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ORIGINAL ARTICLE

Nutritional status in patients with head and neck cancer undergoing radiotherapy: a longitudinal study

Esra Citak[1] · Zeliha Tulek[2] · Omer Uzel[3]

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Abstract

Purpose Patients with head and neck cancers are susceptible to malnutrition during radiotherapy. This study aimed to determine the changes in the nutritional status and its determinants in patients with head and neck cancer during radiotherapy.

Methods This prospective observational study was performed in an outpatient Radiation Oncology clinic with a sample of 54 patients. An interview form (including anthropometric and laboratory parameters), the Patient-Generated Subjective Global Assessment to assess nutritional status, quality of life scales, and toxicity criteria were used for data collection at the baseline, the end of radiotherapy and 1 and 3 months after radiotherapy.

Results While the majority of the patients (90%) were well nourished at baseline, most of the patients (74%) were malnourished at the end of radiotherapy ($p < 0.001$). During radiotherapy, patients developed malnutrition, reflected in a decrease in food intake, approximately 5% loss of body weight, a reduction in mid-arm upper circumference and mid-arm muscle mass, and reduced serum protein and albumin levels. The nutritional status was worse in oropharyngeal cancers ($p = 0.021$), advanced stage ($p = 0.004$), use of concomitant chemotherapy ($p = 0.041$), and worse toxicity ($p < 0.001$). Furthermore, the nutritional status was strongly associated with the quality of life.

Conclusions This study demonstrated negative impact of radiotherapy on the nutritional status of patients with head and neck cancer. The study also showed the association of the nutritional status and the quality of life. The nutritional status should be assessed during different periods in the trajectory of treatment due to its significant contribution to the quality of life.

Keywords Head and neck cancer · Nutritional status · Radiotherapy · Quality of life

Introduction

Although head and neck cancer (HNC) is one of the less common types of cancer, this malignancy has a privileged place among all cancers due to its impact on structures that are fundamental for daily living activities such as swallowing, eating, breathing, and communication [1–3]. These impacts may be due to the disease process itself as well as adverse effects of treatment such as radiotherapy (RT). One of the most important functions which is affected by the disease and RT is eating. Depending on the location and size of the irradiated area and duration of treatment, nutritional deficit arises from acute and late reactions of RT, such as mucositis, xerostomia, taste changes, dysphagia, odynophagia, pain in the mouth and throat and loss of appetite. These reactions usually result in worsening of an already poor nutritional status [1–6].

Patients with HNC receiving RT are at a considerable risk of malnutrition, with up to 80% of patients experiencing significant weight loss during the treatment period [1, 6–10] Treatment modalities can decrease oral intake by physical means as well as by decreasing motivation to eat. The consequences of eating problems and ultimate malnutrition in cancer patients are well documented. Studies have reported

Esra Citak and Zeliha Tulek contributed equally to this work.

Esra Citak, during the study, was affiliated to Istanbul University Cerrahpasa Hospital, Clinic of Radiation Oncology

✉ Zeliha Tulek
tulekz@yahoo.com

1 MoH Okmeydani Training and Research Hospital Oncology Clinic, Istanbul, Turkey

2 Istanbul University Florence Nightingale Faculty of Nursing, Istanbul, Turkey

3 Department of Radiation Oncology, Istanbul University Cerrahpasa School of Medicine, Istanbul, Turkey

weakness and tiredness, impaired immune function, increased complications and side effects of cancer treatment, decreased quality of life, and increased morbidity and mortality [1, 3, 4, 6, 11, 12].

Although there are a plethora of studies on nutrition in cancer patients in general, a limited number of studies has addressed eating problems and nutritional status in this specific group, HNC patients. Especially there is a need to understand pattern of nutritional problems in these patients throughout the trajectory of the treatment. Therefore, it may be possible to identify their nutritional needs. The aim of this study was to assess the nutritional status in HNC patients undergoing RT and to investigate the relationships between socioeconomic, disease- and treatment-related factors. The results of the present study may contribute to the literature in gaining an understanding of nutritional problems across the treatment trajectory.

