

Dietitian-led supportive care for postoperative nutritional achievement: A secondary analysis of a Randomized Controlled Trial

Chiou Yi Ho

Universiti Putra Malaysia Fakulti Perubatan dan Sains Kesihatan

Zuriati Ibrahim (✉ zuriatiib@upm.edu.my)

Universiti Putra Malaysia <https://orcid.org/0000-0001-6210-0443>

Zalina Abu Zaid

Universiti Putra Malaysia Fakulti Perubatan dan Sains Kesihatan

Zulfitri 'Azuan Mat Daud

Universiti Putra Malaysia Fakulti Perubatan dan Sains Kesihatan

Nor Baizura Md Yusop

Universiti Putra Malaysia Fakulti Perubatan dan Sains Kesihatan

Mohd Norazam Mohd Abas

National Cancer Institute of Malaysia

Jamil Omar

National Cancer Institute

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Abstract

Sufficient postoperative dietary intake is crucial for promoting wound healing and ensuring better surgical outcomes. This study aimed to determine the postoperative nutritional achievement and predictors of postoperative dietary intake among gynecologic cancer patients. A total of 118 participants were included in this secondary analysis. Postoperative dietary data were pooled and re-classified into early postoperative dietary intake achievement (EDIA) (daily energy intake (DEI) \geq 75% from the estimated energy requirement (EER)) and delay dietary intake achievement (DDIA) (DEI < 75% EER). There was a significant difference in postoperative changes in weight ($p = 0.002$), muscle mass ($p = 0.018$), and handgrip strength ($p = 0.010$) between the groups. Postoperative daily energy and protein intake in the EDIA was significantly greater than DDIA from operation day to discharged ($p = 0.000$ and $p = 0.036$). Four significant independent postoperative dietary intake predictors were found: preoperative whey protein-infused carbohydrate loading ($p = 0.000$), postoperative nausea vomiting ($p = 0.001$), age ($p = 0.010$), and time to tolerate clear fluid ($p = 0.016$). The multilinear regression model significantly predicted postoperative dietary intake, $F(4,116) = 68.013$, $p = 0.000$, $\text{adj. } R^2 = 0.698$. With the recognition of four predictors, the integration of more specific and comprehensive dietitian-led supportive care with individualized nutrition intervention into the multidisciplinary Enhanced Recovery After Surgery approach should be considered to promote functional recovery.

Introduction

Postoperative catabolic reaction succeeding post-operation may weaken immune function, reduce muscle strength, prolong wound healing, and cause body skeletal muscle tissue catabolism. Surgery-related stress and inadequate postoperative dietary intake may cause extraneous fatigue and prolonged convalescence [32]. Postoperative malnutrition in cancer patients is a worrisome shift in delaying recovery and could affect the survival rate.

The postoperative nutritional requirement is higher to support anabolism and minimize nutritional depletion [2]. Adequate dietary intake is an important key point to achieve optimum nutritional status post operation to speed up the wound healing process, enhance immunity, and assure a better postoperative outcome [31]. The previous Randomized Control Trial (RCT) demonstrated that Enhanced Recovery After Surgery (ERAS) with preoperative whey protein-infused carbohydrate (CHO) loading and postoperative early oral feeding shown positive outcomes, nutrition status preservation, and suppressed inflammatory response without increasing postoperative complication [12]. The further investigation in this trial for subgroup effects regarding postoperative dietary intake was worth to be determined.

A prospective cross-sectional study investigated postoperative dietary intake from completion of the operation to discharge. Total daily energy (kcal) and protein (g) intake for each subject were analyzed and categorized as adequate if intake met \geq 75% of estimated requirements [20]. The study found 58.4% of patients started to have their postoperative first oral intake and first solid food intake on the operation day, respectively. About 53% of patients consumed clear liquids as the first drink after an operation of

gastrointestinal patients [27]. The postoperative early dietary intake achievement (EDIA) could be promoted by introducing oral nutrition supplement (ONS). The postoperative enteral nutrition has been revealed to boost up dietary intake, lessen morbidity, and reduce hospital stays[21]. As a result, the implementation of early postoperative enteral nutrition is conceivable to promote recovery and prevent body protein (muscle) catabolism. However, Henriksen et al. (2003) found that small positive but no significant differences in body composition changes, dietary intake, and return of bowel function in preoperative CHO loading as compared to the fasting group [11].

There was scant previous research or RCT extensively reviewed dietitian-led supportive care on the achievement of nutrition and predictors of postoperative dietary intake in Malaysia. Progress on postoperative dietary intake has remained inconclusive. The current study therefore aimed to demonstrate the dietitian-led supportive care for the nutritional achievement and predictors of postoperative dietary intake.

