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ORIGINAL RESEARCH

Early Dietary Fiber Intake in ICU Patients and Its Associations with Acute Gastrointestinal Injury: A Prospective Observational Study

Ting Liu[1,*], Hai-fang Wang[2,*], Xiao-song Jiang[1], Yu-yu Wang[1], Can Wang[1], Jian-zheng Cai[2]

[1]Department of Intensive Care Medicine, The First Affiliated Hospital of Soochow University, Suzhou, 215006, People's Republic of China; [2]Nursing Department, The First Affiliated Hospital of Soochow University, Suzhou, 215006, People's Republic of China

*These authors contributed equally to this work

Correspondence: Can Wang; Jian-zheng Cai, Email wangcan@suda.edu.cn; 15106205726@163.com

Background: Insufficient early dietary fiber (DF) supplement may be closely associated with adverse clinical outcomes in critically ill patients.

Objective: We evaluated the association between the early intake of dietary fiber (DF) and the development of acute gastrointestinal injury (AGI) in ICU patients.

Methods: A prospective observational study was conducted at the First Affiliated Hospital of Soochow University from April 2021 to March 2023. *DF* intake was quantified using dietary records, and AGI severity was assessed on day 3 (D3) and day 5 (D5) after ICU admission based on the 2012 ESICM recommendations.

Results: A total of 184 ICU patients were enrolled. The mean daily *DF* intake over the first five days was 5.44 ± 4.33 g/day. The cumulative intake reached 11.07 ± 11.60 g by day 3 and 27.21 ± 21.65 g by day 5. The incidence of AGI was 95.6%, 77.7%, and 51.1% on days 1, 3, and 5, respectively. Ordered logistic regression revealed that higher average *DF* intake in the first three days was independently associated with reduced AGI severity on D3 (OR 0.863, 95% CI: 0.771–0.967, $P < 0.05$) and D5 (OR 0.823, 95% CI: 0.712–0.952, $P < 0.05$).

Conclusion: Higher average *DF* intake during the first three days following ICU admission may be associated with reduced AGI severity on D3 and D5. Future multi-center, large-sample, randomized controlled studies are needed to confirm the relationship between early *DF* intake and the severity of AGI.

Keywords: dietary fiber, acute gastrointestinal injury, critically ill patients

Introduction

The gastrointestinal (GI) tract is a vital organ system responsible for digestion, absorption, secretion, and immune defense.[1] In critically ill patients, it is particularly vulnerable to dysfunction such as dysmotility, malabsorption, microbial dysbiosis, and mucosal injury.[2] As such, monitoring GI function is essential in the intensive care setting. In 2012, the Working Group on Abdominal Problems (WGAP) of the European Society of Intensive Care Medicine (ESICM) introduced the concept of acute gastrointestinal injury (AGI) to classify GI dysfunction as part of multiple organ dysfunction syndrome in critically ill patients.[3] The severity of AGI is closely associated with adverse clinical outcomes in ICU patients.[4] Higher AGI grades are linked to reduced caloric intake due to feeding intolerance, prolonged ICU stays, and increased risk of ICU and 28-day mortality.[5–7] Hence, targeted therapeutic interventions that reduce AGI severity are essential for enhancing recovery in ICU patients.

Dietary fiber (DF) is an essential component of human nutrition that is recognized for its broad health benefits in both healthy individuals and patients with chronic conditions.[8] In the colon, fermentable fibers are metabolized by commensal obligate anaerobes to produce short-chain fatty acids (SCFAs)—notably butyrate, propionate, and acetate—that support intestinal barrier function.[9] The provision of DF also decreases the pH of intestinal tract, which promotes the growth of

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butyrate-producing commensal bacteria while inhibiting or preventing the growth of *Clostridioides difficile*,[10] and enhances gut microbial homeostasis.[11] These benefits are well-established outside the ICU setting. Emerging evidence suggests that fiber-supplemented enteral nutrition (EN) may also be safe and beneficial for critically ill patients, particularly those who are hemodynamically stable.[12] For example, DF is found to improve intestinal motility, facilitates gastrointestinal transit,[13] and reduces the incidence of feeding intolerance such as abdominal distension in ICU patients.[14] Liu et al[15] explored the effects of DF supplement strategies in the first 5 days of ICU admission on the incidence of AGI at Day 5 and Day 7 in critically ill patients. Though the results pointed there was an increased risk in the grade of AGI in the Sustained Low Group on D5 and D7 compared with the Rapidly Rising Group, the dose-response relationship and timing of early DF intake in AGI prevention remain inadequately characterized. Therefore, the present study sought to evaluate the association between the early intake of DF and the development of AGI in ICU patients.

Materials and Methods

Design

The study was designed as a prospective observational study to evaluate the association of AGI and DF intake in ICU patients. The reporting of the study conforms to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement.[16] The study protocol was approved by the ethics committee of The First Affiliated Hospital of Soochow University (No. 2021174) and implemented in accordance with the Declaration of Helsinki.

