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Impact of Dietary Behavioural Changes on Prognosis of Postoperative Oesophageal Squamous Cell Carcinoma Patients: A Retrospective Cohort Study

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Received: 20 September 2023 | **Revised:** 9 February 2025 | **Accepted:** 13 February 2025

Funding: This work was supported by Jiangsu Provincial Medical Key Discipline Cultivation Unit (JSDW202233) and Nanjing Medical University Science and Technology Development Fund (NMUB20230112).

Keywords: dietary behaviour changes | oesophageal squamous cell carcinoma | postoperative complications | prognosis

ABSTRACT

Objective: In recent years, the incidence of oesophageal squamous cell carcinoma has been increasing, becoming a major focus of public attention. Despite surgery being the primary treatment method, the long-term prognosis after surgery is also of significant importance. Therefore, this study aims to investigate the impact of dietary behaviour changes on the long-term prognosis of patients with oesophageal squamous cell carcinoma after surgery.

Methods: A retrospective cohort study was adopted, involving patients with oesophageal squamous cell carcinoma who underwent surgery at the Department of Thoracic Surgery, Affiliated Huaian No. 1 People's Hospital of Nanjing Medical University from January 1, 2018, to December 31, 2019. Data collected included characteristics of dietary behaviour, complications, postoperative quality of life scores and survival periods. Data were gathered through review of clinical pathological characteristics and patient survey questionnaires.

Results: Patients with oesophageal squamous cell carcinoma who changed their dietary behaviours had a significant reduction in the risk of postoperative complications, higher quality of life scores (mean QoL score NDC: 9.8 vs. DC: 21.1; $p < 0.001$) and a slightly prolonged overall survival period (univariate hazard ratio: 0.58, 95% CI: 0.40–0.83, $p = 0.003$). Study findings also indicated age as a significant independent risk factor influencing patient prognosis.

Conclusion: To improve postoperative prognosis in patients with oesophageal squamous cell carcinoma, guidance and management of dietary behaviour should be emphasised. Appropriate changes in dietary behaviour are expected to reduce the risk of postoperative complications, improve the quality of life and extend the survival period of patients.

Patient or Public Contribution: The findings of this study have important implications for both patients and the public. By investigating the impact of dietary behaviour changes on the long-term prognosis of patients with oesophageal squamous cell carcinoma after surgery, this study provides valuable insights into potential strategies to improve patient outcomes. For patients, the study emphasises the importance of adopting healthy dietary behaviours after surgery. The results demonstrate that dietary behaviour changes can have a significant impact on the long-term prognosis of postoperative oesophageal squamous cell carcinoma patients. By following a healthy diet, patients may improve their overall quality of life, decrease complications and potentially increase their survival period.

Abbreviations: BMI, body mass index; CI, confidence interval; CT, computed tomography; DC, dietary change group; ESCC, oesophageal squamous cell carcinoma; FEV1, forced expiratory volume in 1 second; FVC, forced vital capacity; HR, hazard ratio; NDC, no dietary change group; OR, odds ratio.

1 | Introduction

Oesophageal squamous cell carcinoma (ESCC) stands as a persistent public health challenge with a steadily increasing incidence rate, especially in high-risk regions of the world (Lutfi et al. 2020; Zhang et al. 2021). Surgical resection remains a cornerstone in the management of localised ESCC, providing patients with the prospect of curative treatment (Waters and Reznik 2022). Despite advancements in surgical techniques and perioperative care, the postoperative period is fraught with potential complications that can markedly detract from patient survival and quality of life.

It has been increasingly recognised that clinical outcomes in ESCC are not solely contingent upon the surgical intervention but are also significantly influenced by postoperative patient management, which includes dietary behaviours (Lu et al. 2022; Yang et al. 2022; Zhang et al. 2022). Adjusting dietary intake and habits after oesophagectomy is crucial due to anatomical and physiological alterations, which can affect nutritional status, the healing process and the risk of complications (Zang et al. 2022). Suboptimal dietary habits may lead to insufficient intake of essential nutrients, compromised immunity and weight loss, which in turn could impede recovery and adversely affect long-term outcomes (Liu et al. 2017).

