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Association between Hospital Prescribed Diets and Length of Stay, Re-Presentation, and Gastrointestinal Symptoms among Acute Uncomplicated Diverticulitis Patients: A Prospective Cohort Study

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Abstract: Background and aim: Variation in practice has been observed among the prescribed diets for inpatients with acute, uncomplicated diverticulitis. This study aimed to observe outcomes (length of stay (LOS), re-presentations, and gastrointestinal symptoms) for acute, uncomplicated diverticulitis inpatients prescribed restricted or liberalised diets during usual care. Methods: Adult inpatients with acute, uncomplicated diverticulitis were prospectively enrolled from 2017 to 2019. Demographics, clinical data, and prescribed diets were collected from medical records. Patients were categorised as having restricted or liberalised diets. Primary outcomes were LOS, re-presentations related to diverticulitis, and gastrointestinal symptoms, collected from medical records and patient surveys. Descriptive statistics were used to characterise all variables. Adjusted regression analysis was used to determine the effect of diet prescription on primary outcomes. Results: Of the 81 included patients, 47% were prescribed restricted diets, and 53% were prescribed liberalised diets. Patients prescribed restricted diets had greater LOS (median 4.0 (IQR: 3.5–5.1) vs. 2.8 (IQR: 2.2–3.8) days, $p < 0.001$) and were more likely to re-present due to diverticulitis at six months (OR 8.1, 95% CI 1.3–51.0, $p = 0.025$) in adjusted models. No difference in gastrointestinal symptoms was observed 30-days post-admission. Conclusion: In patients hospitalised with uncomplicated diverticulitis, restricted diets may be associated with longer LOS and increased odds of re-presentation at 6 months compared to liberalised diets. No differences in post-discharge gastrointestinal symptoms were observed between restricted versus liberalised diets. Randomised controlled trials are needed to confirm the causal role of inpatient diet prescription on clinical outcomes, healthcare utilisation, and patient experience. Registration: prospectively registered; ANZCTR Number: ACTRN12616001378415.

Keywords: diverticulitis; diet therapy; recurrence; dietary fiber; length of stay

1. Introduction

Although preferably managed as outpatients, the rate of adults requiring acute care for uncomplicated diverticulitis is increasing globally [1–6]. The United States has seen a significant increase from 90.9 to 101.9 admissions per 100,000, 88% of which were uncomplicated cases [3,4]. Despite this, the mechanisms behind the development of uncomplicated diverticulitis are still not fully understood [7,8], though they are suspected to involve interactions between genetic factors, neuromuscular abnormalities, colonic motility, ageing, obesity and other comorbidities, changes in the microbiota, diet, and lifestyle factors such as smoking [6,8]. Due to a lack of understanding of its pathogenesis and aetiology combined with a lack of high-quality evidence, variations in treatment and prevention practice continue [9]. Restrictive prescribed diets for conservative management of uncomplicated cases have included nil-by-mouth with intravenous hydration [no oral food or fluids], liquid-only diets such as clear fluids [hypocaloric fluids with negligible protein, fat, and fibre], free fluids [liquids with reduced fibre content], or low-dietary-fibre diets [solid food with reduced fibre content] [10–12]. Restriction to nil-by-mouth or fluid-only diets was hypothesised to enable 'bowel rest', as food intake was considered to increase intestinal pressure and induce peristalsis [13], whereas low-dietary fibre diets were hypothesised to alleviate inflammation of the affected diverticula due to reduced stool bulk and frequency [12].

However, restricting dietary intake may put patients at increased risk of malnutrition, thereby increasing the impact of diet restriction well beyond hospital admission [14]. Malnutrition is common in hospitals, affecting 20–50% of patients and resulting in poor outcomes for both patients and health services [15,16]. Rates of malnutrition were underestimated in patients admitted with uncomplicated diverticulitis, with a recent study identifying that > 60% of patients had severely impaired nutritional status and significantly greater length of stay (LOS) than their well-nourished counterparts [17]. Optimal nutritional status may also be a priority for patients with diverticulitis due to an association between acute diverticulitis and an increased likelihood of being diagnosed with colorectal cancer [18,19]. Another risk of restricted diets may be modulation of the gastrointestinal microbiota, which could be compounded by simultaneous antibiotic use [20–22] and is hypothesised to be involved in the progression of diverticular disease [23]. Given that the microbiota in patients with diverticulitis has been noted to shift towards reduced taxa with anti-inflammatory activity [22–25], evidence-based dietary recommendations are essential to prevent potential harm to patients. Introducing dietary restrictions during a hospital admission for the management of a symptomatic condition may also introduce psychological factors that influence long-term dietary patterns that do not align with current evidence for non-acute diverticular disease [26] and, collectively, with the risk of malnutrition and disrupted microbiota, present potential long-term negative impacts of a short-term dietary restriction.