Materials And Methods

Study Design and Participants

This is a secondary analysis of the previous RCT on the impact of ERAS with whey protein-infused carbohydrate loading and postoperative early oral feeding vs standard care among GC patients admitted for an elective operation which was undertaken from November 2017 to September 2019 [13]. The secondary analysis was conducted from January 2020 to March 2020. All data were pooled, re-classified and focused on the postoperative nutritional achievement and predictors of postoperative dietary intake among GC patients. The rationale for the RCT, design details, and eligibility characteristics as well as the primary results has been published previously [12].

Participants

This secondary analysis included all 118 consented participants who were recruited in RCT (Fig. 1). The inclusion criteria for RCT were ambulated Malaysian aged 18 years and above and scheduled for elective surgery for suspected GC patients while exclusion criteria were physical disability, soy or whey protein allergy, diagnosed with chronic kidney disease, ischemic heart disease, and diabetes mellitus or involved in other intervention studies.

Outcomes Measurement

Participants Group and Study Endpoint

Classification Postoperative dietary intake adequacy

For the postoperative period, the participants' energy requirements were calculated based on the recommendation formula to estimate energy requirements for cancer patients [31]. Postoperative daily dietary intake $\geq 75\%$ EER is considered adequate [20], essential to prevent further nutrition depletion, and

then promote wound healing [5] and reduced infection risk [26]. Hence, we pooled and re-classified participants by using the distribution of total daily energy intake per estimated energy requirement (EER) on postoperative day-two. In this secondary analysis, participants were defined into two groups which were early dietary intake achievement (EDIA) (daily energy intake \geq 75% EER) and delay dietary intake achievement (DDIA) (daily energy intake < 75% EER). The primary endpoint of the study was postoperative nutritional achievement and predictors of the postoperative dietary intake on the postoperative day-two.

Sociodemographic and Clinical Characteristics

Sociodemographic (age) and clinical characteristics included primary diagnosis, cancer stage, comorbidities, family history on cancer and American Society of Anaesthesiologists (ASA) score was tracked and recorded from the electronic medical record system.

Nutritional and Functional Status

Anthropometric and functional status (handgrip strength) measurements were assessed during admission and upon discharge. Weight, fat percentage, fat mass, fat-free mass, and muscle mass of subjects were assessed by the body composition analyzer TANITA model SC 300. The calibrated digital JAMAR® Hand Dynamometer was used to assess handgrip strength. The average score of the three trials was used to interpret a handgrip strength performance. These data were traced from the RCT database.

Biochemical Profile (Serum albumin)

The preoperative and postoperative serum albumin was traced from the RCT database.

Pre-admission and Postoperative Dietary Intake

Preadmission and postoperative dietary intakes, which were assessed using a 24-hour diet recall method via a face-to-face interview by the dietitian, were traced from the RCT database. The 24-hour diet recall was collected during admission and the postoperative days until discharge (daily in the ward). Food intake chart (food, beverage, or ONS if been prescribed by a dietitian) was recorded by participants or staff nurses in charge of the ward. To verify dietary intake in the ward, the research dietitian counter checked the compliance (frequency and dilution) of ONS and amount of diet consumption during mealtime in the ward. Atlas of Food Exchanges and Portion Size [1], household measurements such as cups, spoons, and scoops as well as food models were used to assist participants in assessing the portion size of foods they ate. Recorded dietary intakes were analyzed by using Nutritionist Pro Dietary Software version 2.4 [8]. Energy intake in kilocalories (kcal) and protein intakes in grams (g) were obtained from a summary of the analysis.

Postoperative Outcomes

The preoperative whey protein-infused CHO loading execution was tracked from the RCT database. The postoperative surgical outcomes were included the method of operation, ICU admission, postoperative

infection, postoperative nausea and vomiting (PONV), time to tolerate clear fluid, food toleration, and duration of hospital stays. The time to tolerate clear fluid was defined as the time from the operation end to the time of the patient could tolerate clear fluid. The time to tolerate food was defined as the time from the operation end to the time the patient could tolerate solid food. The duration of hospital stays was defined as the time from admission to discharge. Postoperative outcomes were traced and recorded on a data collection form by a researcher.