Sample and Setting

This study enrolled patients admitted to the 16-bed ICU of the First Affiliated Hospital of Soochow University between April 2021 and March 2023. Patients were included if they were (1) ≥18 years old, (2) stayed in the ICU over 72 hours, and (3) received enteral nutrition (EN) via oral, gastric, or jejunal routes. They were excluded if they (1) got admitted due to Crohn's disease, ulcerative colitis, or short bowel syndrome, (2) were discharged or died within 72 hours of ICU admission, or (3) lacked sufficient data to assess the grade of AGI. Informed consent procedures in this study were implemented in strict compliance with ethical standards and participant protection principles. For participants who were fully conscious and capable of autonomous decision-making, written informed consent was obtained directly from them. If participants presented with consciousness impairment at the time of enrollment, consent was obtained from legally authorized representatives. Where possible, we later sought affirmation of consent from participants once their capacity was restored to ensure ongoing ethical rigor.

Data Collection

Demographic and clinical data were collected for each patient using a standardized general information questionnaire. The demographic variables included age, sex, education level, and body mass index (BMI). The clinical variables included comorbidities, Acute Physiology and Chronic Health Evaluation II (APACHE-II) score (within the first 24 hours of ICU admission), supportive interventions (vasopressor administration, mechanical ventilation, and continuous renal replacement therapy), and medications received (analgesics and sedatives).

The primary exposure was defined as the average DF intake during the first 72 hours of ICU admission, assessed using detailed dietary logs for all patients and stratified by feeding method:

- For patients receiving EN via gastric or jejunal tubes:
  - The dietary log included the type of feed, nutritional composition, hourly infusion rate, and infusion duration.
  - The fiber content of each feed type was sourced from the manufacturer's published nutritional information.
  - Total fiber intake over 72 hours was calculated by multiplying the administered volume by the fiber content per unit volume.

- For patients on oral diets:
  - The dietary log documented the names and amounts of all consumed food items.
  - DF intake was calculated using the Feihua Nutrition Software (V2.7.6.10, Beijing, China).

AGI assessments were conducted at 9:00 a.m. on days 1, 3, and 5 of ICU admission. The primary outcomes were the incidences of AGI on days 3 and 5. Grading was based on the 2012 ESICM recommendations (Table 1), which employ a semiquantitative scale (0 to 4) to assess AGI severity.[3] To ensure consistency and reliability in grading, two researchers underwent standardized training prior to study initiation. The training covered study objectives, methodology, timeline, data collection tools and procedures, and protocols for assessing DF intake and AGI.

Sample Size

A previous study reported an AGI incidence rate of 40.0% in ICU.[4] The sample size estimation, based on the incidence of AGI, was carried out using Power Analysis and Sample Size (PASS version 15.0; New Canaan, CT, USA) with the following settings: alpha = 0.05, power = 90%. A two-tailed *t*-test was applied. The accepted minimal sample size was 120, which assumed a dropout rate of 20%.

Statistical Analysis

All analyses were performed using SPSS 25.0 (IBM Corp., Chicago, IL, USA). Continuous variables were assessed for normality using the Shapiro–Wilk test. Normally distributed data presented as mean ± standard deviation (SD) and compared using analysis of variance (ANOVA). For data that were not normally distributed, results were reported as median [P25, P75] and compared using the Kruskal–Wallis *H*-test. Categorical variables are presented as case count (percentage) and compared using the chi-square test. Associations between DF intake and AGI grades on days 3 and 5 were examined using ordinal logistic regression. Covariates with $P < 0.05$ in univariate analysis were included in the multivariate model. A two-tailed P value of <0.05 was considered statistically significant. Dual-axis visualization was performed using R (v4.2.0) and ggplot2 (v3.4.0) to show the trends in DF intake and AGI severity across ICU days.

Table 1 Classification of Acute Gastrointestinal Injury

Grade	Definition
0 (No AGI)	No AGI.
I (risk of GI dysfunction or failure)	Partial impairment of GI function, manifested as gastrointestinal symptoms related to a known cause and perceived to be transient. • Examples: postoperative nausea and/or vomiting during the first few days after abdominal surgery, postoperative absence of bowel sounds, diminished bowel motility in the early phase of shock.
II (GI dysfunction)	The GI tract is unable to perform digestion and absorption adequately to satisfy the nutrient and fluid requirements of the body. There are no changes in the general condition of the patient due to GI problems. • Examples: gastroparesis with high gastric residuals or reflux, paralysis of the lower GI tract, diarrhea, intra-abdominal pressure (IAP) 12–15 mmHg, visible blood in gastric content or stool. Feeding intolerance is present if at least 20 kcal/kg-BW/day via the enteral route cannot be achieved within 72 hours of a feeding attempt.
III (GI failure)	Loss of GI function. Restoration of GI function is not achieved despite interventions, and the general condition is not improving. • Examples: persistent feeding intolerance despite treatment, manifested as high gastric residuals, persistent GI paralysis, occurrence or worsening of bowel dilatation, IAP 15–20 mmHg, low abdominal perfusion pressure (<60 mmHg). Feeding intolerance is present and may be associated with persistence or worsening of multiple organ dysfunction syndrome.
IV (GI failure with severe impact on distant organ function)	AGI has progressed to become directly and immediately life-threatening, with worsening of multiple organ dysfunction syndrome and shock. • Examples: bowel ischemia with necrosis, GI bleeding leading to hemorrhagic shock, Ogilvie syndrome, abdominal compartment syndrome requiring decompression.