Recent studies have proposed the use of liberalised or 'unrestricted' diets in the acute phase, defined as solid food with no restriction on nutrients or fluids [27,28]. Liberalized diets were supported by a 2018 systematic review, which found patients prescribed liberalised versus restricted diets had equal outcomes in terms of gastrointestinal symptoms, recovery, and recurrence [9]. Despite this research and the risk of negative outcomes associated with restricted diets, only the European Society for Coloproctology, and more recently, the German Society of Gastroenterology, Digestive, and Metabolic Diseases, recommends that patients should be permitted liberalised diets where tolerated [29,30], whereas several recent consensus documents, clinical practice updates, and guidelines either provided no dietary guidance for acute management [31–35] or continued to recommend restricted diets [3,13]. International experts have previously failed to reach consensus on dietary prescription, resulting in its removal from an international consensus statement [36]. With limited evidence for dietary restriction or liberalisation during an acute episode [3,29], it is unsurprising that variation in clinical practice occurs between surgeons prescribing diets during inpatient care [27,37]. A large, 200-site international prospective study is currently underway, examining variability in the presentation and management

of acute diverticulitis [38]. However, to date, few studies have investigated the effect of dietary restriction versus liberalisation on the outcomes of inpatients with uncomplicated diverticulitis [9,31,39].

The aim of this study was to observe the effects of prescribing liberalised versus restricted diets in usual practice for the management of acute, uncomplicated diverticulitis on LOS, re-presentation, and gastrointestinal symptoms.

2. Methods

This study was prospectively registered with the Australian New Zealand Clinical Trials Registry [ANZCTR Number: ACTRN12616001378415] and is reported according to STROBE guidelines [40]. This study received ethical and governance approval from the Gold Coast Hospital and Health Service Human Research Ethics Committee (Approval Number: HREC/16/QGC/282).

2.1. Study Design and Setting

A prospective observational study was conducted across two hospitals (364 and 750 beds, respectively) within a single health service in Queensland, Australia. At these sites, usual practice involved the treating surgical team prescribing patients' dietary progression throughout their admission and referring patients to the treating dietitian for dietary education on discharge. All patients included in this study were reviewed by the treating dietitian and provided with dietary advice before discharge in keeping with local usual practice. The treating dietitian was not a member of this research team and was not involved in any study processes. Participants were recruited from January 2017 to March 2019, and outcome data were collected until October 2019. The number of eligible participants decreased over the recruitment period, which may have reflected a change towards outpatient rather than inpatient care.

2.2. Participant Eligibility Criteria

Participants were adult patients admitted with a computed tomography (CT)-confirmed diagnosis of uncomplicated diverticulitis and receiving conservative treatment, including intravenous or oral antibiotic therapy. Patients were excluded if they had complicated diverticulitis based on a CT report (CT-identified perforation, localised abscess > 5 cm, or distant abscess), required percutaneous drainage of the abscess, laparoscopic lavage, or surgical resection during the index admission, were discharged within 48 h of presentation, were pregnant, or were unable to provide informed consent. Participants were recruited consecutively by screening ward lists and medical records to confirm eligibility prior to obtaining informed consent. Due to the novelty of this study, sample size calculations could not be performed. Informed by patient admission rates and the availability of research staff, a target sample size of 80–100 participants was considered feasible and adequate to power the analytical approach.

2.3. Data Collection

2.3.1. Patient Characteristics and Confounding Variables

Age, sex, ethnicity, body mass index (BMI), medical and surgical history, smoking status, habitual alcohol intake, and previous episodes of diverticulitis were recorded at baseline (within 48 h of admission) from the medical record and/or patient interview. No data were available to determine the type of underlying diverticular disease. Temperature, white cell count (WCC), and C-reactive protein (CRP) were recorded from medical records on presentation to the emergency department, after 48 h, and prior to discharge. CRP was used as a marker for disease severity, as surgical teams at this study site did not routinely use Hinchey/Modified Hinchey classification systems.

