ORIGINAL RESEARCH

Effect of Nutritional Intervention on Energy Intake in Head and Neck Cancer Patients After Radiotherapy

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ABSTRACT

Objective • This study aimed to analyze the impact of nutritional intervention during radiotherapy for head and neck tumors and its effects on energy intake, consumption, and nutritional status.

Methods • A comparative or observational study was conducted, and a total of 103 head and neck tumor patients undergoing radiotherapy were selected for this study and divided into two groups. The control group (n = 51) received routine nursing intervention, while the observation group (n = 52) received additional nutritional intervention. We compared the nutritional status, energy intake and consumption, and emotional well-being between the two groups.

Results • After the intervention, the observation group exhibited significantly higher levels of BMI, serum prealbumin, hemoglobin, and albumin compared to the control group ($P < .05$). Energy intake during radiotherapy was significantly higher in the observation group than in the control group. Furthermore, the energy consumption in the observation group was significantly lower than in the control group ($P < .05$). After the intervention, the observation group reported lower scores on the Self-rating Anxiety Scale and Self-rating Depression Scale compared to the control group ($P < .05$). In a three-month follow-up after radiotherapy, the observation group's EORTC Cancer Quality of Life Scale score was also significantly higher than that of the control group ($P < .05$).

Conclusions• Nutritional intervention proved effective in increasing energy intake and reducing energy consumption in patients undergoing radiotherapy for head and neck tumors. This improvement positively impacted the nutritional status and quality of life of the patients, emphasizing its significant research value. (*Altern Ther Health Med.* [E-pub ahead of print.])

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INTRODUCTION

Head and neck tumors represent a prevalent clinical issue characterized by a high incidence, frequent recurrence, and often unfavorable prognoses.[1-2] Statistics reveal that approximately 40% of head and neck tumor patients die from malnutrition or related complications.[1] During radiotherapy, most of these patients face malnutrition due to dysphagia, swallowing disorders, acute mucositis, and other complications.[2] Malnutrition not only diminishes the patient's ability to tolerate radiotherapy but also reduces its efficacy.

Malignant tumor cell division consumes substantial amounts of energy. However, due to swallowing difficulties, patients often struggle to obtain adequate nutrition, a predicament that intensifies their risk of malnutrition.[2] Radiotherapy stands as the primary treatment modality for head and neck tumors. However, this therapeutic approach is not without its complications, often resulting in issues such as mucosal ulcers and acute mucositis, which can significantly compromise the patients' swallowing function.[3-4]

The emotional effect on patients during this process exacerbates their loss of appetite, leading to risks of malnutrition. Notably, the conventional passive nutrition nursing interventions post-radiotherapy have been deemed insufficient, lacking a comprehensive and scientific approach that would yield optimal nutritional outcomes for these patients.[3]

In recent years, there has been a notable shift in clinical nursing practices, marked by an increased focus on the nutritional well-being of patients undergoing radiotherapy.[4] This shift in the nursing paradigm has generated a broader recognition of the important role that nutritional intervention plays in patient care. In response to these changes, nutritional intervention has emerged as a key strategy to rectify the limitations of traditional nursing methods, providing

scientifically tailored nutrition to patients and aligning with the demands of contemporary nursing practices. This paradigm shift not only represents a critical aspect of modern nursing but also offers a promising direction for the future of patient care.

In recent years, the Chinese Anti-cancer Association has issued a clear mandate for the enhancement of nutritional risk screening and the assessment of nutritional status in cancer patients. The aim is to bolster nutritional support and, in doing so, elevate the overall quality of life for these patients.[5] Building upon this imperative, our study undertook a careful nutritional risk assessment for patients undergoing radiotherapy for head and neck tumors. Subsequently, we implemented a targeted nutritional intervention and examined its impact on the nutritional status of these patients, as detailed below.