Results

Basic Patient Information

The study included a total of 184 ICU patients (Table 2), including 122 (66.3%) males and 62 (33.7%) females. Their age was 62.57 ± 18.82 years. Their BMI was 22.89 ± 3.49 kg/m^2, and the breakdown was as follows: underweight, 12 (6.5%); normal, 124 (67.4%); overweight, 30 (16.3%); obese, 18 (9.8%). Among them, 56 (30.5%) had a high school education or higher. There were 104 (56.5%) patients receiving mechanical ventilation and 12 (6.5%) receiving CRRT. There were 82 (44.6%) patients on vasoactive medications, 99 (53.8%) on analgesic medications, and 84 (45.7%) on sedative medications.

Nutrition Intake

Table 3 summarizes the enteral nutrition intake each day. The cumulative intake was 7.50 [0, 22.5] g over the first three days and 22.50 [8.46, 45.53] g over the first five days. The daily DF intake during the first five days of ICU admission was 4.50 [1.69, 9.11] g/d.

Table 2 General Patient Characteristics

Characteristics[§]	All Patients (n = 184)
Age (years)	62.57 ± 18.88
Sex (M/F)	122/62
BMI (kg/m^2)[§]	22.89 ± 3.49
Underweight (<18.5)	12 (6.5%)
Normal (18.5–24.9)	124 (67.4%)
Overweight (25.0–29.9)	30 (16.3%)
Obese (>30.0)	18 (9.8%)
Education level	
Primary school	41 (22.3%)
Junior high school	87 (47.3%)
General high school and above	56 (30.4%)
APACHE II	12.85 ± 7.58
Supportive interventions	
Mechanical ventilation	104 (56.5%)
CRRT	12 (6.5%)
Medication use	
Vasopressors	82 (44.6%)
Analgesics	99 (53.8%)
Sedatives	84 (45.7%)

Note: [§]Values expressed as mean ± standard deviation or case count (percentage).
Abbreviations: BMI, body mass index; APACHE II, Acute Physiology and Chronic Health Evaluation II score; CRRT, continuous renal replacement therapy.

Table 3 Summary of Nutrient Intake

Days in ICU	*DF* (g)[§]	Carbohydrates (g)[§]	Proteins (g)[§]	Fats (g)[§]	Total Calories (kcal)[§]
D1	0 [0, 1.50]	0 [0, 29.20]	0 [0, 10.20]	0 [0, 8.30]	130.50 [0, 270.18]
D2	0.95 [0, 7.50]	25.75 [0, 92.50]	9.05 [0, 30.00]	7.10 [0, 29.20]	556.09 [0, 750.00]
D3	4.60 [0, 7.50]	92.50 [0, 185.00]	30 [0, 60.00]	29.20 [0, 48.85]	753.00 [533.25, 1193.25]
D4	7.50 [0, 15.00]	123.13 [39.53, 185.00]	36.41 [10.25, 60.00]	32.00 [6.63, 58.40]	1038.40 [750.00, 1500.00]
D5	8.47 [3.00, 15.00]	138.51 [92.50, 185.00]	40.05 [30.00, 60.00]	36.02 [20.03, 58.40]	1080.40 [750.00, 1500.00]

Note: [§]Values expressed as median [P25, P75].
Abbreviation: DF, dietary fiber.

Table 4 Incidence of AGI in ICU Patients

ICU Days / AGI grade[§]	D1	D2	D3	D4	D5
Grade 0	10 (5.4%)	22 (12%)	41 (22.3%)	76 (41.3%)	90 (48.9%)
Grade I	109 (59.2%)	95 (51.6%)	65 (35.3%)	55 (29.9%)	50 (27.2%)
Grade II	53 (28.8%)	55 (29.9%)	65 (35.3%)	44 (23.9%)	34 (18.5%)
Grade III	12 (6.6%)	12 (6.5%)	13 (7.1%)	9 (4.9%)	9 (4.9%)
Grade IV	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (0.5%)

Notes: [§]See Table 1 for definitions. Values are expressed as case count (ratio).
Abbreviation: AGI, acute gastrointestinal injury.

Incidences of AGI

Table 4 describes the incidence of AGI among patients. On day 1, the incidence was 95.6%, with 109 cases (59.2%) of Grade I, 53 cases (28.8%) of Grade II, and 12 cases (6.6%) of Grade III. On day 2, the incidence was 88.0%, with 95 cases (51.6%) of Grade I, 55 cases (29.9%) of Grade II, and 12 cases (6.5%) of Grade III. On day 3, the incidence was 77.7%, with 65 cases (35.3%) of Grade I, 65 cases (35.3%) of Grade II, and 13 cases (7.1%) of Grade III. On day 4, the incidence was 58.7%, with 55 cases (29.9%) of Grade I, 44 cases (23.9%) of Grade II, and 9 cases (4.9%) of Grade III. On day 5, the incidence was 51.1%, with 50 cases (27.2%) of Grade I, 34 cases (18.5%) of Grade II, 9 cases (4.9%) of Grade III, and 1 case (0.5%) of Grade IV.