Contemporary research has shed light on various prognostic factors in the context of ESCC, including tumour characteristics, patient genetics and perioperative care (Fritsch et al. 2021; Sherf Dagan et al. 2017; Tabung et al. 2020). However, the nuances of dietary modifications post-oesophagectomy as a potentially modifiable factor have garnered less attention (Carr et al. 2016; Lewis et al. 2016). Preliminary data hint towards the salutary effects of dietary change, encompassing risk reduction for postoperative complications, improvement in quality-of-life indices and possible extension of survival durations (Borzoui et al. 2018; Wilson et al. 2012). Yet, the extant evidence remains riddled with contradictory findings and a tendency in some studies to overrepresent the influence of diet when evaluated in isolation from other relevant covariates (Park et al. 2022). This discord underscores the imperative need for more focused investigation into the role of diet specifically tailored to the convalescence of ESCC patients post-surgery.

Dietary behaviours post-oesophagectomy in oesophageal squamous cell carcinoma (ESCC) patients have long been acknowledged as a vital component in influencing clinical outcomes. These changes, necessitated by the physiological alterations post-surgery, are crucial for maintaining nutritional balance and mitigating complications. Surprisingly, pre-surgery dietary data is often lacking, making it essential to hypothesise a baseline derived from existing literature. This hypothesised baseline, as referenced in (Borzoui et al. 2018; Carr et al. 2016; Lewis et al. 2016; Liu et al. 2017), assumes a standard dietary pattern similar to other stable, disease-free populations. It allows for a systematic assessment of dietary changes and their correlation with patient outcomes. This approach facilitates a more precise evaluation of the impact of dietary modifications on recovery and long-term prognosis, thereby addressing existing research gaps in understanding dietary influences on convalescence. Our retrospective cohort study intends to address this gap by methodically evaluating the impact of dietary behaviour changes on the long-term prognosis of postoperative ESCC patients. A nuanced analysis of dietary changes in conjunction with other prognostic elements is performed to contextualise the scope of diet's independent contribution to outcomes such as postoperative complications, quality of life and overall survival. Moreover, we aspire to refine the current understanding by delineating the relationship between dietary modifications and the stratified prognostic groups, potentially leading to a more nuanced risk profile and tailored patient advice—heralding a novel dimension to patient-centred recovery paradigms. We hypothesise that well-structured dietary behavioural interventions could substantially benefit these patients by outlining a clear trajectory for recovery and enhancing quality of life in the convalescent phase.

With this study, we explore new frontiers in post-surgery care for ESCC, striving to substantiate and codify the significance of dietary behaviour as a central element in postoperative management. Our objective is to establish an evidence base that will inform practical guidelines and enrich the repository of strategies aimed at rehabilitating patient health and extending longevity after ESCC surgery.

2 | Materials and Methods

2.1 | Study Design and Participants

The purpose of this retrospective cohort study is to explore the impact of dietary behaviour changes on the prognosis of patients with oesophageal squamous cell carcinoma. The study was conducted at the Department of Thoracic Surgery, Affiliated Huaian No. 1 People's Hospital of Nanjing Medical University from January 2018 to December 2019. The subjects of the study were patients with oesophageal squamous cell carcinoma who underwent thoracoscopic and laparoscopic oesophagectomy. To ensure the accuracy and reliability of the research, a series of inclusion and exclusion criteria were used to select the appropriate subjects for the study. The following were the inclusion and exclusion criteria for this study. Exclusion criteria: A. Patients with other malignant tumours will be excluded to avoid interference with the research results. B. Patients without pre-operative CT imaging data do not meet the inclusion criteria, as these data are necessary for research and assessment of tumour conditions. C. Patients receiving neoadjuvant treatment will be excluded, as this may have an additional impact on the patient's dietary behaviour, interfering with our analysis of causes and results. D. Patients who cannot obtain preoperative and postoperative clinical pathological data are also excluded, as these data are key indicators for evaluating treatment effectiveness and patient prognosis. The inclusion criterion: A. Patients included in the research must undergo preoperative endoscopy and have pathological confirmation of squamous cell carcinoma. B. All subjects must undergo chest and abdominal CT enhanced scanning within a week before surgery in our hospital. These scanning data are critical for clinical staging. C. Clinical staging of all patients will be performed according to the eighth edition of TNM classification and recorded during the