MATERIALS AND METHODS

Study Design

A comparative observational study was conducted, and a total of 103 patients receiving radiotherapy for head and neck tumors were admitted to the Department of Head and Neck Oncology in a Grade-A cancer hospital between September 2022 and January 2023 and were enrolled as the study population. These patients were divided into two distinct groups for the study. This study obtained approval from the hospital's Ethics Committee, with informed consent obtained from the patients or their family members.

Inclusion and exclusion Criteria

Inclusion criteria were as follows: (1) Pathological diagnosis of malignant head and neck tumor; (2) All patients having malignant tumors in the head and neck region; (3) All patients received intensity-modulated radiotherapy; (4) Patients were conscious and possessed normal communication skills; (5) Patients with Karnofsky performance score ≥70; (6) patients with complete clinical data were included in this study.

Exclusion criteria were as follows: (1) Patients with severe mental illness; (2) Estimated survival time less than 6 months; (3) Presence of distant metastasis; (4) Severe infection; (5) Patients with severe cardiac or renal insufficiency; (6) Any patients who dropped out of the study.

Study Population and Groups

The enrolled patients were divided into two different groups for the study. (1) Control Group: The control group comprised 51 patients, including 29 males and 22 females, with ages ranging from 25 to 70 years. The average age of this group was (47.55±7.61) years. (2) Observation Group: The observation group consisted of 52 patients, with 32 males and 20 females. The age range within this group extended from 23 to 71 years, with an average age of (47.11±7.53) years. Notably, there were no significant differences in age, disease type, or other baseline data between the two groups ($P > .05$).

Disease Types in Control and Observation Groups

The types of diseases represented in the control group included laryngeal cancer (18 cases), thyroid cancer (14 cases), oral cancer (11 cases), nasopharyngeal cancer (5 cases), and other head and neck tumors (3 cases). Disease types within the control group were distributed as laryngeal cancer (15 cases), thyroid cancer (15 cases), oral cancer (13 cases), nasopharyngeal cancer (6 cases), and other head and neck tumors (3 cases).

Radiotherapy Dosing

The total dose of radiotherapy administered to both study groups amounted to 70 Gy, with each treatment delivered at 2 Gy per session, five times a week, over a span of seven weeks. Concurrently, both groups received routine nursing intervention throughout the radiotherapy process.

Routine Nursing Intervention

Ward Environment. An important aspect of the nursing intervention was maintaining a clean and hygienic ward environment. It required regular disinfection and ventilation procedures. Additionally, efforts were made to optimize indoor temperature and humidity levels, ensuring a comfortable and conducive atmosphere within the ward.

Health Education. Nursing staff proactively engaged in educating patients and their families about tumor-related knowledge. This comprehensive education encompassed topics such as etiology, the radiotherapy procedure, nursing measures, prevention of complications, and essential precautions. The aim was to equip patients with a complete understanding of their condition. Additionally, health manuals were distributed to patients as supplementary educational materials. These resources were designed to enhance patients' comprehension of their medical condition and the management of their health.

Psychological Support. The nursing staff played a proactive role in offering psychological support to patients. It included effective communication with patients, assessing their psychological state, and gaining insights into their genuine needs. Prior to each operation, nursing staff engaged in detailed explanations to alleviate any tension experienced by the patient. This strategy aimed to foster a sense of trust and cooperation in the patient throughout their care. For patients who exhibited emotional stability, nursing staff offered various forms of distraction, such as providing books, newspapers, music, videos, and other resources. These measures were aimed at helping patients refocus their attention and uphold their emotional equilibrium.

Radiotherapy Nursing. Post-radiotherapy, patients commonly experience radiation-induced skin reactions and oral mucosal issues. These may manifest symptoms like skin itching, redness, erosion, oral mucosal congestion, erythema, and ulcers. To address these challenges, extreme care should be given to safeguard the skin and prevent damage and infection. Additionally, patients should prioritize oral hygiene and remain vigilant about any alterations in their oral mucosa. Engaging in regular functional exercises is essential to maintain and enhance their overall well-being.