At baseline, participants reported their most recent stool type according to the Bristol Stool Chart (BSC) [41], a widely used scale of seven pictures with descriptors to aid in evaluating stool form and consistency as a numbered stool 'type', with types 3–4 considered

ideal, types 1–2 indicative of constipation, and types 5–7 reflecting stools that lack form, including diarrhoea. Gastrointestinal symptoms were measured via patient interview within 48 h of admission using the Gastrointestinal Symptom Rating Scale (GSRS). The GSRS scale produces an overall score from a total of fifteen questions, as well as sub-scores for pain, reflux, indigestion, diarrhoea, and constipation [42,43]. Participants recruited from December 2016 to March 2017 (n = 21) were assessed using the original 4-point GSRS scale (scores of 0–3) [43], with the remainder of participants assessed with the more recent 7-point version of the GSRS (scores 1–7) [42,44], where higher scores indicate worse gastrointestinal symptoms. All scores were converted to a 7-point scale, with the highest possible total score of 105.

2.3.2. Independent Variable: Inpatient Dietary Prescription

Patients were typically fasted or placed on fluid-only diets (clear fluids and/or free fluids) for varying time periods before being advanced to a solid food diet (such as low-fibre, soft, puree, or regular). Patients' diets were prescribed by the treating surgeons as part of usual practice. Patients' dietary prescriptions (e.g., nil-by-mouth, clear fluids, free fluids, low fibre, 'regular', soft or puree diets) and subsequent dietary changes throughout admission were noted from the medical record and cross-checked against the electronic food service system (Delegate Food Service System version 12.10, Delegate Technology GmbH; Vienna, Austria). Adherence to prescribed diets was assessed via a 24 h dietary recall conducted within 48 h of the patient's admission. Participants were considered compliant if they did not report consuming items outside their allocated diet [e.g., no solid foods while nil-by-mouth or on fluid-only diets]. Based on the diet prescribed by treating surgeons, patients who progressed to solid food diets within 48 h from the time of CT were considered to have received a 'liberalised' diet prescription. Patients who spent >48 h from the time of CT prescribed either nil-by-mouth, clear fluid, or free fluid diets before being prescribed solid food [such as low-fibre, soft, puree, or 'regular' diets] were considered to have received a more 'restricted' diet prescription. The time point from the time of the CT was chosen as all patients were required to fast until the results of the abdominal CT had been reviewed and a prescribed diet documented by the surgical team. To minimise bias, patients were allocated to the restricted or liberalised diet groups using this objective criterion by a researcher blinded to clinical outcome at the end of this study.

2.3.3. Outcome Variables

Primary outcome measures included index admission LOS, hospital re-presentations for diverticulitis, and LOS of re-presentations. LOS for index and subsequent presentations were calculated from admission and discharge time stamps in electronic medical records. Re-presentations were considered diverticulitis-related if documented in the clinical notes by the treating doctor, irrespective of whether a clinical diagnosis was confirmed via CT. Gastrointestinal symptoms and function were the secondary outcomes, measured via patient interview using the GSRS [42,43] at 30-days.

2.3.4. Follow-Up Data: 30 Days and 6 Months

Participants were provided with an appointment card with an agreed date and time and an image of the BSC as a prompt for telephone review. Participants were contacted approximately 30 days post-index admission to re-administer the GSRS and indicate their most recent stool type per the BSC [41]. Researchers attempted to contact participants on three occasions before deeming them lost to follow-up. Re-presentations to the hospital, reason for re-presentation, and duration of re-presentations at both 30-days and 6-months post-index admission were extracted from electronic medical records.

2.4. Statistical Analysis

Statistical analysis was completed using SPSS software (IBM SPSS Statistics for Windows, version 27 (IBM Corp., Armonk, NY, USA)). Descriptive statistics were used to

characterise all variables. Categorical variables were presented as numbers/percents, while continuous variables were presented as mean ± standard deviation (or median and interquartile range (IQR) if non-parametric). Regression analysis was used to determine the effect of diet prescription on primary outcomes such as LOS (linear regression) and hospital re-presentation related to diverticulitis (logistic regression).