Relationship Between DF Intake and AGI

Figure 1 presents the trends in DF intake and AGI severity across ICU days. Table 5 shows that according to univariate analysis, the following factors significantly ($P < 0.05$) affected the incidence of AGI on day 3: APACHE II score, CRRT, the occurrence of AGI on day 1, the average DF intake and the total caloric intake over the first three days. An ordered logistic regression analysis was conducted using AGI on day 3 as the dependent variable and the factors listed above as

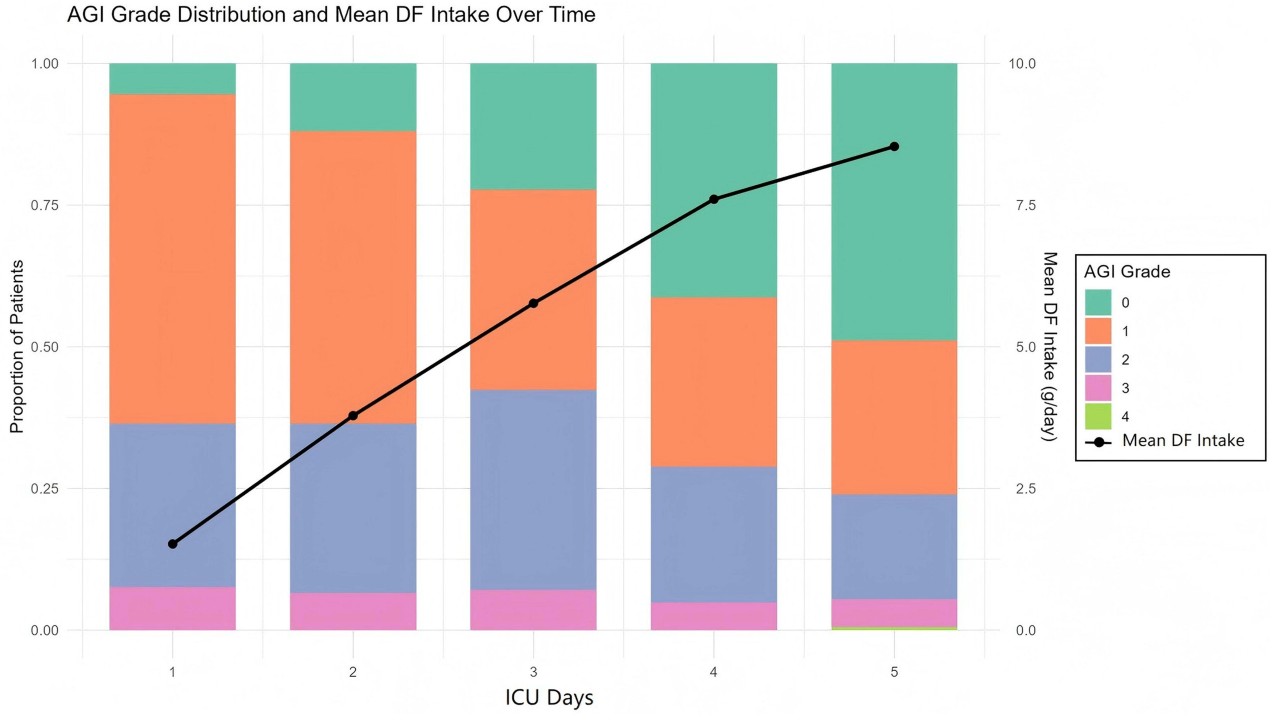

Figure 1 Trends in *DF* intake and AGI severity across ICU days.

Table 5 Single Factor Analysis of Variables Affecting AGI on Day 3

Variables[§]	AGI Grade on Day 3[†]				*F* / *H* / χ^2	*P*
	0 (n = 41)	I (n = 65)	II (n = 65)	III or IV (n = 13)		
Basic information						
Age (year)	64.20 ± 17.20	66.48 ± 14.31	59.28 ± 21.70	54.31 ± 24.32	2.599	0.054
Sex - Male	31 (75.6%)	41 (63.1%)	41 (63.1%)	9 (69.2%)	2.245	0.523
BMI (kg/m^2)	22.89 ± 2.50	22.50 ± 3.18	22.86 ± 4.07	25.02 ± 4.02	1.936	0.125
APACHE II	11.34 ± 6.24	11.40 ± 6.887	14.20 ± 7.79	18.08 ± 10.50	4.308	0.006**
Supportive intervention						
Mechanical ventilation	19 (46.3%)	33 (50.8%)	42 (64.6%)	10 (76.9%)	6.539	0.088
CRRT	0 (0.0%)	5 (3.1%)	2 (3.1%)	5 (38.5%)	26.026	<0.001***
Medication						
Vasopressor	16 (39.0%)	27 (41.5%)	29 (44.6%)	10 (76.9%)	6.260	0.100
Analgesics	17 (41.5%)	37 (56.9%)	36 (55.4%)	9 (69.2%)	4.077	0.253
Sedative drugs	13 (31.7%)	30 (46.2%)	32 (49.2%)	9 (69.2%)	6.468	0.091
AGI						
AGI on D1	34 (82.9%)	64 (98.5%)	63 (96.9%)	13 (100%)	14.176	0.003**
Intake in the first 3 days						
Mean total calories (kcal)	750.00 [504.50, 1166.83]	547.31 [403.03, 1000.00]	500.00 [0, 547.31]	547.31 [217.68, 548.33]	22.013	<0.001***
Mean *DF* (g)	5.00 [1.90, 10.00]	4.90 [0, 7.50]	0 [0, 5.00]	0 [0, 2.50]	28.842	<0.001***

Notes: [†]Data are expressed as mean ± standard deviation, median [P25, P75], or case count (ratio). **$P < 0.01$, ***$P < 0.001$.
Abbreviations: [§]BMI, body mass index; APACHE II, Acute Physiology and Chronic Health Evaluation II score; AGI, acute gastrointestinal injury; CRRT, continuous renal replacement therapy.