Pain Management. Nursing staff plays a pivotal role in assessing the level of pain experienced by each patient and

implementing tailored nursing interventions. Patients with mild pain are encouraged to use distraction techniques, such as watching TV, listening to music, or engaging in conversations about personal matters. For patients with moderate pain, physical therapies like cold compresses and massages are employed to alleviate discomfort. When pain arises, it is recommended that patients take rest to minimize pain irritation. In cases of severe pain, patients were advised to follow the physician's guidance and use prescribed analgesics to alleviate their discomfort effectively.

Nutrition Guidance. Based on routine care, the control group received routine nutrition guidance, with nurses providing essential nutritional education to patients. This guidance aimed to increase patients' awareness of a scientifically balanced diet and to help them adapt to their dietary habits. The nursing staff played a crucial role in directing patients toward a scientifically balanced diet during radiotherapy. This dietary approach emphasized high-quality protein, fresh vegetables and fruits, and easily digestible foods as primary components. Conversely, patients were advised to refrain from consuming foods with known irritants, such as spicy, tobacco, alcohol, and other prohibited food.

Nutritional Intervention in the Observation Group

Nutritional Assessment. In the observation group, patients received a comprehensive nutritional intervention. This intervention commenced with a thorough evaluation of each patient's nutritional status. The Patient-Generated Subjective Global Assessment (PG-SGA) was employed as an accurate tool to assess the nutritional condition of the patients.

Dietary Guidance. Subsequently, dietitians and nurses collaborated to formulate a customized diet plan for each patient, guided by the assessment results. This individualized dietary strategy aimed to optimize the dietary choices of each patient based on their specific nutritional needs.

Correction of Dietary Beliefs. Patients with dysphagia often require enteral nutrition and parenteral nutrition support. However, some patients may hold deep-rooted traditional dietary beliefs, making them resistant to accepting nasal feeding nutrition. In response to this challenge, the nursing staff takes an active role in making patient-centered communication. They introduced the significance of various nutritional support methods, worked to reshape patients' traditional dietary concepts, corrected any misconceptions about dietary contraindications, and assisted patients in mastering essential dietary skills.

Nutritional Support Strategies. In cases where the PG-SGA score exceeded or was equal to 9, a proactive nutritional intervention was initiated and continued throughout the treatment. The aim was to guide patients towards the consumption of oral nutritional supplements and nutrient solutions. For patients dealing with dysphagia, a nasal feeding nutrition approach was adopted to provide the necessary nutritional support. Patients who exhibited resistance to eating due to symptoms like oral mucosal reactions resulting from radiotherapy's side effects received special attention. The nursing staff played a vital role in effective communication with these patients to help them overcome their reluctance and actively engage in dietary intake.

Observation Indices

Nutritional Status Assessment. Both before and after the intervention, a 3 ml fasting venous blood sample was obtained from the patients. This sample was placed in a procoagulant tube and subsequently separated via centrifugation at 3500 r/min. The resulting serum was collected for analysis. The levels of serum prealbumin (PA), hemoglobin (Hb), and albumin (ALB) were determined using enzyme-linked immunosorbent assay (ELISA). Additionally, the body mass index (BMI) of both patient groups was compared during the assessment.

Energy Intake and Expenditure Assessment. At the conclusion of the intervention, patients underwent measurements while in a resting state. The recorded measurement data was collected for subsequent analysis. The total energy expenditure was calculated employing the Mifflin-St Jeor formula, which is widely recognized for this purpose. Physicians estimate energy intake based on their clinical expertise, accounting for factors such as patient weight and overall patient condition.

Emotional State Assessment. To assess the emotional state of patients both before and after the intervention, the Self-rating Anxiety Scale (SAS) and Self-rating Depression Scale (SDS) were employed. Notably, specific cut-off values of 50 for SAS and 53 for SDS were used as reference points. Higher scores on these scales indicate a greater severity of anxiety and depression.[6]

Quality of Life Assessment. The EORTC Quality of Life Questionnaire (QLQ-C30) was employed to assess the quality of life. This assessment took place both before the intervention and three months after discharge. The evaluation encompassed five aspects of body function: role fulfilment, societal engagement, cognitive function, and general health status. Furthermore, it considered physical symptoms and economic status.[7] The total score on this assessment ranged from 0 to 130, with higher scores indicating a higher quality of life.