First, to ascertain which variables were significantly associated with diet prescription, *t*-tests were performed, followed by simple logistic regression. Variables significantly associated with diet prescription and other variables considered important (informed by a literature review) were then included in a series of multiple linear regression models (for LOS) and multiple logistic regression models (for hospital re-presentation related to diverticulitis) to identify variables predictive of these outcomes with the best model fit. LOS was log-transformed to achieve a normal distribution. Participants with missing data were not omitted from the analysis (intention-to-treat approach). Due to the small sample size and the small number of re-presentations, regression analysis for re-presentations could not be performed. Due to large amounts of missing data for BSC type and GSRS score at 30-days post-discharge, these outcome was also unable to be analysed via regression.

3. Results

A total of 91 patients were recruited for this study; three were later excluded due to not meeting eligibility criteria (recruited in error), and seven were excluded due to LOS from the time of triage being <48 h, leaving a final sample size of 81. A total of 56 (69%) participants were successfully contacted at the 30-day follow-up.

There were no significant differences in age, sex, smoking status, alcohol use, body temperature, WCC, or BSC type on admission between patients placed on restricted versus liberalised diets. Patients were observed to be prescribed from one to six diet codes during their admission, with the liberalised group having significantly fewer diet code changes throughout their admission (<0.001; Table 1). The most common diet code progressions were clear fluids to low fibre (*n* = 26 patients), followed by clear fluids to free fluids to low fibre (*n* = 22 patients). Patients on restricted diets had lower body weight, lower BMI, and higher CRP than those on liberalised diets; however, differences in BMI and CRP may not be clinically relevant. There were no associations between diet allocation and a history of diverticular disease or previous hospitalisation for diverticulitis (Table 1).

Table 1. Baseline characteristics of participants.

Characteristic	Total Sample (*n* = 81)	Restricted Diet (*n* = 38)	Liberalised Diet (*n* = 43)	*p* Value
Female, *n* (%)	44 (54.3)	23 (60.5)	21 (48.8)	0.292
Age (years) [a]	59.3 ± 13.3	58.1 ± 12.7	60.4 ± 13.8	0.458
Weight (kg) [a]	79.3 ± 16.8	73.1 ± 14.1	84.7 ±17.2	0.001 *
BMI (kg/m^2) [a]	27.7 ± 4.4	26.3 ± 3.8	28.9 ± 4.6	0.008 *
Baseline BSC score	5 (3–6)	5 (4–6)	5 (3–6)	0.704
Admission temperature (°C) [b]	37.0 (36.5–37.8)	37.1 (36.5–37.8)	36.9 (36.5–37.8)	0.708
Baseline CRP (mg/L) [bc]	51 (21–79)	69 (43–122)	35 (15–58)	0.005 *
Baseline WCC [b]	12.0 (9.6–14.9)	12.5 (8.6–16.0)	12.0 (9.9–14.6)	0.985
Number of prescribed diet codes [bd]	3.0 (2.0–3.0)	3.0 (2.8–4.0)	2.0 (2.0–3.0)	<0.001 *
Smoking status on admission				0.867
Yes *n* (%)	17 (21.0)	8 (21.1)	9 (20.9)	
No *n* (%)	30 (37.0)	13 (34.2)	17 (39.5)	
Ex-smoker *n* (%)	34 (42.0)	17 (44.7)	17 (39.5)	

Table 1. *Cont.*

Characteristic	Total Sample (n = 81)	Restricted Diet (n = 38)	Liberalised Diet (n = 43)	p Value
Alcohol intake exceeds guidelines				
Yes n (%)	29 (35.8)	14 (36.8)	15 (34.9)	0.854
No n (%)	52 (64.2)	24 (63.2)	28 (65.1)	
Diverticular disease [e] diagnosed prior to admission				
Yes n (%)	48 (59.3)	23 (60.5)	25 (58.1)	0.827
No n (%)	33 (40.7)	15 (39.5)	18 (41.9)	
First Presentation with Diverticulitis				
Yes n (%)	40 (49.4)	17 (44.7)	23 (53.5)	0.432
No n (%)	41 (50.6)	21 (55.3)	20 (46.5)	

BMI: body mass index; BSC: Bristol stool chart; CRP: C-reactive protein; LOS: length of stay; WCC: white cell count. [a] Presented as mean ± standard deviation. [b] Presented as median (IQR) as data not normally distributed. [c] Number of dietary codes prescribed during the patient's hospital admission. [d] (only available for n = 71). [e] Known diverticular disease of any classification. * Indicates statistical significance.