Materials and methods

Study design

This study was designed as a prospective observational study to assess the nutritional status and to define its determinants in patients with HNC undergoing RT. The study was part of a larger project, which had been presented in an earlier article [13].

Sample and setting

Our cohort consisted of 61 consecutive HNC patients who attended the Outpatient Clinic of Radiation Oncology at Istanbul University Cerrahpasa Medical Faculty in Istanbul. The sample and setting have already been described [13]. Among the 61 patients enrolled, only 54 completed the follow-up. The other 7 were excluded from the analysis as already explained previously [13].

Data collection

The data were collected between Jan 2010 and Feb 2011 through interviews with the study instruments. As study instruments, an interview form to obtain personal, disease, and nutrition-related data (anthropometric measurements, laboratory parameters), PG-SGA (Patient-Generated Subjective Global Assessment) to assess the nutritional status, EORTC QLQ-C30 (European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire), and EORTC H&N35 (European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire and Head and Neck Module) scales to measure quality of life and RTOG (Radiation Therapy Oncology Group) criteria to determine radiation toxicity were used. All instruments had been validated for the Turkish population [14, 15]. The instruments were employed at four different times: Baseline, end of RT (EORT), 1 month after EORT and 3 months after EORT. In addition to these instruments, the patients were asked to fill in food diaries to calculate protein and the calorie gap between requirement and actual intake. Due to the low quality of data obtained from diaries these data could not be used.

PG-SGA To determine the nutritional status the PG-SGA, a simple and reliable malnutrition screening tool was used in this study. This tool includes weight, weight changes, symptoms, alterations in food intake and functional capacity, components of metabolic stress, and physical examination. Nutritional status is categorized into one of three groups: well nourished (A), moderately malnourished (B), and severely malnourished (C). The patients are also given a numerical score. Higher scores (over 3) indicate a need for nutritional intervention [16].

Anthropometric measurements The anthropometric measurements of height, body weight, upper middle arm circumference, and triceps skinfold thickness were recorded. All anthropometric measures were made by the principal investigator as per instructions in the National Health and Nutrition Examination Survey [17]. The triceps skinfold thickness (TSF), which shows the amount of subcutaneous fat, was measured with the Harpenden caliper (dial graduation 0.2 mm, measuring pressure 10 g/mm^2). The mid-arm muscle area (MAMA) was calculated as the difference between the mid-arm circumference and the square of the ($\pi \times$ TSF) divided by the ($4 \times \pi$). Then the corrected MAMA score was calculated by subtraction of 10 for males and 6.5 for females for exclusion of the bone area [18].

RTOG toxicity score The acute morbidity criteria determines the adverse effects of radiation [19]. Mucosa, salivary gland, and pharynx/esophagus domains of RTOG criteria were considered as factors that may affect the nutritional status of the patients. These were assessed at the baseline, during RT (every week), at EORT, and at 1 and 3 months after EORT.

EORTC QLQ-C30 (v.3.0) and H&N35 scales The EORTC Core Quality-of- Life Questionnaire (QLQ-C30) and HNC Module (QLQ-H&N35) were used to assess quality of life [15, 20]. These scales are well-known validated self-report questionnaires. In the statistical analysis, nutrition-related items of the questionnaires were used for comparison with the nutritional status, as measured by the PG-SGA. The items that were chosen included fatigue, nausea and vomiting, appetite loss, constipation, and diarrhea items from QLQ-C30; pain in mouth, swallowing, problems in senses, social eating, teeth, opening mouth, dry mouth, sticky saliva, nutritional supplement, feeding tube and weight loss items from the QLQ-H&N35.