Table 6 Ordinal Logistic Regression Analysis of Factors Affecting AGI on Day 3

Variables[§]	*B*	*SE*	*Wald*	*P*	*OR* (95% CI)
Mean *DF* intakes in the first 3 days	−0.147	0.058	6.469	0.011*	0.863 [0.771, 0.967]
APACHE II	0.062	0.191	10.349	0.001*	1.064 [1.024, 1.104]
CRRT	0.985	0.627	2.469	0.116	2.678 [0.784, 9.151]
AGI on D1	2.266	0.724	9.794	0.002*	9.462 [2.332, 39.861]
Mean total calorie intake in the first 3 days	−0.001	0.001	2.433	0.119	0.999 [0.998, 1.001]

Notes: *$P < 0.05$.
Abbreviations: [§] APACHE II, Acute Physiology and Chronic Health Evaluation II score; CRRT, continuous renal replacement therapy; AGI, acute gastrointestinal injury.

independent variables (Table 6). The average intake of DF in the first three days was negatively correlated with the incidence of AGI on day 3 (*OR* 0.863, 95% *CI*: 0.771–0.967, $P < 0.05$).

Table 7 shows that according to univariate analysis, the following factors significantly ($P < 0.05$) affected the incidence of AGI on day 5: BMI, APACHE II score, mechanical ventilation, CRRT, use of vasopressors, sedatives, or analgesics, the average DF intake and the total caloric intake over the first three days. An ordered logistic regression analysis was conducted using AGI on day 5 as the dependent variable and the factors listed above as the independent variables (Table 8). The average intake of DF in the first three days was negatively correlated with the incidence of AGI on day 5 (*OR* 0.823, 95% *CI* 0.712–0.952, $P < 0.05$).

Discussion

Although the exact recommended dose varies by age and sex, healthy adults should consume at least 25 g DF daily.[17] ICU nutrition emphasizes phased support to mitigate catabolism while minimizing complications such as feeding intolerance, refeeding syndrome, and gut ischemia.[18] While ASPEN/SCCM recommends 10–20 g/day of fermentable soluble fiber as adjunctive therapy in patients with diarrhea, no specific dose is provided for routine use in stable patients

Table 7 Single Factor Analysis of Variables Affecting AGI on Day 5

Variables[§]	AGI Grade on Day 5[†]				F / χ^2	P
	0 (n = 90)	I (n = 50)	II (n = 34)	III or IV (n = 10)		
Basic information						
Age (year)	62.87 ± 17.70	64.46 ± 19.08	60.38 ± 22.43	57.80 ± 14.73	0.538	0.657
Sex - Male	60 (66.7%)	32 (64.0%)	24 (70.6%)	6 (60.0%)		
BMI (kg/m^2)	22.81 ± 3.28	22.18 ± 3.22	23.15 ± 3.92	26.27 ± 3.42	4.087	0.008**
APACHE II	11.46 ± 6.94	13.42 ± 7.26	13.38 ± 7.63	20.70 ± 9.97	5.614	0.002**
Supportive intervention						
Mechanical ventilation	40 (44.4%)	36 (72.0%)	20 (58.8%)	8 (80.0%)	12.533	0.006**
CRRT	3 (3.3%)	3 (6.0%)	3 (8.8%)	3 (6.5%)	10.860	0.013*
Medication						
Vasopressor	27 (30.0%)	27 (54.0%)	19 (55.9%)	9 (90.0%)	19.649	<0.001***
Analgesics	38 (42.2%)	32 (64.0%)	21 (61.8%)	8 (80.0%)	10.576	0.014*
Sedative drugs	29 (32.2%)	24 (48.0%)	22 (64.7%)	9 (90.0%)	19.556	<0.001***
AGI						
AGI on D1	85 (94.4%)	48 (96.0%)	31 (91.2%)	10 (100%)	1.537	0.674
Intake in the first 3 days						
Mean total calories (kcal)	547.31 [431.98, 909.75]	534.15 [109.00, 750.00]	500.00 [100.00, 564.23]	547.31 [187.50, 547.31]	11.268	0.010*
Mean *DF* (g)	4.62 [0, 7.50]	4.36 [0, 7.50]	0 [0, 5.00]	0 [0, 0.63]	16.086	0.001**

Notes: [†]Data are expressed as mean ± standard deviation, expressed as median [P25, P75], or case count (ratio). *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.
Abbreviations: [§]BMI, body mass index; APACHE II, Acute Physiology and Chronic Health Evaluation II score; AGI, acute gastrointestinal injury; CRRT, continuous renal replacement therapy.