Fifty-one patients (63%) had other comorbidities; 35 (43%) had cardiovascular disease; 27 (33%) had previous gastrointestinal/abdominal surgery; and 38 (47%) had other gastrointestinal conditions, the most common being gastro-oesophageal reflux disease (n = 10; 12%) followed by abdominal hernia (n = 8; 10%).

At baseline, there were significant differences in indigestion and reflux scores between patients prescribed restricted and liberalised diets, with patients on restricted diets reporting worse symptoms (Table 2). No significant difference was seen in 30-day GSRS scores between diet prescriptions. Patients on restricted diets had significantly longer LOS for index admission and duration of antibiotics than patients receiving liberalised diets (Table 3).

Table 2. Gastrointestinal Symptom Rating Scale (GSRS) scores at baseline and 30-day follow-up.

GSRS Scores [a]	Total Sample	Restricted Diet	Liberalised Diet	p Value
Baseline (within 48 h of admission)	n = 81	n = 38	n = 43	
TOTAL score	41 (32–54)	44 (33–58)	36 (30–54)	0.130
Reflux	2 (2–4)	3 (2–6)	2 (2–2)	0.002 *
Pain	10 (7–13.5)	11(7–14)	9 (7–12)	0.496
Constipation	7 (4–11)	7 (4.8–10.3)	7 (4–12)	0.992
Diarrhoea	7 (3–13)	7 (3–12.25)	7 (3–15)	0.878
Indigestion	12 (9.5–18)	14 (11.75–18)	11 (7–16)	0.021 *
30 days post hospital discharge	n = 56	n = 27	n = 29	
TOTAL score	19.5 (17–31)	23 (17–33)	19 (17–31)	0.895
Reflux	2 (2–4)	2 (2–4)	2 (2–4)	0.971
Pain	3 (3–6)	3 (3–7)	4 (3–5.5)	0.697
Constipation	3.5 (3–6)	3 (3–6)	4 (3–6.5)	0.930
Diarrhoea	3 (3–8)	3 (3–9)	3 (3–6.5)	0.978
Indigestion	5.5 (4–8)	6 (4–11)	5 (4–7)	0.254

GSRS: gastrointestinal symptom rating scale. [a] Presented as median (IQR) as data not normally distributed. * Indicates statistical significance.

The regression model identified that LOS (index admission) was significantly associated with inpatient dietary prescription, BMI, and GSRS score for indigestion at baseline (Table 4). Being underweight (BMI < 18.5 kg/m^2) and prescribed a restricted diet were significantly associated with re-presenting to the hospital for diverticulitis within six months of the index admission. However, all the estimated effects in the regression model were

imprecise, especially for BMI (Table 5). CRP was not associated with any outcome; therefore, it was not included as a confounding variable in multivariable models.

Table 3. Healthcare use is related to diverticulitis post-index admission.

Measure of Healthcare Use	Total Sample *n* = 81	Restricted Diet *n* = 38	Liberalised Diet *n* = 43	*p* Value
Hospital LOS (days) [a]	3.7 (2.7–4.5)	4.0 (3.5–5.1)	2.8 (2.2–3.8)	<0.001 *
Antibiotics duration (days) [a]	3.6 (2.6–4.6)	4.0 (3.5–5.0)	3.0 (2.0–3.9)	<0.001 *
Re-presentation related to diverticulitis within 30 days				
Yes *n* (%)	4 (4.9)	3 (7.9)	1 (2.3)	n/a
No *n* (%)	77 (95.1)	35 (92.1)	42 (97.7)	
Re-presentation related to diverticulitis within 6 months				
Yes *n* (%)	12 (14.8)	9 (23.7)	3 (7.0)	0.058 [b]
No *n* (%)	69 (85.2)	29 (76.3)	40 (93.0)	

LOS: length of stay. [a] Presented as median (IQR) as data not normally distributed. [b] Fisher's exact test. Chi-square test was $p = 0.048$. * Indicates statistical significance.

Table 4. Regression model for the effect of dietary prescriptions on length of stay.