Statistical analysis

The data were analyzed using the statistical package IBM SPSS for Windows (Version 21.0, IBM Corp, Armonk, NY). The patients were categorized into groups (well nourished vs malnourished) according to PG-SGA, and end of RT PG-SGA scores were used as reference point for comparisons. Analysis of the data was carried out as below:

- Baseline descriptive data: mean, standard deviation, median, percentage
- Comparison of the means of the same group at different times was made using the Friedman analysis of variance (when variables were scores) and the Cochran's Q test (when variables were percentages). For post hoc analysis, the Sign test (for Friedman) and the McNemar test (for Cochran) were used.
- Comparison of the means of two independent groups (nutritional status by associated factors) was made using the chi-square and the Fisher's exact tests (when variables were categorical) and the Mann-Whitney *U* test (when variables were ordinal).

Table 1 Sociodemographic and disease-related characteristics of patients ($n = 54$)

Parameters	*n*	%
Gender		
Female	5	9.3
Male	49	90.7
Age ($X \pm$ SD, min-max)	55.4 ± 1.5	21–76
Level of education		
≤ Primary school	31	57.4
> Primary school	23	42.6
Marital status		
Married	48	88.8
Single/ divorced/ widowed	6	11.2
Employment status		
Working	23	42.6
Not working (incl.retired and housewives)	31	57.4
Level of income		
Moderate-high	33	61.1
Low	21	38.9
Type of cancer		
Larynx	36	66.6
Oral cavity	7	12.9
Pharynx	8	14.9
Parotis gland	3	5.6
Stage		
Stage 1–2	11	20.4
Stage 3–4	43	79.6
Have had surgery	37	68.5
Current treatment		
RT	34	62.5
RT + chemotherapy	20	37.5
Tracheostomy	27	50.0
RT dose		
< 60 Gy	13	24.1
≥ 60 Gy	41	75.9
RT duration (days) ($X \pm$ SD, range)	29.75 ± 2.89	25–35

Results

Sociodemographic and disease-related characteristics

The sociodemographic and disease-related characteristics of our patient cohort have been presented in Table 1.

Changes in nutritional status over time

Table 2 reports changes in the nutritional status and nutrition-related characteristics over time. At baseline, the majority of the patients (90%) were well nourished according to PG-SGA, but at the EORT most of the patients (74%) were malnourished (all were moderately malnourished) ($p < 0.001$). While the mean score of PG-SGA was 4.7 at the baseline, it rose to 13.9 at the EORT indicating a requirement for nutritional intervention. These changes over time showed a statistical significance ($p < 0.001$).

While most of the patients ($n = 47$, 87%) had normal oral nutrition at the baseline, this rate decreased ($n = 19$, 35.2%) significantly at the EORT ($p < 0.001$). Most of the patients had returned to normal oral intake at 1 month after EORT. The same pattern was observed for food intake. While the majority of the patients ($n = 52$, 96.3%) consumed more than 50% of their meal size, this rate decreased ($n = 21$, 38.9%) significantly at the EORT ($p < 0.001$). The anthropometric and laboratory parameters of the patients were assessed objectively. The mean weight loss of the sample was 3.35 ± 4.30 kg, equating to approximately 5% of body weight. A high percentage of the subjects (20%) from this sample experienced weight loss > 10% during RT. All anthropometric (weight, BMI, TSF, MUAC, MAMA) and laboratory (albumin and total protein) measurements deteriorated significantly at the EORT (respectively, $p < 0.001$, $p < 0.001$, $p = 0.001$, $p < 0.001$, $p = 0.015$ for anthropometric measures; and $p < 0.001$, $p < 0.001$ for laboratory measures).

Table 2 Nutrition-related characteristics, anthropometric, and laboratory parameters over time ($n = 54$)