Statistical Analysis

The analyses were conducted using IBM SPSS (version 23.0). Descriptive statistics were used for participants' descriptive characteristics. Kolmogorov-Smirnov test and visual inspection of the stem-and-leaf plot confirmed that all variables were normally distributed. Levene's statistics were non-significant and thus the assumption of homogeneity of variances was not violated. The homoscedasticity was assessed and found to be supported. A visual inspection of normal Q-Q and detrended Q-Q plots for each variable confirmed that all were normally distributed. Therefore, the numerical data were presented in mean \pm standard deviation while categorical data in frequency and percentage. Since data were normally distributed, an independent t-test was used to compare the numerical variable between the groups. Pearson's Chi-square test (with $\alpha = 0.05$) were used to evaluate categorical data. The two-way mixed-model ANOVA was used to analyze the trend of postoperative dietary intake achievement between the groups. Pearson correlation coefficient was calculated where indicated. Significant univariate variables ($p < 0.05$) were entered into the multilinear regression analysis model to identify predictors of postoperative dietary intake achievement on postoperative day-two. All probability values were used two-sided and a level of significance of less than 0.05 ($p < 0.05$) was considered statistically significant.

Results

There were 46 (39%) and 72 (61%) participants in EDIA and DDIA groups, respectively. Mean of age were 47.5 ± 11.9 years old for EDIA and 52.1 ± 11.8 years old for DDIA group. For clinical characteristics, nutritional and functional status (Table 1). Table 2 demonstrated the postoperative surgical, nutritional and functional outcomes. There was significant difference in changes of weight ($p = 0.002$), muscle mass ($p = 0.018$) and handgrip strength ($p = 0.010$) between the group. Figure 2 showed the trend of postoperative total daily energy intake between the groups. A significant main effect for group was found, $F(1, 110) = 136.18$, $p = 0.000$, partial eta squared = 0.558 with confidence level EDIA being significantly higher than DDIA. A significant interaction between time and groups was reported, $F(2.82, 255.95) = 22.40$, $p = 0.000$, partial eta squared = 0.172. Figure 3 presented the trend of postoperative total daily protein intake between the groups. A significant main effect for group was found, $F(1, 111) = 204.67$, $p = 0.000$, partial eta squared = 0.655 with confidence level EDIA being significantly higher than DDIA. A significant interaction between time and groups was reported, $F(2.03, 244.54) = 1.56$, $p = 0.036$, partial eta squared = 0.117.

Table 3 presented a multivariate analysis that analyzed all the significant parameters in the univariate analysis and revealed that four variables were statistically significant to contribute to the prediction.

Hence, the significant independent predictors of postoperative dietary intake on postoperative day-two included preoperative whey protein-infused CHO loading ($p = 0.000$), PONV ($p = 0.001$), age ($p = 0.010$), and time to tolerate clear fluid ($p = 0.016$). The multilinear regression model statistical significantly predicted postoperative dietary intake achievement on postoperative day-two, $F(4,116) = 68.013$, $p = 0.000$, $\text{adj. } R^2 = 0.698$.

Table 1. Clinical characteristics, nutritional status and function status
in Gynaecologic Cancer patients ($N = 118$).

Parameters	EDIA (n = 46)	DDIA (n = 72)	p-value
Age (years) (mean ± SD)	47.5 ± 11.9	52.1 ± 11.8	^b 0.039*
Primary diagnosis (n, %)			
Ovarian cancer	18 (39)	32 (44)	
Endometrial cancer	18 (39)	22 (31)	
Cervical cancer	8 (17)	13 (18)	
Uterine cancer	2 (5)	5 (7)	
Stage of cancer (n, %)			
1	42 (91)	64 (89)	
2	1 (2)	2 (3)	
3	1 (2)	0 (0)	
Advanced	2(4)	6 (8)	
Comorbidities (n, %)			^a 0.021*
Hypertension	13 (28)	35 (49)	
Hypertension and dyslipidaemia	1 (2)	12 (17)	
None	32 (70)	25 (34)	
ASA classification score (n, %)			^a 0.034*
1	26 (57)	16 (22)	
2 & 3	20 (43)	56 (78)	
Preoperative nutritional status (mean ± SD)			
Weight (kg)	63.7 ± 12.7	65.9 ± 16.4	^b 0.419
BMI (kg/m ²)	35.6 ± 6.1	37.1 ± 6.2	^b 0.193
Muscle mass (kg)	37.1 ± 4.0	37.3 ± 4.7	^b 0.808
Percentage weight loss within 1-month (%)	-3.3 ± 5.8	-5.9 ± 7.4	^b 0.041*

EDIA: Early Dietary Intake Achievement; DDIA: Delayed Dietary Intake Achievement; ASA: American Society of Anaesthesiologists BMI: body mass index; PG-SGA: Patient-generated scored global assessment;

^aChi-square test; ^bIndependent t-test; * $p < 0.05$; ** $p < 0.01$.