study. The study complied with the guidelines of the Helsinki Declaration and was authorised by the Ethics Committee of Nanjing Medical University (KY-2024-116-01). Definitions of Dietary Behaviour: Dietary behaviour change (DC) was defined as a measurable alteration in dietary habits post-surgery, including but not limited to increased fruit and vegetable consumption, reduced intake of high-fat foods and adherence to smaller, more frequent meals. No dietary behaviour change (NDC) was defined as maintenance of the same dietary habits as prior to surgery without any significant changes. The patient's dietary behaviour was assessed and classified based on a composite score derived from the dietary behaviour questionnaire. Vocal cord paralysis was included as a postoperative complication, and data on its incidence were collected and analysed in relation to dietary behaviour changes.

2.2 | Data Collection Methods

A. Survival Information and Postoperative Complications Collection: The survival status of patients was monitored and updated during the follow-up visits every 3 months postsurgery up to the study cutoff date or until patient death. Survival time was calculated starting from the date of surgery to the date of death from any cause or to the last follow-up. To determine postoperative complications accurately, we categorised them into major and minor complications based on severity and clinical impact. Major complications included anastomotic leakage, pulmonary complications such as pneumonia, and cardiac events such as myocardial infarction. Minor complications comprised wound infections, dysphagia and vocal cord paralysis. The presence of these complications was systematically reviewed and documented by examining discharge summaries, surgical notes and outpatient records within 30 days postsurgery, which is the typically accepted period for recording early postoperative complications.

B. Baseline Data Collection: Patient demographic and clinical baseline data including age, sex, body mass index (BMI), preoperative comorbidities (pulmonary function, tumour location, TNM staging) were collected from the medical records. Preoperative CT imaging data and any neoadjuvant treatments were also documented.

C. Dietary Behaviour Assessment: To assess dietary changes accurately, we employed a composite scoring system adapted from validated food frequency questionnaires, tailored to the postoperative context of ESCC patients. This scoring was based on dietary behaviours known to impact recovery, such as increased fruit and vegetable consumption and meal frequency. The 'hypothesized baseline' was derived as the mean score from literature-reported dietary behaviours within disease-free populations (Neuhouser 2019; Sprake et al. 2018). This questionnaire (Table S1) was designed to capture data on food intake types, dietary diversity, meal frequency and overall diet quality. After conducting a review of the patients, we scored the patient's diet behaviour according to Table S2 and calculated the average score of all different time points as the final score for this patient's dietary behaviour. This method offered a comparative framework against which postoperative dietary changes could be evaluated, ensuring a standardised approach to inferring significant dietary adjustments.

D. Quality of Life Data Collection: For assessing quality of life, we used a standardised questionnaire referenced from the European Organisation for Research and Treatment of Cancer (EORTC) Quality of Life Questionnaire (EORTC QLQ-C30) that is tailored for oesophageal cancer patients (Muhetaer et al. 2023). The validated survey (Table S3) was used to evaluate multiple dimensions of patient health and quality of life 12 months after surgery.

E. Definitions of Dietary Behaviour: Postoperative dietary habits change (PDHC) was operationally defined as any positive or negative alteration in the patient's diet following oesophageal cancer surgery, with the intention of improving nutritional intake and managing symptoms such as dysphagia, reflux or anastomotic stenosis that may arise due to anatomical alterations post-oesophagectomy. Patients were categorised as having 'positive PDHC' if they reported any of the following changes during the follow-up period compared to their preoperative habits: an increased frequency of small meals, improved nutritional balance such as greater intake of proteins or vitamins, increased hydration, reduced consumption of irritants (spicy foods, alcohol), inclusion of easy-to-swallow foods and adoption of dietary recommendations provided by a dietician or clinician specifically designed for post-oesophagectomy. Conversely, 'negative PDHC' was recorded if the patient exhibited harmful dietary patterns such as irregular meal times, increased consumption of processed or high-fat foods, below-recommended caloric intake or failure to adhere to dietary advice postoperatively.