	Baseline		At the EORT		1 month after EORT		3 months after EORT			
Characteristics[a]	*n*	%	*n*	%	*n*	%	*n*	%	Cochran's Q	*p*
No. of malnourished patients (according to PG-SGA)	5	9.3	40	74.1	5	9.3	1	1.9	94.559	< 0.001
Mean scores of PG-SGA[b]	4.7	–	13.9	–	5.8	–	3.0	–	107.755	< 0.001
Way of nutrition										
Oral normal	47	87.0	19	35.2	50	92.6	53	98.1	75.769	< 0.001
Supplementation (oral/enteral)	7	13.0	35	64.8	4	7.4	1	1.9		
Food intake (% of meals)										
> 50%	52	96.3	21	38.9	51	94.5	54	100.0	85.500	< 0.001
< 50%	2	3.7	33	61.1	3	5.6	–	–		
Anthropometrics[b]	Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SD		χ^2	*p*
Weight (kg)	71.65 ± 15.46		68.30 ± 14.99		68.92 ± 15.19		70.54 ± 15.05		44.187	< 0.001
BMI (kg/m^2)	25.03 ± 4.84		24.02 ± 4.49		24.20 ± 4.56		24.56 ± 4.65		39.923	< 0.001
TSF (mm)	21.79 ± 4.47		21.31 ± 3.98		21.50 ± 3.93		21.81 ± 4.00		15.997	0.001
MUAC (cm)	27.42 ± 3.41		26.64 ± 3.26		26.79 ± 3.48		26.94 ± 3.27		18.654	< 0.001
MAMA (cm^2)	24.77 ± 9.94		22.68 ± 9.14		23.04 ± 10.16		23.13 ± 9.55		10.510	0.015
Laboratory measures[b]										
Total protein (mg/dl)	6.97 ± 0.65		6.50 ± 0.68		6.88 ± 0.50		7.00 ± 0.54		50.884	< 0.001
Albumin (mg/dl)	3.62 ± 0.42		3.41 ± 0.35		3.69 ± 0.34		3.78 ± 0.49		68.371	< 0.001

([a] Cochran's Q test was used to compare percentages of the same group at different times and McNemar test was used for further analysis; [b] Friedman analysis of variance test was used to compare averages of the same group at different times and Wilcoxon's signed rank test was used for further analysis). (*BMI* body mass index, *TSF* triceps skinfold thickness, *MUAC* mid-upper arm circumference. *MAMA* mid-arm muscle area)

Associates of Nutritional Status

Nutritional status was compared according to sociodemographic status, disease-, treatment- and nutrition-related parameters (which were presumed to be associated with the nutritional status) (Table 3). For comparisons, the worst nutritional status (nutrition at the EORT) was considered as the reference point. With regard to sociodemographics, there was no statistically significant differences found between well nourished and malnourished patients.

Analysis of association between the nutritional status and disease-related parameters showed patients with oral cavity and pharyngeal cancer ($p = 0.021$) and patients who had advanced disease stage were malnourished ($p = 0.004$). The nutritional status varied between treatment types. Patients who were treated with chemo-radiotherapy were more likely to be malnourished when compared to those treated with RT alone ($p = 0.041$). The dose of RT was not associated with nutritional status (Table 3).

The other associates of nutritional status were anthropometrics and laboratory values. Body weight ($p = 0.035$), weight loss ($p < 0.001$), MUAC ($p = 0.050$), and MAMA values ($p = 0.028$) were found to be associated with nutritional status. The other anthropometrics and laboratory measurements did not show association (Table 3). Patients who did not receive nutritional supplements were more likely to be malnourished than those who did ($p = 0.020$). Patients who reported a food intake of less than 50% of meals were more malnourished than patients who consumed more than 50% ($p < 0.001$).

The RTOG criteria were considered a factor that affected the nutritional status of the patients. The changes in the RTOG scores during RT have been displayed in Fig. 1. Toxicity began to worsen during treatment (at the second week), made a peak at the end of the treatment and started to recover after treatment. All parameters were returned towards pre-treatment levels except for the salivary gland, which took a longer time to recover. Changes over time in the three parameters were statistically significant. Furthermore, the nutritional status was worse in patients who had higher toxicity scores of the mucosa, salivary gland and pharynx/esophagus ($p < 0.001$, $p = 0.015$, $p = 0.002$, respectively) (Fig. 2).