Parameters	EDIA (n = 46)	DDIA (n = 72)	p-value
Total daily energy intake (kcal/day)	1490 ± 247	1319 ± 355	^b 0.005**
Total daily protein intake (g/day)	61.9 ± 15.8	53.3 ± 16.4	^b 0.006**
Serum albumin level (g/dL)	39.4 ± 4.4	37.4 ± 6.5	^b 0.053
Functional status (mean ± SD)			
Handgrip strength	17.0 ± 6.3	15.2 ± 6.0	^b 0.121
EDIA: Early Dietary Intake Achievement; DDIA: Delayed Dietary Intake Achievement; ASA: American Society of Anaesthesiologists BMI: body mass index; PG-SGA: Patient-generated scored global assessment;			
^a Chi-square test; ^b Independent t-test; * $p < 0.05$; ** $p < 0.01$.			

Table 2
Postoperative surgical, nutritional and functional outcomes (N= 118)

Parameters	EDIA (n = 46)	DDIA (n = 72)	p-value
Surgical outcomes			
Preoperative whey protein CHO loading (n, %)			^a <0.001**
Yes	45 (98)	17 (24)	
No	1 (2)	55 (76)	
Method of operation (n, %)			^a 0.072
Laparoscopic	27 (59)	54 (75)	
Laparotomy	19 (41)	18 (25)	
ICU admission (n, %)			^a 0.001**
Yes	1 (2)	17 (24)	
No	45 (98)	55 (76)	
Postoperative nausea and vomiting (n, %)			^a <0.001**
Yes	7 (15)	53 (74)	
No	39 (85)	19 (26)	
Postoperative infection (n, %)			
Yes	1 (2)	5 (7)	
No	45 (98)	67 (93)	
Operation time (mean ± SD)	2.3 ± 1.1	2.7 ± 1.2	0.031*
Postoperative serum albumin (g/dL) (mean ± SD)	32.5 ± 6.1	28.5 ± 6.0	^b <0.001**
Time to start clear fluid (hours) (mean ± SD)	9.7 ± 2.9	19.7 ± 9.0	^b <0.001**
Time to tolerate solid diet (hours) (mean ± SD)	21.3 ± 11.6	46.6 ± 19.6	^b <0.001**
Duration of hospital stays (hours) (mean ± SD)	114.6 ± 38.4	150.0 ± 30.1	^b <0.001**
Nutritional outcomes			
Weight (kg)	-0.3 ± 2.5	-1.7 ± 2.3	^b 0.002**

EDIA: Early Dietary Intake Achievement; DDIA: Delayed Dietary Intake Achievement; CHO: carbohydrate; ICU: Intensive care unit; ^aChi-square test; ^bIndependent t-test; **p* < 0.05; ***p* < 0.01.

Parameters	EDIA (n = 46)	DDIA (n = 72)	p-value
Muscle mass (kg)	0.4 ± 1.8	-0.5 ± 2.4	^b 0.018*
Functional outcomes			
Handgrip strength (kg)	0.7 ± 4.0	-1.4 ± 4.8	^b 0.010*
EDIA: Early Dietary Intake Achievement; DDIA: Delayed Dietary Intake Achievement; CHO: carbohydrate; ICU: Intensive care unit; ^a Chi-square test; ^b Independent t-test; * <i>p</i> < 0.05; ** <i>p</i> < 0.01.			

Table 3
Predictors of postoperative dietary intake on postoperative day-two (N= 118).

Postoperative dietary intake on postoperative day-two summary measure	Beta	95% CI	p-value
Preoperative whey protein-CHO loading	0.552	407.532– 693.712	< 0.001**
PONV	-0.210	-330.754 - -87.173	0.001**
Age	-0.127	-9.506 - -0.993	0.010**
Time to start clear fluid	-0.182	-18.347 - -2.533	0.016*
CHO: carbohydrate; PONV: postoperative nausea and vomiting; R = 0.842; R ² = 0.708, adjusted R ² = 0.698; F = 68.013, <i>p</i> = 0.000; Stepwise multilinear regression; * <i>p</i> < 0.05; ** <i>p</i> < 0.01.			