2.3 | Statistical Analysis

For describing continuous variables, we determined the use of mean or median based on the normality of the distribution, assessed by the Shapiro–Wilk test. Normally distributed data were summarised using means and standard deviations, while non-normally distributed data were summarised using medians and interquartile ranges (IQR). Statistical analyses were conducted using multiple methodologies. Univariate analyses were performed using the Chi-square test for categorical variables and t-tests or Mann–Whitney U tests for continuous variables as appropriate. Multivariate logistic regression analyses were used to adjust for potential confounders and to determine the independent effects of dietary behaviour changes on postoperative outcomes. Follow-up was carried out through regular outpatient clinic visits or telephonic interviews every 3 months for the first-year post-surgery and biannually thereafter. At each follow-up, we collected data regarding the patients' survival status, quality of life measures and incidence of postoperative complications. Initially, a cohort of 300 patients was followed. Over the study period, we recorded 45 deaths and 70 events of postoperative complications. The loss to follow-up was minimal with only 10 patients (3.33%) being unaccountable, mainly due to the relocation or change in contact information. For survival analysis,

Cox proportional hazards regression was used in multivariate analysis to identify independent predictors of survival. Statistical evaluations incorporated this baseline by using multivariate logistic regression to adjust for confounders and determine dietary behaviour changes' independent effects on outcomes. The composite dietary scores, calculated against the baseline estimates, enabled a clear distinction of dietary impacts on postoperative prognosis. All statistical analyses were performed using the Free Statistics software version 1.9 together with the R software package (http://www.R-project.org, The R Foundation). Statistically significant differences were considered when $p < 0.05$.

3 | Results

3.1 | Baseline Characteristics

Our cohort comprised 300 subjects, stratified into two groups based on post-surgery dietary behaviour changes: the no dietary change group (NDC, $n = 150$) and the dietary change group (DC, $n = 150$). Baseline characteristics included age, sex, body mass index (BMI) and clinical staging. The two groups were comparable in age (mean NDC: 70.6 years, mean DC: 71.2 years; $p = 0.278$) and sex distribution (63.7% female). Notably, BMI differed significantly between groups ($p = 0.006$), with the DC group having a higher proportion of patients with a normal BMI. For further details, see Table 1, which includes the specific statistical methods used for each variable.

3.2 | Quality of Life Outcomes

Data on quality of life (QoL), assessed 12 months postoperatively using an adaptation of the EORTC QLQ-C30 questionnaire (Muhetaer et al. 2023), indicated a significant improvement in the DC group compared to the NDC group (mean QoL score NDC: 9.8 vs. DC: 21.1; $p < 0.001$).

3.3 | Postoperative Complications and Survival Analysis

Univariate analysis revealed a significant negative correlation between dietary behaviour change and postoperative complications (crude odds ratio: 0.34, 95% CI: 0.21–0.55, $p < 0.001$). Multivariate logistic regression, controlling for age and other potential confounders, confirmed this association (adjusted odds ratio: 0.43, 95% CI: 0.23–0.81, $p = 0.008$). Other factors, including lung function index, hypertension and smoking status, were not independently associated with complications (see Table 2). With respect to overall survival, dietary behaviour change positively impacted survival rates (univariate hazard ratio: 0.58, 95% CI: 0.40–0.83, $p = 0.003$; multivariate hazard ratio: 0.38, 95% CI: 0.23–0.64, $p < 0.001$, after adjusting for age and tumour stage). Age emerged as an independent risk factor for decreased survival (hazard ratio per year increase: 1.08, 95% CI: 1.04–1.12, $p < 0.001$). Survival curves and additional statistical details can be found in Table 3. The results underline the positive influence of dietary behaviour changes on postoperative outcomes, highlighting the importance of post-surgery dietary guidance in the oesophageal squamous cell carcinoma patient cohort.

4 | Discussion

This retrospective cohort study, conducted over a year, aims to explore the impact of dietary behaviour changes on the prognosis of postoperative oesophageal squamous cell carcinoma patients. In it, we researched differences in post-surgery complications, quality of life and survival duration between patients who altered their diets and those who did not. Our results indicate that the patients who changed their eating habits post-surgery showed a significant decrease in postoperative complication rates and an increase in survival duration. Meanwhile, we navigated the complexities of evaluating dietary habits in a postoperative ESCC cohort by establishing a 'hypothesized baseline', informed by available literature. This baseline facilitated the calibration of dietary assessments, allowing us to discern the nuanced impacts of specific dietary changes on postoperative complications, quality of life and overall survival. The evidence underscored dietary behaviour modification as a pivotal, independent factor in the recovery and long-term management of ESCC. This finding complements numerous studies, both nationally and internationally, and strongly confirms the significant influence of diet changes on the prognosis of postoperative oesophageal squamous cell carcinoma patients.