Variables in the Model	B Statistic		95% CI for B	*p* Value
	Log LOS	LOS (Days) [a]		
Dietary allocation	0.366	1.44	0.0204–0.529	<0.0001
Baseline GSRS score (indigestion)	0.018	1.018	0.003–0.033	0.019
BMI	0.018	1.018	0.000–0.037	0.054

BMI: body mass index; GSRS: gastrointestinal symptom rating scale; LOS: length of stay. Regression is based on 81 cases. $R^2 = 0.284$; Adjusted $R^2 = 0.256$. [a] Converted from log LOS.

Table 5. Regression model for the effect of dietary prescription on hospital re-presentation for diverticulitis within six months of index admission.

Variables in the Model	Odds Ratio	Standard Error	95% CI	*p* Value
Dietary allocation	8.1	7.6	1.3–51.0	0.025 *
Female sex	8.1	9.3	0.9–76.1	0.067
BMI classification				
Underweight	21.1	30.1	1.3–347.5	0.033 *
Overweight	1.1	1.1	0.1–8.3	0.932
Obese (I and II)	6.7	7.5	0.7–61.0	0.094

BMI: body mass index. Regression is based on 81 cases. Cox and Snell $R^2 = 0.233$; Nagelkerke $R^2 = 0.410$; Homer and Lemeshow Test: $\chi^2 = 4.502$, df = 7, $p = 0.721$. * Indicates statistical significance.

4. Discussion

This study explored the outcomes in patients allocated restricted versus liberalised diets as part of usual practice in the inpatient management of acute, uncomplicated diverticulitis. Patients who received restricted diets were observed to have a longer hospital stay and to be more likely to re-present to the hospital with a diverticulitis-related admission at six months, compared to patients on liberalised diets. Further, there were no observed differences in gastrointestinal symptoms between patients on restricted versus liberalised diets at 30-days post-admission, conflicting with evidence-based models of care founded on traditional beliefs that liberalised dietary intake may exacerbate gastrointestinal symptoms [11,13].

In this study, patients placed on restricted diets had significantly longer LOS than those prescribed liberalised diets, even when adjusting for gastrointestinal symptom severity and BMI. Although many important confounders were not able to be accounted for, this finding is in keeping with previous observational research, which found that patients prescribed liberalised diets upon hospitalisation for uncomplicated diverticulitis were significantly more likely to be discharged than those prescribed restricted diets [27]. A

plausible explanation for this is that diet tolerance is often a criterion for discharge; therefore, the explanation for the lower LOS associated with the liberalised diet may not be biological but rather a systems concern [45]. This has implications for healthcare sustainability; if an intervention is contributing to increased LOS, it is important that the intervention improve outcomes for patients. In the case of diet restriction, there is no evidence of improved outcomes with this approach in patients with uncomplicated diverticulitis where oral food is tolerated.

Diverticulitis-related re-presentations were significantly associated with dietary restriction in index admission as well as an underweight BMI. There is no recognised mechanism of action in which a short-term dietary restriction during hospitalisation may directly influence the risk of diverticulitis recurrence at 6 months. However, the restriction may have indirectly increased the risk of diverticulitis-related representation. Imposed dietary restrictions in the general hospital population have led to distress, discomfort, and worsened diet quality [46]. In those with gastrointestinal disease, hospital-imposed dietary restrictions have been associated with a lasting fear of food [47–49]. A recent observational study found patients with a previous history of diverticulitis had significantly lower intakes of calories, fibre, dietary vitamins A, C, D, and E, and Oxygen Radical Absorbance Capacity index compared to healthy controls [50]. Restricted diets are inadequate to meet patients' nutritional requirements [51], contributing to the development or worsening of malnutrition [14], and may be a mechanism by which restricted diets were observed to have higher rates of readmission in this study. Malnutrition and inadequate dietary intake are risk factors for morbidity, mortality, and readmissions in many acute and chronic disease states [16]. However, as the current study did not assess patients for malnutrition or pre-existing unintentional weight loss, which has been associated with significantly higher odds for diverticulitis readmission [52], future research is required to explore the relationship between nutrition status, dietary restriction, and recurrence of diverticulitis.