Data Processing and Statistical Analysis. All data were processed using SPSS 22.0 (IBM, Armonk, NY, USA). Normality tests were performed on all variables. For normally distributed variables, results were expressed as ($\bar{x} \pm s$). Appropriate statistical tests based on the homogeneity or heterogeneity of variance were employed for group comparison. For normally distributed data with homogeneity of variance, the *t* test was applied. In cases where the variance was heterogeneous, the Wilcoxon rank-sum test was utilized. Count data was represented as percentages [n (%)], and intergroup comparisons were conducted through the χ^2 test. Statistical significance was defined as $P < .05$.

RESULTS

Comparison of Nutritional Status Between Groups

Before the intervention, there were no statistically significant differences in nutritional status and body weight

Table 1. Comparison of Serum Nutritional Indexes and Body Weight Before and After Intervention ($\bar{x} \pm s$)

Groups	BMI (kg/m²)		Hb (g/L)		PA (mg/L)		ALB (g/L)	
	Before Intervention	After Intervention	Before Intervention	After Intervention	Before Intervention	After Intervention	Before Intervention	After Intervention
Observation Group (n = 52)	18.15±2.59	20.43±4.76	102.45±15.51	135.69±30.78	142.17±20.31	195.12±38.42	22.14±6.51	39.85±8.41
Control Group (n = 51)	18.21±2.66	19.15±4.35	101.95±15.73	126.47±30.61	141.93±20.83	180.86±38.75	21.97±6.65	32.21±8.35
t	0.098	2.959	0.235	4.271	0.422	4.375	0.215	3.301
P value	.922	.004	.814	.001	.674	.001	.831	.001

Note: BMI stands for body mass index, Hb represents hemoglobin, PA indicates serum prealbumin, and ALB stands for albumin. The table displays mean values with standard deviations ($\bar{x} \pm s$) for each parameter before and after the intervention, and statistical significance is denoted by '*t*' and '*P*' values.

Table 2. Comparison of Energy Intake and Expenditure During Radiotherapy ($\bar{x} \pm s$)

Groups	n	Energy Intake (Kcal/d)	Energy Expenditure (Kcal/d)	*t*	*P* value
Observation Group	52	1587.44±350.76	1037.91±261.32	9.059	<.001
Control Group	51	1065.16±300.25	1411.53±350.62	5.358	<.001
t		8.111	6.139		
P value		<.001	<.001		

Note: The table presents the mean values with standard deviations ($\bar{x} \pm s$) of energy intake and expenditure during radiotherapy for the observation and control groups. The '*t*' and '*P*' values indicate the results of statistical comparisons between the two groups, with statistical significance denoted by < .001.

Table 3. Comparison of Anxiety and Depression Scores Before and After Intervention ($\bar{x} \pm s$, score)

Groups	n	SDS		*t*	*P* value	SAS		*t*	*P* value
		Before Intervention	After Intervention			Before Intervention	After Intervention		
Observation Group	52	55.38±8.46	40.81±5.29	9.235	.001	54.53±8.65	41.65±5.13	8.153	.001
Control Group	51	54.91±8.23	45.33±5.17	6.234	.001	54.61±8.52	46.22±5.66	5.188	.001
t		0.252	3.865			0.042	3.784		
P value		.802	.001			.967	.011		

Note: The table displays the mean scores with standard deviations ($\bar{x} \pm s$) for anxiety (SAS) and depression (SDS) before and after the intervention for the observation and control groups. The ‹*t*' and '*P*' values indicate the results of statistical comparisons within each group, with statistical significance denoted by .001.