For postoperative complications, our results illustrated that patients who changed their dietary behaviour significantly decreased their risks of complications. This could be due to improved nutritional status from appropriate dietary behaviour, which boosts patient constitution and supports recovery post-surgery, enhances immunity, prevents infections and limits complications risk—all playing a positive role (Alverdy 2023; Brady et al. 2003; Bielawska and Allard 2017; Ho et al. 2022; Leistra et al. 2015). Moreover, proper dietary behaviour can promote the recovery of digestive functions beneficial for wound healing post-surgery (Lee et al. 2023; Redpath et al. 2021; Steenackers et al. 2018; Waitzberg et al. 1999).

For survival duration, our study also found that patients who changed dietary behaviour have shown a longer overall survival duration than those who did not alter their dietary behaviours. Good dietary habits can enhance immunity, thus delaying cancer recurrence or metastasis, improving quality of life and further prolonging survival duration (Calabrese et al. 2020; Estanislau et al. 2022). This conclusion is consistent with research in areas like hepatobiliary surgery, gastrointestinal surgery and others, further demonstrating the importance of proper dietary habits for postoperative patients (Liu et al. 2022; Ma et al. 2021; Nance et al. 2020; Sarwer et al. 2011; Zhong et al. 2020). Besides, our study also showed age as an important factor influencing postoperative complications and survival duration, further proving the concept of patient-centred care. Simultaneously, it points out that in actual nursing work, factors like patient's age, constitution, individual differences, etc., should also be given full attention.

In conclusion, this retrospective cohort study showcased to us the significant impact of dietary behaviour changes on postsurgery

TABLE 1 | Classification and clinical characteristics of patients based on changes in dietary behaviour.

Variables	Total ($n=300$)	NDC ($n=155$)	DC ($n=145$)	p
Age (year), Mean ± SD	70.9 ± 4.6	70.6 ± 4.4	71.2 ± 4.8	0.278
Gender, *n* (%)				0.870
Female	191 (63.7)	98 (63.2)	93 (64.1)	
Male	109 (36.3)	57 (36.8)	52 (35.9)	
Abnormal BMI, *n* (%)				0.006
No	201 (67.0)	115 (74.2)	86 (59.3)	
Yes	99 (33.0)	40 (25.8)	59 (40.7)	
FEV1/FVC (%), Mean ± SD	89.8 ± 19.7	90.5 ± 20.2	89.1 ± 19.2	0.530
Hypertension, *n* (%)				0.163
No	194 (64.7)	106 (68.4)	88 (60.7)	
Yes	106 (35.3)	49 (31.6)	57 (39.3)	
Diabetes mellitus, *n* (%)				0.984
No	273 (91.0)	141 (91)	132 (91)	
Yes	27 (9.0)	14 (9)	13 (9)	
Smoking, *n* (%)				0.078
No	187 (62.3)	104 (67.1)	83 (57.2)	
Yes	113 (37.7)	51 (32.9)	62 (42.8)	
Drinking, *n* (%)				0.130
No	195 (65.0)	107 (69)	88 (60.7)	
Yes	105 (35.0)	48 (31)	57 (39.3)	
Albumin (mg/dL), Mean ± SD	43.8 ± 4.2	43.2 ± 4.4	44.3 ± 4.0	0.025
Tumour location, *n* (%)				0.754
Upper	37 (12.3)	20 (12.9)	17 (11.7)	
Middle	216 (72.0)	113 (72.9)	103 (71)	
Low	47 (15.7)	22 (14.2)	25 (17.2)	
T stage, *n* (%)				0.750
T1	68 (22.7)	37 (23.9)	31 (21.4)	
T2	67 (22.3)	36 (23.2)	31 (21.4)	
T3	165 (55.0)	82 (52.9)	83 (57.2)	
N stage, *n* (%)				0.120
N0	194 (64.7)	91 (58.7)	103 (71)	
N1	69 (23.0)	40 (25.8)	29 (20)	
N2	26 (8.7)	16 (10.3)	10 (6.9)	
N3	11 (3.7)	8 (5.2)	3 (2.1)	
Grade, *n* (%)				0.584
I	91 (30.3)	49 (31.6)	42 (29)	
II	100 (33.3)	54 (34.8)	46 (31.7)	
III	109 (36.3)	52 (33.5)	57 (39.3)	
Surgery duration (hour), Mean ± SD	3.8 ± 1.1	3.9 ± 1.1	3.8 ± 1.0	0.256
Arrhythmia, *n* (%)				0.005
No	248 (82.7)	119 (76.8)	129 (89)	
Yes	52 (17.3)	36 (23.2)	16 (11)	
Pleural effusion, *n* (%)				0.054
No	243 (81.0)	119 (76.8)	124 (85.5)	
Yes	57 (19.0)	36 (23.2)	21 (14.5)	
Anastomotic fistula, *n* (%)				0.733
No	282 (94.0)	145 (93.5)	137 (94.5)	
Yes	18 (6.0)	10 (6.5)	8 (5.5)	
Pulmonary infection, *n* (%)				0.179
No	232 (77.3)	115 (74.2)	117 (80.7)	
Yes	68 (22.7)	40 (25.8)	28 (19.3)	
Length of stay(days), Mean ± SD	17.4 ± 6.7	20.9 ± 7.1	13.7 ± 3.3	< 0.001
Quality of life scores, Mean ± SD	15.3 ± 6.1	9.8 ± 2.2	21.1 ± 2.4	< 0.001