In this study, females had an 8.1-fold greater likelihood of re-presenting with diverticulitis. Though this was a non-significant trend, previous research has identified female sex as a predictor of readmission for diverticulitis [52,53]. Furthermore, this study found underweight BMI significantly increased the odds of re-presentation; however, this observation lacks confidence due to the large 95% CI (OR 21.1 (95% CI: 1.3, 347.5)). Interestingly, obesity was not a significant factor in the model, despite previously being identified as a risk factor for diverticulitis [54] and re-presentation [52]. Previous research has found that patients re-presenting with diverticulitis were more likely to be female and have multiple comorbidities, including obesity and unintentional weight loss [52]. However, the effect of dietary prescriptions on re-presentation was not assessed. Omitting the assessment of dietary prescription and re-presentation may present a significant limitation of previous research, as our study found patients prescribed restricted diets were over eight times more likely to re-present to the hospital within six months ($p < 0.05$).

Inpatient dietary restriction was significantly associated with higher baseline GSRS scores for reflux and indigestion. Baseline GSRS scores were measured during the 0–48 h period after admission when patients had already received the diet as prescribed by treating surgeons. The role of gastrointestinal symptom severity in the surgeons' dietary prescription at admission is unknown, as there are many other factors that may explain this difference, such as dietary restrictions triggering greater symptoms, CRP, and/or the usual practice of the available surgeon. Importantly, there were no significant differences between groups in gastrointestinal symptoms at 30 days, indicating that neither restricted nor liberalised diets impacted recovery. This is supported by research that observed the effects of implementing the 2012 Dutch guidelines recommending liberalised diets for patients hospitalised with uncomplicated diverticulitis, which was deemed safe on the basis of no higher complication rate in the cohort when compared with expected complication rates [28]. The significant difference between dietary restriction and baseline CRP may re-present a tendency to restrict diet in patients deemed more likely to experience complications, possibly in preparation for potential deterioration requiring surgical inter-

vention. Despite the difference in baseline CRP between groups, CRP was not associated with outcomes, suggesting that disease severity did not impact the difference in LOS or rates of recurrence between groups. Supporting this, a recent cohort study also found that CRP was not predictive of recurrence in patients with acute, uncomplicated diverticulitis [55]. These findings need to be replicated in studies that can provide a more precise diverticulitis phenotype based on severity. Therefore, based on regression analysis, the greatest predictors of LOS were dietary restriction, baseline GSRS scores for indigestion, and BMI.

5. Limitations

Randomisation was not able to be performed due to the observational nature of this study. Although this precluded the ability to control confounding factors, this study now provides sufficient justification and evidence to inform a future randomised controlled trial that will assist in identifying the diet-related mechanisms of action that produce the observed effects. There is a large risk of selection bias, decreasing confidence in the results. Readers should not infer causation due to the observational nature of this study design and the limited control and availability of confounding variables such as underlying diagnosis and disease classification. As a single-site study with a small sample size, the results may not be generalisable to other areas or demographics. Results can also not be generalised to adults managed as outpatients rather than inpatients. Some participants were visiting from interstate or overseas, and as such, outcomes for these patients at 30 days and six months may be under-reported if complications were treated elsewhere in facilities not linked to state-wide medical records. The GSRS tool was adjusted after the first 21 participants due to the higher sensitivity of the updated 7-point scale over the original 4-point version. Though scores were converted with the assistance of a biostatistician, this may have had a slight impact on the responses chosen by patients; however, there were no differences in scores or in diet allocation between those using the 4-point vs. 7-point tool. Regression analyses for certain outcomes were unable to be performed due to attrition, such as BSC and GSRS at 30 days. Outcomes were limited due to patient burden; however, this meant that many outcomes important to patients and the healthcare system were not measured, such as quality of life, anxiety, and nutrient intake. A gold standard measure was not available for the allocation of disease severity, necessitating reliance on an indirect measure (CRP).

6. Conclusions

Patients admitted to the hospital with uncomplicated diverticulitis who received restricted diets, as compared to liberalised diets, were observed to have 1.2 days longer LOS and an 8.1 times increased likelihood of re-presentation within six months in adjusted models. There was no observed difference in gastrointestinal symptoms at 30 days post-discharge between patients placed on liberalised versus restricted diets. Randomised controlled trials are required to examine the impact of dietary management of uncomplicated diverticulitis on patient outcomes [including objective and value-based measures], healthcare utilisation, and cost-effectiveness to confirm a cause-and-effect relationship and inform sustainable, value-based health care.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in this study.

Data Availability Statement: The data that supports the findings of this study are available from the corresponding author upon reasonable request.

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