Discussion

The present study found that EDIA not only achieved higher and faster total daily energy and protein intake significantly throughout the hospitalization period but also experienced less weight and muscle depletion compared DDIA. The prolonged preoperative fasting period was diminished by preoperative CHO loading with a whey protein-infused CHO drink and postoperative early oral feeding thus changed the body from a ‘fast’ state to ‘fed’ state [16]. EDIA initiated earlier postoperative oral feeding as per ERAS recommendation. Majority of EDIA received intensive nutritional intervention where they were not only received the energy-dense clear fluid ONS preoperative 3-hours but also energy-dense clear fluid ONS postoperative once started clear fluid and followed by energy-dense complete ONS after allowing solid diet while most of DDIA received plain water after allowed for clear fluid, nourishing fluid and followed by soft diet [29]. Postoperative intensive nutritional intervention management aimed to prevent nutritional depletion due to negative energy protein balance, maintain an appropriate nutritional status to support rehabilitation and wound healing [31]. The integration of energy- and protein-dense ONS into postoperative nutritional intervention regime intended to secure protein and energy intake while the oral intake was building [2].

The current finding was similar to the results from studies by Yeung and colleagues and Brown and colleagues where adequate energy and protein intake during the perioperative period prevent nutritional depletion and promote a speedy recovery[34]. Postoperative suboptimal energy protein intake increases the nutritional depletion rate if there was no further nutritional intervention to be carried out [31]. Therefore, the free unrestricted diet was recommended from 4 hours post-operation and ONS should be provided to ensure adequate postoperative energy and protein intake [23]. The postoperative patients, who were rapidly progressed to standard diet immediately after 500ml clear fluid toleration, achieved higher energy protein intake compared with those under slow progression conventional transition diet, with no significant increase complication rate [10]. This indicated postoperative early oral feeding and rapid progression to a normal diet after tolerating clear fluid hastened diet toleration time boosted up postoperative total daily energy and protein intake as well as cut down the reliance on ONS [4]. In addition, ICU admission showed that affected negatively and delayed the postoperative dietary intake might due to clinically hemodynamic unstable to initiate feeding and experienced dysphagia after extubation [25]. Present study also demonstrated that the operation time influences postoperative dietary achievement. Longer duration of operation is usually associated with more complex operations, higher complications and prolonged recovery as well as delayed postoperative dietary intake [9].

Dietary energy and protein intake were correlated with body composition including muscle mass. Inadequate oral intake might extend the catabolic response and further deplete the nutritional status post-operation [26]. The prolonged inadequate oral intake and hypercatabolic trigger skeletal muscle degradation [14, 24]. Therefore, postoperative total daily energy and protein intake determine protein metabolism and muscle wasting. These approaches minimize the energy protein negative balance, provide early energy protein supply, reduce protein loss, improve muscle function, and promote the anabolic state. Preservation of postoperative weight loss and muscle wasting could be achieved by minimizing body glycogen breakdown, glucose synthesis from protein or fat, and fat oxidation [29]. The body composition and handgrip strength conservations might result from the combined effect of shortening of preoperative fasting and postoperative early feeding. Henrikson and colleagues also concluded that patients with preoperative CHO plus protein loading acquired greater muscle strength [11]. Beattie and colleagues identified that a greater extent of muscle function preservation to those close to preoperative levels with early oral feeding with ONS [3].

In the present finding, there are four statistically significant independent predictive factors related to postoperative dietary intake achievement on postoperative day-two among surgical GC patients which including age, pre-operative whey protein-infused CHO loading, presence of postoperative nausea and vomiting, and time to start clear fluid. Age influences post-operation dietary intake and tolerance. Old age was demonstrated as a risk factor of postoperative severe malnutrition [18]. Another study also revealed that old age and female patients were significantly associated with delayed postoperative oral toleration. This finding might be due to old female patients are more perceptive to gastrointestinal discomfort while initiating oral intake post-operation. They favor to resume and increase oral intake gradually as compared with male or younger patients [15]. There was a study showed that geriatric patients experienced a higher risk of being malnourished post-operation [18]. Hence, postoperative intensive nutrition management with

providing ONS was suggested among geriatric surgical patients to increase dietary energy and protein intake, prevent further nutritional depletion and shorten the duration of hospital stays [31].