Quality of life and nutritional status

In order to understand the impact of malnutrition on patients' lives, associations between the nutritional status and some parameters of quality of life (especially symptom items related to nutrition) were investigated (Fig. 3). All these symptoms were worse in malnourished group. Fatigue, nausea-vomiting, loss of appetite, constipation, social eating, sticky saliva, nutritional supplement, and weight loss were associated with

Table 3 Nutritional status by disease and treatment-related and nutritional parameters ($n = 54$)

Disease and treatment-related parameters [a]	Well nourished		Malnourished			
	No	%	No	%	χ^2	*p*
Type of cancer						
Larynx	13	36.1	23	63.9	5.834	0.021[b]
Oral cavity and pharynx	1	5.6	17	94.4		
Disease stage						
1–2	7	63.6	4	36.4	10.229	0.004[b]
3–4	7	16.3	36	83.7		
Tracheostomy						
Present	9	33.3	18	66.7	1.543	0.214
Absent	5	18.5	22	81.5		
History of surgery						
Present	10	27	27	73	0.74	1.000[2]
Absent	4	23.5	13	76.5		
Treatment						
Only RT	12	35.3	22	64.7	4.195	0.041
Chemo-RT	2	10.0	18	90.0		
RT dose						
< 60 Gy	4	26.7	11	73.3	0.006	1.000[2]
≥ 60 Gy	10	25.6	29	74.4		
Anthropometrics[c]	Mean ± SD	Median	Mean ± SD	Median	z_{MWU}	*p*
Weight (kg)	75.25 ± 11.52	73.25	65.87 ± 15.42	63.00	− 2.113	0.035
Weight loss	− 0.45 ± 2.3	− 0.25	4.68 ± 4.03	4.60	− 4.218	< 0.001
BMI (kg/m^2)	25.83 ± 3.76	23.85	23.39 ± 4.60	23.10	− 1.708	0.088
TSF (mm)	20.92 ± 4.44	22.50	21.45 ± 3.86	21.00	− 0.218	0.827
MUAC (cm)	27.92 ± 2.49	28.00	26.20 ± 3.40	26.00	− 1.957	0.050
MAMA (cm^2)	26.89 ± 9.07	27.00	21.20 ± 8.80	19.67	− 2.191	0.028
Laboratory measures[c]						
Total protein (mg/dl)	6.44 ± 0.68	6.50	6.52 ± 0.69	6.50	− 0.270	0.787
Albumin (mg/dl)	3.40 ± 0.53	3.54	3.41 ± 0.27	3.50	− 0.565	0.572
Use of supplement (oral /enteral)[a]	No	%	No	%	χ^2	p
No	5	14.3	30	85.7	7.018	0.020
Yes	9	47.4	10	52.6		
Food intake (% of meals)[a]						
< 50%	2	6.1	31	93.9	17.437	< 0.001
> 50%	12	57.1	9	42.9		

([a] Chi-square test was used to compare percentages of two independent groups, [b] Fisher's exact test, [c] Mann-Whitney *U* test was used to compare averages of two independent groups)

significant malnutrition ($p < 0.05$). Pain (in mouth), opening mouth, and swallowing were worse in the malnourished group, but the difference did not reach at a statistically significant level ($p = 0.053$, 0.056, 0.063, respectively). The global QOL was significantly worse in the malnourished group.

Discussion

It is well-known that patients with HNC receiving RT are at a considerable risk of malnutrition, especially one of its most important indicators, which was proposed to be the sixth vital sign [21], weight loss [1, 3, 12, 22]. Despite the presence of conflicting evidence about the impact of malnutrition on mortality and morbidity [9, 12], many articles report associations between these parameters [6, 11, 12, 23].