Table 8 Ordinal Logistic Regression Analysis of Factors Affecting AGI on D5

Variables[§]	*B*	*SE*	*Wald*	*P*	*OR* (95% CI)
Mean *DF* intake in the first 3 days	−0.131	0.065	4.008	0.045*	0.877 [0.772, 0.997]
BMI	0.061	0.043	2.046	0.153	1.063 [0.978, 1.157]
APACHE II	0.028	0.021	1.697	0.193	1.028 [0.986, 1.072]
Mechanical ventilation	0.281	0.388	0.526	0.468	1.325 [0.619, 2.833]
CRRT	0.896	0.588	2.323	0.163	2.450 [0.774, 7.758]
Analgesics	0.048	0.389	0.016	0.901	1.050 [0.490, 2.248]
Sedatives	0.943	0.392	5.798	0.016*	2.569 [1.192, 5.537]
Vasopressor	0.838	0.341	6.049	0.014*	2.311 [1.185, 4.506]
Mean total calorie intake in the first 3 days	−0.001	0.001	1.221	0.269	0.999 [0.998, 1.001]

Note: *$P < 0.05$.
Abbreviations: [§]AGI, acute gastrointestinal injury; BMI, body mass index; APACHE II, Acute Physiology and Chronic Health Evaluation II score; CRRT, continuous renal replacement therapy.

without GI symptoms.[19] In practice, fiber is often introduced gradually and titrated based on tolerance. The ESPEN 2023 ICU guideline does not discuss DF,[20] possibly due to evidentiary gaps and prioritization on safety. In this work, the mean daily DF intake of the cohort increased from day 1 to day 5. The total incidence of AGI (all grades combined) gradually decreased over time and the incidence of Grade II–III AGI peaked on day 3. According to ordinal logistic regression analysis, the mean DF intake in the first three days was associated with reduced AGI severity on days 3 and 5.

The fermentation of DF generates SCFAs, which enhance gut barrier function, modulate immune responses, and help restore the gut microbiota.[21–23] However, DF is often restricted in ICU patients due to risks associated with hemodynamic instability, dysmotility, and impaired gastrointestinal transit.[11] Early DF intake in ICU patients remains controversial. Koch et al[24] conducted a meta-analysis, which covers 20 studies and involves 1405 critically ill patients, and found "very low-certainty evidence" supporting the clinical benefits of fiber-supplemented EN. Fu et al[22] carried out a prospective cohort study in ICU patients to study the relationship between DF intake and SCFA-producing bacteria.

They reported that of 129 ICU patients, the median DF intake over the first 72 hours is 13.4 g (27.3 g after excluding those who received no fiber).

AGI is a common problem in the critically ill population and its incidence is high.[7] Yang et al[9] found that of 98 patients with cerebrovascular disease admitted to a neurology ICU, the incidence of AGI is 90.8%. Shen et al[25] reviewed the medical records of 178 patients admitted to a general ICU at a regional university hospital and found that 92.13% of patients present with AGI in the first week. In this study, the AGI incidence on day 1 was even higher (94.60%), likely because many patients had hemodynamic instability and/or received mechanical ventilation at the time of admission,[7] although the AGI incidence decreased steadily over time. Zhong et al[7] conducted a prospective observational study to examine the AGI grades and outcomes for ICU patients. For the ICU patients who have AGI, the comparison between day 3 and day 1 shows deterioration for 14.56% and improvement for 8.74% of the patients, respectively. For our cohort, the combined incidence of Grade II and Grade III AGI peaked on day 3, which is possibly related to guideline recommendations to initiate enteral nutrition within 24–48 hours in ICU patients.[20] However, during this early phase, many patients experience acute physiological stress, impaired gastrointestinal motility, and reduced absorptive capacity.[14] These factors, along with feeding intolerance symptoms such as diarrhea and abdominal distension, may contribute to a transient rise in AGI severity.

There is currently limited knowledge about the relationship between DF intake and AGI in ICU patients. Liu et al[15] found in a prospective observational study that compared to ICU patients with a rapidly rising DF intake trajectory during the first five days of admission, those with sustained low or slowly rising DF intake trajectories have a significantly higher risk of developing moderate-to-severe AGI by days 5 and 7. Berger and Hurni[26] suggested that DF is relevant for mitigating AGI in hemodynamically stable ICU patients, noting that fiber-enriched enteral nutrition is increasingly accepted due to its role in supporting the gut microbiota, reducing constipation, and potentially preventing gastrointestinal dysfunction. Liu et al[27] reported that compared to ICU patients with severe acute pancreatitis receiving standard enteral nutrition, those who received early enteral nutrition supplemented with fructooligosaccharides (a soluble dietary fiber) had significantly lower AGI scores, fewer intra-abdominal infections, shorter ICU stays, and reduced mortality. Besides, Fu et al[22] reported that for ICU patients, higher DF intake over the first 72 hours is associated with significantly greater relative abundance of SCFA-producing bacteria, reduced *Enterococcus* overgrowth, and fewer gastrointestinal symptoms such as abdominal distension, all without increased risk of diarrhea or other adverse events.

In this study, the severity of acute gastrointestinal injury (AGI) in ICU patients on day 3 was positively correlated with the APACHE-II score as well as the occurrence of AGI on day 1. The APACHE-II score is a widely used tool for assessing disease severity in adult ICU patients, with higher scores indicating more severe conditions.[28] Zhong et al[7] also found that higher APACHE-II scores correlate with more severe AGI. Little is known about the correlation between day 1 AGI and the severity of AGI in ICU patients on day 3, likely because of the more severe conditions of patients who develop AGI on day 1. We also found that the severity of AGI in ICU patients on day 5 was positively associated with the use of sedative and vasoactive medications. Sedatives may delay gastric emptying and prolong intestinal transit time, leading to increased absorption of water and electrolytes, excessive proliferation of pathogenic bacteria, higher risk of gastrointestinal infections, and disruption of the gastrointestinal barrier, all of which are factors of AGI worsening.[29] The use of vasoactive medications suggests hemodynamic instability, circulatory dysfunction, reduced gastrointestinal perfusion, ischemia and hypoxia in the gastrointestinal tract, and damage to the intestinal mucosal barrier, which are factors of AGI exacerbation.[30] Moreover, vasoactive medications may directly damage the gastrointestinal tract, as high doses of vasoactive medications and positive inotropic agents, particularly catecholamines, can directly harm organ function and cause immune-mediated damage.[31]