Note: NDC equals No Dietary Change. DC equals Dietary Change. Abnormal BMI equals BMI > 25 or BMI < 18.5.

oesophageal squamous cell carcinoma patients, prompting us to focus more on the guidance of patient's dietary habits and behaviours in daily nursing work to enhance patient's prognosis post-surgery, improve the quality of life and extend patients' survival duration (Shaharudin et al. 2013; Vear et al. 2023; Wei et al. 2023). This carries significant instructive implications for our future research work, nursing practice and nursing education (Chair et al. 2022; Young et al. 2019).

5 | Implications for Nursing

Our findings highlight significant implications for nursing practice in the postoperative care of oesophageal squamous

TABLE 2 | Results of univariable/multivariable logistic regression analysis and predictors of postoperative pneumonia complications.

Variable	Postoperative complications			
	Crude. OR 95% CI	Crude. *p*	Adj. OR 95% CI	Adj. *p*
Dietary changes				
NDC	Ref		Ref	
DC	0.34 (0.21 ~ 0.55)	< 0.001	0.43 (0.23 ~ 0.81)	0.008
Age	1.06 (1 ~ 1.11)	0.033	1.08 (1.02 ~ 1.14)	0.013
Gender				
Female	Ref			
Male	1.12 (0.7 ~ 1.8)	0.638		
BMI				
Abnormal	Ref			
Normal	0.91 (0.56 ~ 1.48)	0.702		
FEV1/FVC%	1 (0.99 ~ 1.01)	0.863		
Hypertension				
Yes	Ref			
No	0.9 (0.56 ~ 1.46)	0.680		
Diabetes mellitus				
Yes	Ref			
No	0.83 (0.37 ~ 1.85)	0.641		
Smoking				
Yes	Ref			
No	0.85 (0.53 ~ 1.36)	0.495		
Drinking				
Yes				
No	1.11 (0.69 ~ 1.79)	0.670		
Albumin (mg/dL)	0.96 (0.91 ~ 1.02)	0.186		
Tumour location				
Upper				
Middle	0.68 (0.34 ~ 1.37)	0.280		
Low	0.58 (0.24 ~ 1.38)	0.215		
T stage				
T1				
T2	1.23 (0.63 ~ 2.42)	0.547		
T3	0.79 (0.45 ~ 1.39)	0.413		
N stage				
N0				
N1	0.97 (0.56 ~ 1.68)	0.903		
N2	0.92 (0.4 ~ 2.11)	0.845		
N3	3.35 (0.86 ~ 13.01)	0.081		
Surgery duration	1.18 (0.95 ~ 1.46)	0.125		
Length of stay	1.09 (1.04 ~ 1.14)	< 0.001		

Note: NDC equals No Dietary Change. DC equals Dietary Change.

cell carcinoma patients. Nursing interventions should prioritise dietary education and support tailored to patient needs, focusing on reinforcing positive dietary behaviours that minimise complications and promote rehabilitation. The study provides a basis for developing standardised dietary guidelines as part of postoperative care protocols, potentially improving patient outcomes and enhancing their quality of life. Nurses can play a crucial role in dietary counselling and monitoring, encouraging adherence to dietary recommendations and offering personalised dietary strategies to optimise recovery outcomes.