In our study, the proportion of malnutrition was 74% at the EORT. Our results are comparable to those of Unsal et al. [8] who reported a high percentage (88.2%) of malnutrition at EORT. Following up nutrition-related parameters during the trajectory of RT showed a pattern of nutritional decline as the RT progressed. While most of the patients (90%) were well nourished at the baseline, this number decreased (26%) significantly at EORT ($p < 0.001$). Likely, food intake

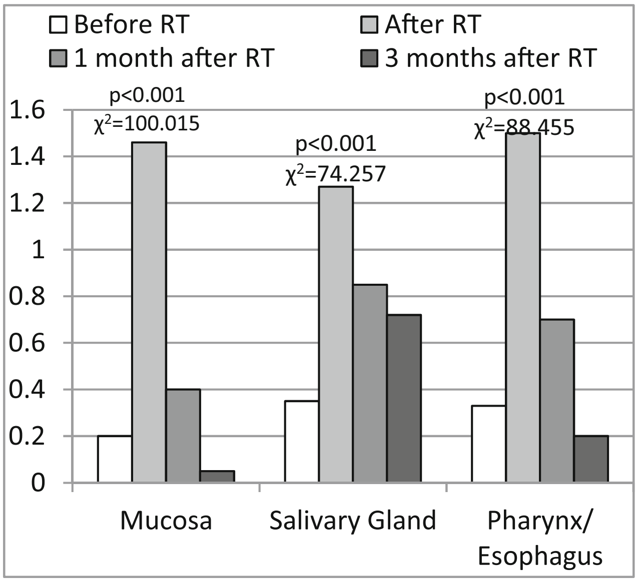

Fig. 1 Changes of patients' mean RTOG toxicity scores along RT trajectory (Friedman analysis of variance test was used to compare averages of the same group at different times)

(consuming > 50% of a meal) decreased from 87% (at baseline) to 35.2% (at EORT) ($p < 0.001$). When considering that decreased food intake has been reported not only in cancer patients, but also in all hospitalized patients [24], our finding in HNC patients is not surprising due to involvement of the area that is vital for eating and swallowing activity. Therefore our finding confirmed previous studies reporting decrease in dietary intake [6, 22, 25, 26]. The anthropometric and laboratory parameters followed a similar pattern, too.

In our study, the percentage of patients who used nutritional supplements was 13% at the baseline; this rate increased to 65% at EORT (oral supplement in 57.5% and feeding tube in 7.5%). Nutritional supplements were used less at 1 and

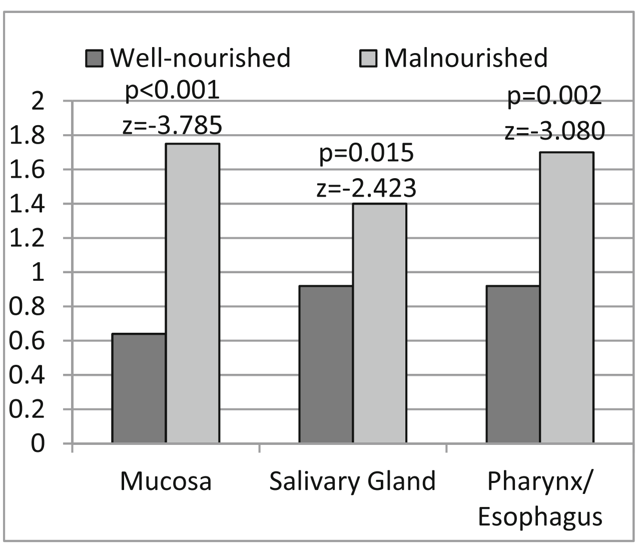

Fig. 2 Nutritional status by RTOG toxicity score (Mann-Whitney *U* test was used to compare means of two independent groups)

3 months after EORT. Larsson et al. [3] showed a similar trend in their HNC patient group. Nutritional intervention during RT has been previously shown to positively influence nutritional status [2]. However, some authors stated that it was difficult to draw up conclusions on the efficacy of a particular intervention, since the studies were not homogenous [27]. The general consensus on this subject is to give an individualized dietary counseling [2]. The mean weight loss of our sample was 3.35 ± 4.30 kg, equating to approximately 5% of the body weight. A high percentage of subjects (20%) from this sample experienced severe weight loss (> 10% body weight) during radiation treatment. This result is similar to findings of other studies [3, 10, 26, 28]. Other anthropometric (BMI, TSF, MUAC, and MAMA) and laboratory (protein and albumin) measurements were also significantly deteriorated in the end of RT. Pistóia et al. [26] reported significant reductions in the MAMA and MUAC scores of the HNC patients, too. Hopanci et al. [28] reported that the body mass index, weight, fat percentage, fat mass, fat-free mass, and muscle mass decreased significantly from the baseline compared to the end of treatment when patients were not compliant with their nutritional supplement.