This study has several limitations. First, it was conducted at a single medical center, and the generalizability to broader ICU populations is undetermined. Second, due to funding constraints and the high cost of biochemical assays, we did not objectively measure biomarkers of intestinal mucosal injury[32,33] (eg, serum diamine oxidase,[33] D-lactic acid[34]), which may introduce bias in the assessment of AGI severity. Third, although we adjusted for key clinical confounders, the inherent complexity and heterogeneity of ICU patient conditions mean that residual confounding cannot be excluded. We were unable to perform a formal power analysis tailored to the final multivariable models, and full control of all potential confounders (eg, feeding tolerance, hemodynamic instability, protein and fat intake) was not feasible within the observational design. Together, these methodological constraints limit the robustness of our conclusions. Finally, while our findings suggest a potential benefit of early DF intake on AGI, the mechanisms underlying their relationship remain

speculative. The temporal sequence of DF intake and AGI improvement does not preclude reverse causation or time-dependent confounding. Future multi-center randomized controlled trials with larger sample and the incorporation of gut-specific biomarkers are needed to validate the present findings and clarify the causal pathways linking DF intake, SCFA production, and gastrointestinal integrity in critically ill patients.

Conclusions

Higher average DF intake during the first three days following ICU admission may be associated with reduced AGI severity on D3 and D5, but this conclusion remains preliminary due to the observational design and potential unmeasured confounding in the present study. Future multi-center, large-sample, randomized controlled studies are needed to confirm the relationship between early DF intake and the severity of AGI.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflict of interest.

References

1. Sharkey KA, Mawe GM. The enteric nervous system. *Physiol Rev*. 2023;103(2):1487–1564. doi:10.1152/physrev.00018.2022
2. Reintam Blaser A, Preiser JC, Fruhwald S, et al. Gastrointestinal dysfunction in the criticallyill: a systematic scoping review and research agenda proposed by the section of metabolism,endocrinology and nutrition of the European society of intensive care medicine. *CritCare*. 2020;24(1):224. doi:10.1186/s13054-020-02889-4
3. Reintam Blaser A, Malbrain ML, Starkopf J, et al. Gastrointestinal function in intensive carepatients: terminology, definitions and management. Recommendations of the ESICMWorking Group on Abdominal Problems. *Intensive Care Med*. 2012;38(3):384–394. doi:10.1007/s00134-011-2459-y
4. Zhang D, Li Y, Ding L, et al. Prevalence and outcome of acute gastrointestinal injury incritically ill patients: a systematic review and meta-analysis. *Medicine*. 2018;97(43):e12970. doi:10.1097/MD.0000000000012970
5. Li H, Lu J, Li H, et al. Association between nutrition support and acute gastrointestinal injury critically ill patients during the first 72 hours. *Clin Nutr*. 2021;40(1):217–221. doi:10.1016/j.clnu.2020.05.011
6. Klanovicz TM, Franzosi OS, Nunes DSL, et al. Acute gastrointestinal failure is associatedwith worse hemodynamic and perfusion parameters over 48 h after admission in patientswith septic shock: retrospective cohort study. *Nutr Clin Pract*. 2023;38(3):617–627. doi:10.1002/ncp.10928
7. Zhong M, Xu W, Qiu Y, et al. Association of changes in acute gastrointestinal injury gradewith prognosis in critically ill patients: a prospective, single-center, observational study. *J Multidiscip Healthc*. 2021;14:279–286. doi:10.2147/JMDH.S291883
8. Alahmari LA. Dietary fiber influence on overall health, with an emphasis on CVD, diabetes,obesity, colon cancer, and inflammation. *Front Nutr*. 2024;11:1510564. doi:10.3389/fnut.2024.1510564
9. Yao Y, Cai X, Fei W, et al. The role of short-chain fatty acids in immunity, inflammation andmetabolism. *Crit Rev Food Sci Nutr*. 2022;62(1):1–12. doi:10.1080/10408398.2020.1854675
10. Valdés-Duque BE, Giraldo-Giraldo NA, Jaillier-Ramírez AM, et al. Stool short-chain fattyacids in critically ill patients with sepsis. *J Am Coll Nutr*. 2020;39(8):706-712. doi:10.1080/07315724.2020.1727379
11. McClave SA, Omer E, Eisa M, et al. The importance of providing dietary fiber in medicaland surgical critical care. *Nutr Clin Pract*. 2024;39(3):546–556. doi:10.1002/ncp.11092
12. Liu T, Feng P, Wang C, et al. Effects of dietary fibre on enteral feeding intolerance andclinical outcomes in critically ill patients: a meta-analysis. *Intensive Crit Care Nurs*. 2023;74:103326. doi:10.1016/j.iccn.2022.103326
13. Chen T, Ma Y, Xu L, et al. Soluble dietary fiber reduces feeding intolerance in severeacute pancreatitis: a randomized study. *JPEN J Parenter Enteral Nutr*. 2021;45(1):125–135. doi:10.1002/jpen.1816
14. Green CH, Busch RA, Patel JJ. Fiber in the ICU: should it be a regular part of feeding? *Curr Gastroenterol Rep*. 2021;23(9):14. doi:10.1007/s11894-021-00814-5
15. Liu T, Liu B, Jiang YQ, et al. Effects of different dietary fiber supplement strategies onincidence of acute gastrointestinal injury in ICU patients: a prospective observational study. *Intensive Crit Care Nurs*. 2024;84:103673. doi:10.1016/j.iccn.2024.103673
16. Cuschieri S. The STROBE guidelines. *Saudi J Anaesth*. 2019;13(Suppl 1):S31–s34. doi:10.4103/sja.SJA_543_18