Table 4. Comparison of QLQ-C30 Scores Before Intervention and During Follow-up $\bar{x} \pm s$

Groups	n	QLQ-C30 Scores		*t*	*P* value
		Before Intervention	Follow-up		
Observation Group	52	65.91±10.59	113.85±15.17	18.627	<.001
Control Group	51	66.07±10.62	95.22±15.49	11.118	<.001
t		0.076	6.166		
P value		.939	<.001		

Note: This table presents the mean QLQ-C30 scores with standard deviations ($\bar{x} \pm s$) before intervention and during follow-up for the observation and control groups. The '*t*' and '*P*' values indicate the results of statistical comparisons within each group, with statistical significance denoted by < .001.

between the two groups ($P > .05$). After the intervention, notable improvements were observed in the BMI, ALB, PA, and PA levels of both groups. Notably, the observation group exhibited more significant improvements than the control group, with these differences proving statistically significant ($P < .05$), see Table 1.

Comparison of Energy Intake and Expenditure Between Groups

Throughout the course of radiotherapy, the observation group displayed a higher energy intake compared to the control group. Conversely, the energy expenditure of the observation group was lower than that of the control group. These differences were statistically significant ($P < .05$). See Table 2.

Comparison of Emotional State Between Groups

Before intervention, there were no statistically significant differences in SDS and SAS scores between the two groups ($P > .05$). After the intervention, the scores of the observation group were notably lower than those of the control group, and this difference was statistically significant ($P < .05$), see Table 3.

Comparison of Quality of Life Between Groups

Before the intervention, there were no statistically significant differences in QLQ-C30 scores between the two groups ($P > .05$). After the intervention, there were notable improvements in QLQ-C30 scores for both groups. Significantly, the observation group exhibited higher scores compared to the control group, with this difference proving statistically significant ($P < .05$), see Table 4.

DISCUSSION

Improvement of Nutritional Status Through Intervention

Patients with head and neck tumors undergoing radiotherapy often experience varying degrees of damage to the surrounding normal tissue cells and salivary glands. Additionally, the oral mucosa is susceptible to radiation, which heightens the risk of radiation-induced mucositis. This condition, in turn, can result in impaired mastication and swallowing functions, ultimately leading to malnutrition.[8-9]

The study's findings indicated that patients in the observation group who received nutritional intervention exhibited higher levels of PA, Hb, ALB, and body weight compared to those in the control group following conventional intervention ($P < .05$). These results suggest that nutritional intervention effectively enhances the nutritional status of patients undergoing head and neck cancer radiotherapy, supporting their immune response and, consequently, improving their overall quality of life.

The rationale behind this result is the scientific and precise assessment of patients' nutritional status during radiotherapy. Dietitians develop tailored diet plans for

patients based on these assessments. Additionally, the correction of patients' dietary misconceptions is vital. Additionally, the correction of patients' dietary misconceptions was vital. This correction fostered a high level of patient cooperation and allowed for the implementation of various nutritional intervention measures, effectively meeting the nutritional needs of patients.

PA, Hb, and ALB served as clinical indicators of the response to malnutrition. PA is a vital transport protein in the blood, playing a critical role in binding and facilitating movement. Moreover, it has the ability to stimulate lymphocyte maturation, thus bolstering the body's immune system.[10] In clinical settings, serum PA, Hb, and ALB are established indicators used to assess the body's response to malnutrition. Hb is an essential component of red blood cells responsible for oxygen transport. ALB is a crucial plasma protein and a vital nutrient for the human body, effectively maintaining nutritional balance.

Nutrition Intervention's Impact on Energy Intake and Consumption

Nutrition intervention has the potential to increase energy intake while simultaneously reducing energy consumption. A significant number of patients with head and neck tumors encounter malnutrition during radiotherapy, primarily due to issues such as dysphagia and acute mucositis. This malnutrition not only reduces the sensitivity and tolerance to radiotherapy but also adversely affects its therapeutic efficacy. The proliferation of malignant tumor cells necessitates substantial energy consumption. However, the presence of dysphagia often obstructs the body's ability to acquire adequate nutrition, leading to a considerable decrease in energy intake.