PONV is a common reason for delayed functional recovery[22]. Anorexia or loss of appetite is a common reason for postoperative inadequate dietary intake related to gastrointestinal dysfunction and postoperative pain. Severe PONV, salivary secretion reduction, and change in taste could be induced by intubation, anesthesia, and surgery-related inflammation after the abdominal major surgery [17]. PONV was shown to be reduced with preoperative CHO loading[6]. ERAS study in gynecological oncology showed that postoperative early oral feeding lessened abdominal distension, postoperative nausea, and vomiting and also hasten gastrointestinal recovery [19]. The fear of PONV and food preference might cause self-delay postoperative feeding [27]. The patient-centered dietary approach, which included antiemetics and prescription of unrestricted diet, may have assisted in commencing feeding. The early nutrition assessment to detect insufficient dietary intake and intensive nutrition intervention to optimize dietary intake were recommended postoperatively. Intensive and individualised postoperative nutrition intervention improves dietary intake, enhance functional recovery, and prevent further nutritional depletion[24].

The present finding demonstrated that preoperative whey protein-infused CHO loading and time to start clear fluid boost up the postoperative dietary intake. As per evidenced based ERAS recommendation, preoperative CHO loading lessened PONV and improved postoperative oral toleration [28, 34]. Postoperative early oral feeding, where initiated clear fluid ingestion 4–6 hours post-operation as one of the elements of ERAS recommendation [16], stimulates the early dietary intake and toleration in virtue of accelerating intestinal function recovery and prevents the occurrence of peristalsis of the stomach and small intestine and irregular contraction waves resulted from prolonged fasting. Thus, the intestinal mucosal barrier function could be maintained, and further accelerating organ recovery[29]. Preoperative CHO loading was shown a positive impact in minimizing insulin resistance and catabolism of muscle mass and subsequently resulted in the minimisation of postoperative complications and preservation of nutritional status and muscle strength [28]. Yamada and colleagues also reported that the preoperative CHO loading ensured better body weight preservation [33].

Current results did not show the correlation between preoperative nutritional status and postoperative dietary intake achievement. The perioperative nutrition approaches in the ERAS protocol (preoperative CHO loading and postoperative early oral feeding), PONV management, and age showed a greater impact on the postoperative dietary intake than preoperative malnutrition. Hence, the role of dietitian-led nutritional intervention after a major operation has been demonstrated that improved energy and protein intake. Perioperative dietitian-led nutritional management is crucial to optimize nutritional status [30]. Other than nutritional intervention management immediate post-operation, individualized intensive nutritional intervention management with integration of ONS upon discharge is an essential element to be provided and explained to the patients and caregiver to achieve energy protein requirement and promote postoperative recovery [7].

Strength and Limitations

The present study was the first study to demonstrate postoperative nutritional achievement as well as investigate the predictors of postoperative dietary intake achievement among GC patients in Malaysia. However, the current study did have a few limitations. This was a single-center study observation that focused on surgical GC patients who underwent elective operation only. Thus, the predictive model may not suit other surgical cancer patients. The model might become more superior if there are various types of cancer patients from multicentre involvement. Last but not least, the selection bias might be happened due to the operation may not be offered to those who non-operable GC and the severely malnourished patients.

Conclusions

The postoperative early dietary intake achievement not only assures a shorter duration of hospital stays but also preserves body composition among GC patients. The identification of postoperative dietary intake predictors stimulates the development of, better multidisciplinary patient-centered ERAS approach which is incorporated with a more specific and comprehensive dietitian-led individualized intensive nutrition intervention management pre- and post-operation to promote postoperative functional recovery. This further suggests the crucial needs of perioperative nutritional management among surgical cancer patients.

Declarations

Funding: The authors did not receive support from any organization for the submitted work.

Conflicts of Interest: There is no conflict of interest in this study.

Availability of data and material: Data are available from the authors upon reasonable request.

Code availability: Not applicable

Authors' Contributions: HCY conceptualized, design, and completes the data collection, analysis and interpretation of the study. ZI, ZAZ, ZAMD and NBMY provided supervision in the design and execution of the study. HCY wrote the first draft of the manuscript. ZI, ZAZ, ZAMD, NBMY, MNMA and JO reviewed and edited the manuscript. All authors read and approved the final manuscript.

Ethical Approval: The study was registered in the National Medical Research Registry Malaysia and Clinical Trial Registration with registration number NCT03667755 for publication purposes. The ethical approval of the study was received from the Medical Research Ethics Committee (MREC) with reference number NMRR-17-1070-36021.

Consent to participate: Informed consent was obtained from all the participants in the study.