17. Mckeown NM, Fahey GC, Slavin J, et al. Fibre intake for optimal health: how canhealthcare professionals support people to reach dietary recommendations? *BMJ*. 2022;378:e054370. doi:10.1136/bmj-2020-054370
18. Gunst J, Egi M, Van Den Berghe G. Nutrition and metabolic control for ICU patients. *Intensive Care Med*. 2025;51(6):1150–1152. doi:10.1007/s00134-025-07937-7
19. Mcclave SA, Taylor BE, Martindale RG, et al. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society ofcritical care medicine (SCCM) and American society for parenteral and enteral nutrition(A.S.P.E.N.). *JPEN J Parenter Enteral Nutr*. 2016;40(2):159–211. doi:10.1177/0148607115621863
20. Singer P, Blaser AR, Berger MM, et al. ESPEN practical and partially revised guideline:Clinical nutrition in the intensive care unit. *Clin Nutr*. 2023;42(9):1671–1689. doi:10.1016/j.clnu.2023.07.011
21. Nakahori Y, Shimizu K, Ogura H, et al. Impact of fecal short-chain fatty acids on prognosisin critically ill patients. *Acute Med Surg*. 2020;7(1):e558. doi:10.1002/ams2.558
22. Fu Y, Moscoso DI, Porter J, et al. Relationship between dietary fiber intake and short-chain fatty acid-producing bacteria during critical illness: a prospective cohort study. *JPEN J Parenter Enteral Nutr*. 2020;44(3):463–471. doi:10.1002/jpen.1682
23. Freedberg DE, Messina M, Lynch E, et al. Impact of fiber-based enteral nutrition on the gut microbiome of ICU patients receiving broad-spectrum antibiotics: a randomized pilot trial. *Crit Care Explor*. 2020;2(6):e0135. doi:10.1097/CCE.0000000000000135
24. Koch JL, Lew CCH, Kork F, et al. The efficacy of fiber-supplemented enteral nutrition incritically ill patients: a systematic review and meta-analysis of randomized controlled trialswith trial sequential analysis. *Crit Care*. 2024;28(1):359. doi:10.1186/s13054-024-05128-2
25. Shen C, Wang X, Xiao YY, et al. Comparing gastrointestinal dysfunction score and acutegastrointestinal injury grade for predicting short-term mortality in critically ill patients. *World J Gastroenterol*. 2024;30(42):4523–4531. doi:10.3748/wjg.v30.i42.4523
26. Berger MM, Hurni CA. Management of gastrointestinal failure in the adult critical caresetting. *Curr Opin Crit Care*. 2022;28(2):190–197. doi:10.1097/MCC.0000000000000924
27. Liu F, Xiao Z, Zeng H, et al. Early enteral nutrition with fructooligosaccharides improves prognosis in severe acute pancreatitis. *Sci Rep*. 2025;15(1):5267. doi:10.1038/s41598-025-89739-x
28. Gupta J, Kshirsagar S, Naik S, et al. Comparative evaluation of mortality predictors in trauma patients: a prospective single-center observational study assessing injury severity score revised trauma score trauma and injury severity score and acute physiology and chronic health evaluation II scores. *Ind j crit care med*. 2024;28(5):475–482.
29. Chang H, Li S, Li Y, et al. Effect of sedation with dexmedetomidine or propofol ongastrointestinal motility in lipopolysaccharide-induced endotoxemic mice. *BMCAnesthesiol*. 2020;20(1):227. doi:10.1186/s12871-020-01146-z
30. Xu J, Li S, Hu Y, et al. Construction and validation of a risk prediction model for acutegastrointestinal injury in non-icu elderly critically ill patients. *J Gen Intern Med*. 2025;40(11):2643–2651. doi:10.1007/s11606-025-09573-9
31. Wang Y, Wang J, Liu W, et al. Establishment of comprehensive prediction model of acutegastrointestinal injury classification of critically ill patients. *Zhonghua Wei Chang Wai KeZa Zhi*. 2018;21(3):325–330.
32. Cai Y, Gong D, Xiang T, et al. Markers of intestinal barrier damage in patients with chronicinsomnia disorder. *Front Psychiatry*. 2024;15:1373462. doi:10.3389/fpsyt.2024.1373462
33. Miyoshi J, Miyamoto H, Goji T, et al. Serum diamine oxidase activity as a predictor ofgastrointestinal toxicity and malnutrition due to anticancer drugs. *J Gastroenterol Hepatol*. 2015;30(11):1582–1590. doi:10.1111/jgh.13004
34. Li J, Ma P, Liu Z, et al. L- and D-Lactate: unveiling their hidden functions in disease andhealth. *Cell Commun Signal*. 2025;23(1):134. doi:10.1186/s12964-025-02132-z

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