6 | Study Limitations and Future Research Directions

This study has several limitations, including a relatively small sample size, a short follow-up duration and the absence of dynamic observations on dietary changes over time. Future research should focus on longitudinal studies with larger populations to validate these findings and provide a deeper understanding of how dietary modifications impact patient recovery and long-term outcomes. Further exploration of interventions to assist patients who do not change dietary behaviour post-surgery could be key to improving overall survival rates. Additionally, investigating the biological mechanisms by which dietary changes influence immune function and cancer recurrence could contribute to the development of more targeted dietary interventions in clinical settings.

TABLE 3 | Results of univariable/multivariable Cox regression analysis and predictors of postoperative overall survival.

Variable	Overall survival rate			
	Crude. HR 95% CI	Crude. *p*	Adj. HR 95% CI	Adj. *p*
Dietary changes				
NDC	Ref		Ref	
DC	0.58 (0.4 ~ 0.83)	0.003	0.38 (0.23 ~ 0.64)	< 0.001
Age	1.06 (1.03 ~ 1.09)	< 0.001	1.08 (1.04 ~ 1.12)	< 0.001
Gender				
Female	Ref			
Male	1.14 (0.81 ~ 1.61)	0.440		
BMI				
Abnormal	Ref			
Normal	0.9 (0.64 ~ 1.26)	0.529		
FEV1/FVC%	1.01 (1 ~ 1.01)	0.153	1.01 (1 ~ 1.02)	0.033
Hypertension				
Yes	Ref			
No	1.2 (0.86 ~ 1.67)	0.294		
Diabetes mellitus				
Yes	Ref			
No	1.49 (0.9 ~ 2.47)	0.125		
Smoking				
Yes	Ref			
No	0.98 (0.7 ~ 1.37)	0.892		
Drinking				
Yes	Ref			
No	0.95 (0.67 ~ 1.33)	0.750		
Albumin (mg/dL)	0.98 (0.94 ~ 1.02)	0.237		
Tumour location				
Upper	Ref			
Middle	0.73 (0.45 ~ 1.2)	0.220		
Low	1.01 (0.56 ~ 1.83)	0.968		
T stage				
T1	Ref			
T2	0.97 (0.59 ~ 1.61)	0.913		
T3	1.09 (0.72 ~ 1.67)	0.680		
N stage				
N0	Ref			
N1	1.58 (1.09 ~ 2.31)	0.017		
N2	1.06 (0.51 ~ 2.2)	0.873		
N3	2.38 (1.15 ~ 4.93)	0.020		
Surgery duration	1.02 (0.87 ~ 1.19)	0.828		
Length of stay	1 (0.97 ~ 1.02)	0.809	0.95 (0.91 ~ 0.99)	0.014

Note: NDC equals No Dietary Change. DC equals Dietary Change.

Author Contributions

Jianqiang Zhao and Zhiyun Xu designed the study. Fengqing Ji, Yunyun Chen and Yan Ma collected the data. Haiyan Wu and Xinqi Wei analysed the data. Zhiyun Xu and Fengqing Ji interpreted the results. Zhiyun Xu wrote the first draft of the manuscript. Jianqiang Zhao contributed to the refinement of the manuscript. The final manuscript has been read and approved by the authors.

Acknowledgements

We would like to express our gratitude to the team members for their contributions to this article, and then we will work diligently to do relevant research in the future.

Ethics Statement

The study was performed under the Declaration of Helsinki guidelines and was approved by the Ethics Committee of Nanjing Medical University. All methods described in this study were conducted in accordance with relevant guidelines and regulations. Informed consent was waived by the Ethics Committee of Nanjing Medical University due to the retrospective nature of the study. The Ethics Committee of Nanjing Medical University reviewed the study protocol and granted the waiver of informed consent based on their determination that the study met the necessary criteria for exemption from informed consent requirements.

Consent

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.