical history,** the present study revealed that about two thirds of the studied subjects had past history for hypertension. This might be due to the majority of the studied subjects were old aged so they were at higher risk for acquiring chronic

diseases like hypertension. This finding was in agreement with ***Abd-Elraheem et al., (2020),*** who mentioned that half of the studied patients had past history for hypertension.

In relation to **current medications**, the current study showed that all study subjects received antibiotics and proton pump inhibitor. This might be due to the scheduled routine of ICU for all newly admitted patients to decrease risk of infection and as gastrointestinal tract prophylaxis. These findings were in the same line with ***Elpasiony et al., (2017),*** who studied the "Impact of Abdominal Massage on Ventilator-Associated Pneumonia among Patients with Enteral Feeding" and they found that all patients received antibiotics and the majority of them received proton pump inhibitor.

Regarding **body mass index (BMI)**, the current study revealed that almost two fifths of the studied patients were overweight. This might be due to the majority of the studied subjects were elderly and had no work or retired which precipitate them to weight gain. This result was in accordance with ***Morsy et al., (2021),*** who mentioned that about half of the studied sample was overweight before starting tube feeding. Also, ***El-Feky & Ali, (2020),*** in a study titled "Effect Of Abdominal Massage on Gastric Residual Volume Among Critically Ill Patients at Cairo University Hospitals" mentioned that overweight was dominant among more than half of the studied patients.

The current study aimed to assess the gastrointestinal outcomes among intermittent enterally fed critically ill patients. The gastrointestinal outcomes in this study includes; abdominal distension, vomiting, gastric residual volume, intra-abdominal pressure and constipation.

As regards to **abdominal distension** as a gastrointestinal outcome**,** the present study showed that, about one fourth of the studied subjects had abdominal distension. From the researcher's point of view, abdominal distension can develop depending on various reasons such as the content, density and temperature of the feeding formula, its fat content and incorrect technique of intermittent enteral feeding. This result was in agreement with ***Kahraman et al., (2020),*** who mentioned that, more than one fourth of the studied patients had abdominal distension. While, this finding was in disagreement with ***Gönderen et al., (2022),*** who reported that minority (7.1 %) of the studied subjects had abdominal distention.

In relation to **vomiting** as another gastrointestinal outcome, the current study showed that none of the studied subjects had vomiting. This is might be related to all studied subjects had hemodynamic stability as inclusion criteria and suitable amount of feeding per meal. This finding was in the same line with ***Kahraman et al., (2020),*** who found that only one patient (1.9 %) of the studied sample had vomiting. Moreover, this result was in disagreement with ***Morsy et al., (2021)*** who mentioned that vomiting presents in about one third (32.8 %) of the studied sample.

Concerning **gastric residual volume (GRV)**, the present study, showed that the mean score of gastric residual volume (GRV) for the studied patients was 12.82±4.59 ml. The Canadian Clinical Practice Guidelines define an acceptable gastric residual volume between 250 and 500 mL. This result can be attributed to the enteral feeding technique adopted in the intensive care unit in the present study where enteral feeding is started gradually and accelerated in accordance with absence of gastrointestinal complications. This finding was in the same line with ***Kahraman et al., (2020),*** who mentioned that only minority the studied sample had increased gastric residual volume. Meanwhile, this result was not consistent with a study published by **Dhandapani and Yaddanapudi, (2019),** entitled ''Intolerance among Patients on Bolus Method of Intermittent Enteral Feeding Admitted in ICU in a Tertiary Care Hospital'' who said that the incidence of high gastric residual volume was more than half of the studied sample (52%).

Concerning **intra-abdominal pressure** as gastrointestinal outcome**,** the present study revealed that more than two thirds of the studied subjects had normal intra-abdominal pressure. As well as, the mean score of intra-abdominal

pressure for was 9.58±3.43 mmHg. Intra-abdominal pressure is the pressure concealed within the abdominal cavity which is measured indirectly using the bladder to obtain the inferred measurement. A normal pressure reading is 0-5 mmHg, while in critically ill patients it may raise to 7-12 mmHg ***(Du et al., 2021; Gorad & Prabhu, 2021).***

This result might be related to majority of the studied subjects had hemodynamic stability and no gastrointestinal problems. This finding was in the same line with ***Abdelhafez & Abd Elnaeem, (2019),*** whose study title was '' Effect of Abdominal Massage on Gastrointestinal Complications and Intra-Abdominal Pressure of Critical-Enteral-Feed Patients'' who reported the intra-abdominal pressure readings of the studied sample were within accepted level and not exceeds to be intra-abdominal hypertension.

Regarding **constipation** as a gastrointestinal outcome**,** the present study revealed that, more than half of the studied subjects had mild constipation. This finding might be the majority of the studied subjects were elderly and had limited ability for movement. This result was in agreement with ***Morsy et al.,*** **(2021)**, who found that about one half of the studied patients had constipation. Meanwhile, this result was contradicted with ***Gönderen et al., (2022)*** who reported that minority of the studied sample had constipation.

Concerning **correlation between body mass index and gastrointestinal outcomes** (abdominal distension, gastric residual volume, intra-abdominal pressure and constipation), the current study revealed that, there was highly statistically positive correlation between body mass index and intra-abdominal pressure. Meanwhile, there was statistically negative correlation between body mass index and constipation.

Regarding **correlation between gastrointestinal outcomes** of the studied patients (abdominal distension, gastric residual volume, intra-abdominal pressure and constipation), the current study showed that, there was statistically positive correlation between abdominal distension and gastric residual volume. Meanwhile, there was highly statistically positive correlation between intra-abdominal pressure and abdominal distension. Also, there was statistically negative correlation between constipation and abdominal distension.

Conclusion:

Based on the result of the current study, it can be concluded that: about one fourth of the studied subjects had abdominal distension, none of them had vomiting, the mean score of gastric residual volume (GRV) for the studied patients was 12.82±4.59 ml, more than two thirds of them had normal intra-abdominal pressure and more than half of the studied subjects had mild constipation with highly statistically positive correlation between body mass index and intra-abdominal pressure.

Recommendations:

• On-going and regular in-service educational programs about assessment of gastrointestinal outcomes among enterally fed critically ill patients and how to measure gastric residual volume and intra-abdominal pressure.

• The study should be replicated on large sample and in different geographical settings in order to generalize the results.

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