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Figures

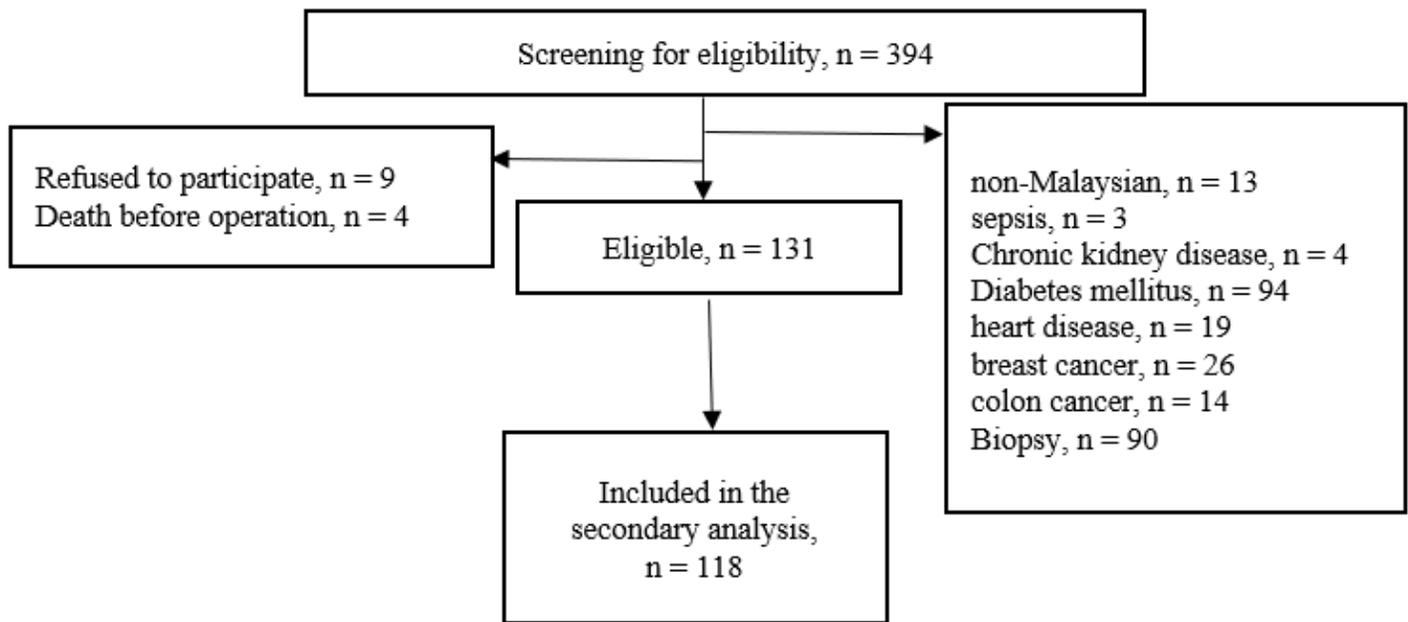


Figure 1

Flow Diagram of the Subjects' Selection Process and Specific Reasons for Exclusion