Our study demonstrated associations between the nutritional status and disease-related factors. Patients other than those with laryngeal cancer and patients who had advanced stage were significantly malnourished. Advanced stage is one of the most commonly reported factors for malnutrition [1, 10, 29]. Patients who were treated by chemo-radiotherapy were malnourished when compared with patients treated with RT alone. Concomitant chemotherapy has been reported to be associated with nutritional deterioration [7]. Radiation induced toxicity of the mucosa, salivary gland, and pharynx/esophagus were significantly more severe in the malnourished group. Severe RT toxicity has been reported as one of the predictors of weight loss [10] and MUAC reduction [30] during RT.

Other factors associated with the nutritional status were anthropometrics and laboratory values. Patients with lower body weight, higher weight loss, lower MUAC and lower corrected MAMA values were malnourished. It is known that the corrected MAMA score is a good indicator of muscle depletion. This is indicative of sarcopenia, a condition characterized by muscle mass and skeletal muscle loss [26]. Additionally, patients who maintained nutrition with regular foods were more likely to be malnourished when compared to the patients who were fed by supplements (usual diet plus supplement and only supplements) ($p = 0.020$). A Cochrane review [1] has previously reported that oral nutrition will not provide adequate nourishment during the course of RT for many HNC patients. Our finding confirmed the importance of nutritional supplementation in this specific patient population [12, 28, 31]. However, it should be noted that when the stage of the disease is advanced even prophylactic PEG does not improve the nutritional intake [32].