The study findings demonstrated that, during radiotherapy, the observation group exhibited higher energy intake compared to the control group ($P < .05$). Simultaneously, the observation group had lower energy expenditure compared to the control group ($P < .05$). These results indicate that nutritional intervention effectively promotes the nutritional intake of patients undergoing head and neck cancer radiotherapy while simultaneously reducing energy expenditure. This dual action ensures the provision of adequate nutrition.

Body weight is a primary indicator for assessing the nutritional status of an individual. Weight loss can be indicative of the loss of non-fat tissue, a clear manifestation of protein-calorie malnutrition. Research has confirmed that patients with head and neck cancer undergoing radiotherapy typically experience an average weight loss of approximately 5.87%. This weight loss not only increases the risk of infection but also elevates the risk of mortality.[11] Studies have consistently shown that providing nutritional intervention for patients with malignant tumors during radiotherapy and chemotherapy can effectively enhance energy intake, which helps in maintaining the body weight of patients and reduces the risk of malnutrition, aligning with the findings of this study.[12]

Nutritional Intervention and Its Impact on Emotional State and Quality of Life

Patients undergoing radiotherapy for head and neck cancer often grapple with heightened levels of anxiety, depression, and other negative psychological states due to the impact of the disease and its treatment. Research reveals that as many as 55% of patients with malignant tumors experience accompanying anxiety and depression. These negative emotional states not only contribute to weight loss but also significantly impede the overall quality of life for patients.[13] The emotional state of a patient plays a direct role in their recovery process. A positive emotional state can foster patient recovery, whereas a negative emotional state may lead to a series of complications which are detrimental to the prognosis.

Our study results indicated that after the intervention, the SAS and SDS scores in the observation group were notably lower than those in the control group ($P < .05$). These findings demonstrate that nutritional intervention effectively regulates the emotional state of patients undergoing head and neck cancer radiotherapy. It not only boosts patients' confidence in their treatment but also enhances their compliance, ultimately contributing to an improved quality of life. The reinforcement of nutritional intervention during radiotherapy has the capacity to increase energy intake, effectively maintain body nutrition, and promote the recovery process for patients dealing with the disease.

The study findings revealed that the quality of life scores for the observation group was higher than the control group ($P < .05$). This result highlights the ability of nutritional intervention to enhance the quality of life for patients undergoing head and neck cancer radiotherapy. Studies have consistently established a positive correlation between weight loss and malnutrition and the quality of life in cancer patients receiving radiotherapy. Nutritional intervention plays a pivotal role in effectively improving patients' energy intake, preserving body nutrition, and facilitating weight gain, thereby contributing to a meaningful enhancement in quality of life. These findings align with the past studies.[14]

Study Limitations

Despite the valuable insights provided by this research, it is important to acknowledge its limitations. First, the study's sample size may limit the generalizability of the findings to a broader population. Secondly, the complexity of clinical settings can introduce unaccounted variables. Furthermore, the study design precludes the establishment of causality and emphasizes the need for further interventional studies. Finally, the study focused on a specific population undergoing head and neck cancer radiotherapy; thus, caution should be exercised when extending the results to other cancer types or treatment modalities. Despite these limitations, the findings contribute to our understanding of the beneficial impact of nutritional intervention on patients' well-being during cancer treatment.

CONCLUSION

In conclusion, the increase of nutritional intervention alongside routine care for head and neck cancer patients undergoing radiotherapy demonstrates its potential to increase energy intake, lower energy expenditure, and effectively maintain vital nutrition. Additionally, this approach plays a significant role in regulating patients' emotional well-being and enhancing their overall quality of life, making it a promising candidate for broader clinical adoption. However, the study's limitations, including a small sample size and a relatively short duration, warrant further investigation. Future research efforts should prioritize larger sample sizes and more rigorous experimental designs to provide additional valuable insights for clinical practice.

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CONFLICT OF INTERESTS

The authors report no conflict of interest.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of this study are available from the corresponding author upon request, subject to reasonable conditions.

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