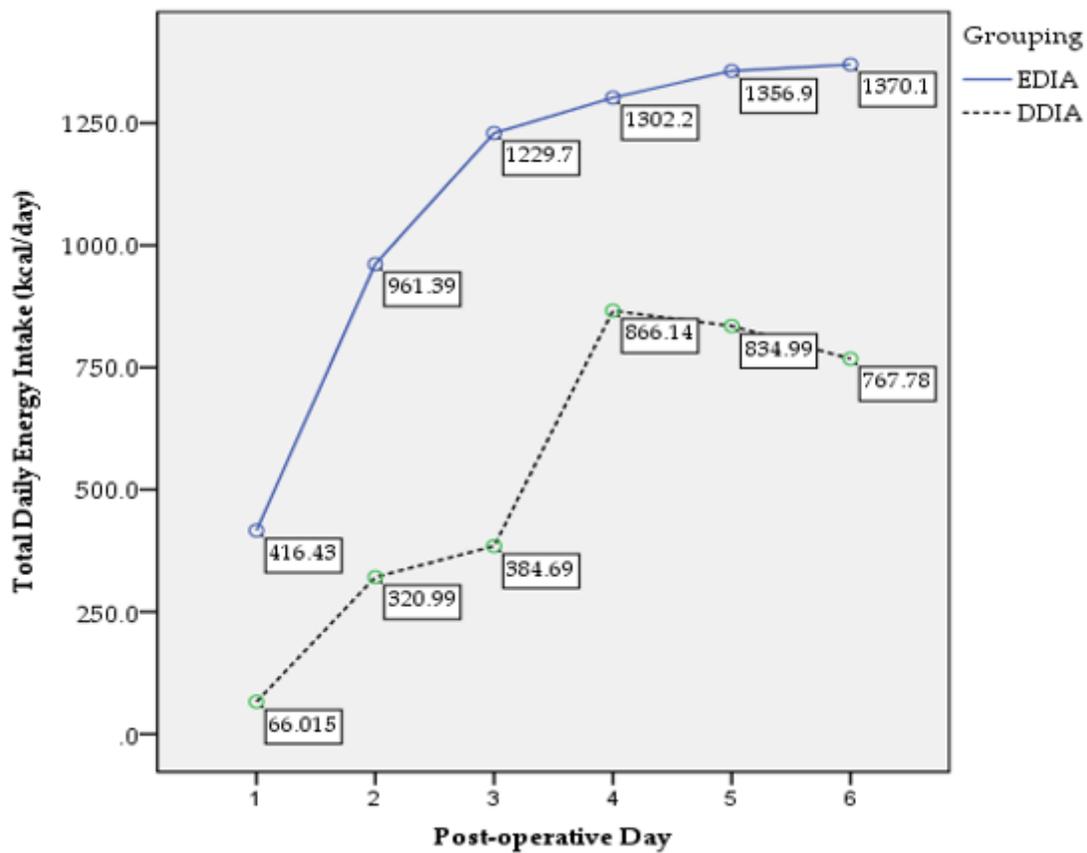


Figure 2

Postoperative total daily energy intake trend.

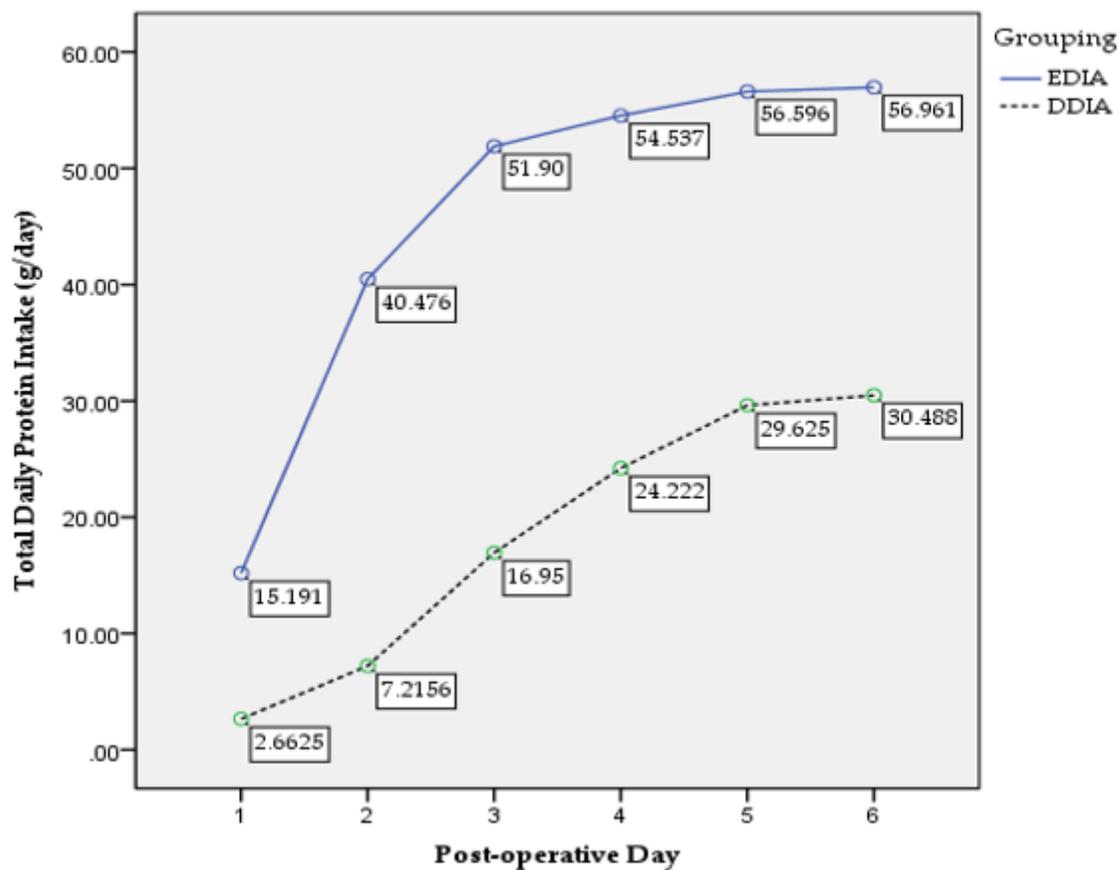


Figure 3

Postoperative total daily protein intake trend.

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