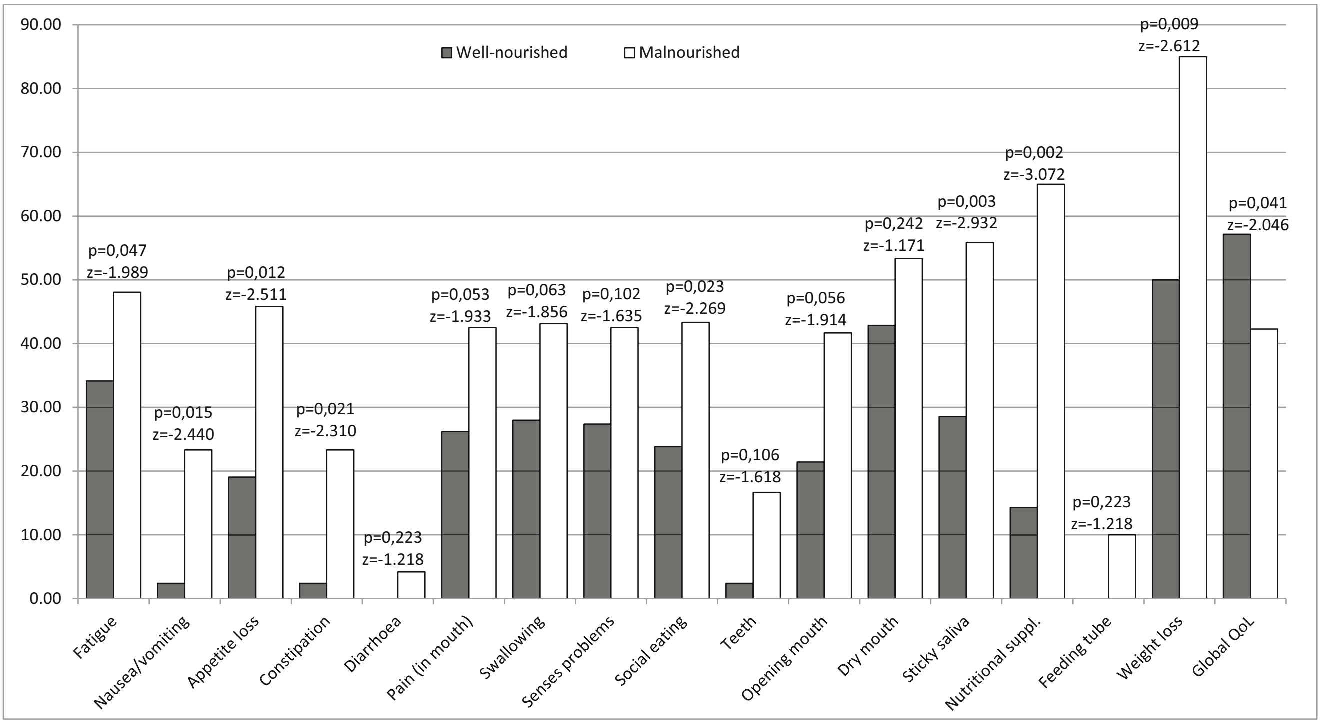

Fig. 3 Nutritional Status by QOL Symptoms (Mann-Whitney *U* test was used to compare means between independent groups)

Patients who reported a food intake of less than half of their regular meal size were more malnourished than patients who took more than half of the meals. Our findings also revealed malnutrition was seen in more than 40% of those whose food intake was more than half of a meal. Our data should be interpreted carefully, since we failed to fill the diet diaries of those we did not know about the content of the food consumed by the patients. Furthermore, about half of the patients on supplements were malnourished, indicating the timing of the supplementation might be an important consideration in clinical practice. In a computational modeling of cancer cachexia, researchers simulated the effects of normalizing food intake to the baseline level and found that the timing of nutritional intervention was important in maintaining the muscle mass. They reported that if an intervention were initiated later, it would not stop the muscle depletion [33].

This study demonstrated significant differences between well nourished and malnourished groups in terms of the impact of malnutrition on patients' quality of life. Nutrition-related symptom items and global quality of life were worse in the malnourished group. Many researchers reported this association in their studies [4–6, 34, 35]. When the match of these self-reported QoL symptoms (dry mouth, swallowing, and pain in mouth) and toxic effects (RTOG) assessed by the researcher was evaluated, there was no consistency in the results. This finding, which is comparable with findings of Oates et al. [36], may demonstrate the importance of evaluating patients by not objective methods only but also with subjective methods. (This situation is more important when symptoms experienced by patients are not visible).

The present study is limited by a relatively small sample size. Studies involving more patients with longer follow-ups are needed. It would have been better to use more sensitive methods to evaluate anthropometrics such as bioelectric impedence or dual radiograph absorptiometry if we had had access to these facilities. We attempted to use diet diaries but failed, this may have led to insufficient data regarding intake and content of the food. The strength of the present study is that all anthropometric measurements have been made by the same person (first author) which contributed to standardization. The study was prospective and informed us on changes in nutritional parameters over time.

Conclusions

This study demonstrated the negative impact of RT on the nutritional status of patients with HNC. Our findings confirmed that the nutritional status deteriorated during treatment, with maximum deterioration at the end of RT. The most affected nutritional parameters were oral intake, anthropometric values, serum protein, and albumin levels. It is important to note that the patients did not just only lose weight but also muscle mass, which indicates sarcopenia. In our study, the nutritional status was found to be worse in oropharyngeal cancers (vs laryngeal types), advanced stage, use of concomitant chemotherapy and higher radiation toxicity. Our results showed that the nutritional status was strongly associated with the quality of life. Our results emphasized the vital need for nutritional support to patients during RT. Nutritional assessment should become an integral component of the care of patients with HNC, and should be carried out during different periods in the trajectory of treatment due to its significant contribution to the quality of life. It would be worthwhile studying nutritional needs and interventions more deeply.

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Author contributions EC completed participant recruitment, data collection, and writing of the manuscript. ZT designed the study, analyzed the data, and completed the writing of the manuscript. OU provided significant advice and consultation all throughout the study and participated in the writing of the manuscript. All authors read and approved the final manuscript.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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