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Association of Patients' Energy and Protein Intake with the Stage of the Disease in Oropharyngeal Cancer

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ABSTRACT

Background and Objectives: Despite the importance of nutrition on, lip, oral cavity, and pharynx cancer patients, the relationship between dietary intake and stage of their disease is not well-documented. This study aims to investigate the association between energy and protein intake with the clinical stage of the disease.

Materials and methods: This cross-sectional study executed convenience sampling to enlist 282 patients aged over 18 years from Apeksha Hospital, Maharagama for one year. The sample included individuals histologically confirmed with lip, oral cavity, or pharynx cancer, of any sex, with proficiency in Sinhala and/or English. Patients with diabetes, chronic kidney disease, and cardiovascular disease were excluded. Dietary intake was scrutinized through a 24-hour recall and analyzed using Food Base 2000 software. Nutrition-related symptoms were measured using the Patient-Generated Subjective Global Assessment (PG-SGA). Pearson's Chi-squared test facilitated statistical interpretation of the association between daily energy and protein intake with the stage of the disease.

Results: The majority of the patients were male (89%), the mean age was 59 years, most had cheek mucosa cancer (20.92%), and Stage III of the disease (53.55%). 81% fed by oral route and the most had difficulty in swallowing. The average energy and protein intake of a subject was 1428.24 kcal/day and 47.69 g/day respectively. There was not enough evidence to suggest an association between patients' energy intake ($p=0.389$) and protein intake ($p=0.755$) with their Stage of the Disease.

Conclusions: This investigation concludes that the energy and protein consumption of the patient is not associated on the stage of their disease. Hence, nutritional interventions can be planned despite of the stage of the disease. The study concludes, that the most prominent nutrition-related symptom is difficulty in swallowing, which emphasizes the importance of early intervention of alternative feeding routes. The study reveals that protein consumption is suboptimal across all stages of the disease.



INTRODUCTION

Lip, oral cavity, and pharynx cancer incidence varies globally, with certain countries exhibiting notably higher rates. South Asia had the highest Age-standardized incidence rates for lip and oral cavity cancer (Du, Nair, Jamieson, Liu & Bi, 2020). On the contrary, the lowest incidence was found in Central America (Hunag et al., 2023). Lip, oral cavity and pharynx cancers have been estimated to be responsible for about 4.1% of all cancer cases and 3.7% of cancer-related deaths globally in 2020 (Sung et al., 2021). In 2020, there were an estimated 747,316 newly reported cases of lip, oral cavity, and pharyngeal cancer with a global Age-standardized ratio of 8.1 new cases per 100,000 population (Hunag et al., 2023). Lip, oral cavity, and pharynx cancer rank first in cancer incidence in the male population of Sri Lanka (Cumulative rate 1.906) with increasing age-specific rates (Cancer Incidence Data, Sri Lanka, 2007). The National Cancer Control Programme in Sri Lanka reports that the crude incidence of oral cancer was 20.6, in 2019 with 2759 new case.

Studies have shown that the dietary energy and protein intake of head and neck cancer patients can decrease significantly during treatment, while energy and protein intake from oral nutrition supplements can increase significantly after radiotherapy (Neoh et al., 2020). Reduced dietary intake can lead to malnutrition, which can affect treatment outcomes and patient quality of life. Nutrition impact symptoms, such as dysphagia, xerostomia, and early satiety, can contribute to a decreased dietary intake. Additionally, pain, anxiety, and depression can reduce or eliminate the central drive to eat within the brain (appetite center). A decrease in protein and energy intake has been reported in head and neck cancer patients undergoing radiotherapy. All head and neck cancer patients experienced taste changes and dry mouth that required oral nutrition supplements at the end of the treatment (Neoh et al., 2020). Prevalence of malnutrition among oral or oropharyngeal patients' is 16% and swallowing problems and insufficient protein intake are significantly related to malnutrition (Jager-Wittenaar et al., 2011).

The dietary intake of individuals can be assessed by 24-hour dietary recall. A 24-hour dietary recall is a structured interview intended to capture detailed information about all foods and beverages (and possibly, dietary supplements) consumed by the respondent in the past 24 hours, most commonly, from midnight to midnight the previous day (National Cancer Institute, 2025). The Patient-Generated Subjective Global Assessment (PG-SGA) is well recognized in clinical research as the reference method for assessing nutrition status in patients with cancer (Guerra et al., 2017).

Staging of the oral cavity cancer follows the TNM classification: T=tumor, N=nodal status, M=metastases (Zhang et al., 2021). The TNM classification is a system for classifying a malignancy. This method allows for simplification, with cancers staged from I-IV, with stage IV being the most severe stage. Stage 0 is used to indicate carcinoma in situ, which is not considered cancerous but may become cancerous in the future.

This study aimed to find out the association between energy and protein intake with the stage of the disease in patients with lip, oral cavity and pharynx cancer at different stages of the disease.

MATERIALS AND METHODS

Study design and setting

This cross-sectional study was conducted among adult lip, oral cavity, and pharynx cancer patients. In this study, we used convenient sampling.

In total, 282 adult patients attending Apeksha Hospital, Maharagama clinics, were selected during one year. Cochran's Formula for Sample size calculation in smaller populations was used to calculate the sample size. Both males and females over the age of 18 years, with histologically diagnosed with lip, oral cavity, and pharynx cancer were included.

The patients diagnosed with diabetes mellitus or any other chronic disorders that need modifications of the diet at the time of

interviewing were excluded.

Ethical approval was granted by the Ethical Review Board (202005HIO1), Wayamba University of Sri Lanka, and was performed according to the ethical standards described in the Declaration of Helsinki. Permission to conduct the research was obtained from the director of the hospital and the consultants in charge of the patients. Informed consent was taken from all patients before the data collection.

Socioeconomic-demographic and clinical characteristics measurement

Data on demographic details, and medical conditions (histological diagnosis of cancer, Type of cancer, Stage of cancer).

Assessment of nutritional intake

Each patient underwent a 24-hour dietary recall which was performed by the nutritionist of the Apeksha hospital, Maharagama. This was done to assess the current nutrition intake of the patient. Food and beverages consumed in the last 24 hours, starting from the last midnight and finishing at midnight, were identified by the 24h dietary recall. The household serving intake, and subsequently the gram intake of food, was collected for every meal to estimate energy and protein intake. Household portion sizes were used to calculate the grams of food that were consumed. For this purpose, household cups and spoons were applied. The nutrient contents of the daily diet intake were analyzed by the Foodbase 2000 software (Institute of Brain Chemistry and Human Nutrition, UK) at Wayamba University of Sri Lanka (Thamilini, Silva and Krishnapriya, 2014). This was done by entering meal recipes with the exact gram intake of all food items. The Foodbase 2000 software calculated the nutritional facts of the whole foods taken in a day from recall. Each patient's daily energy requirement and daily protein requirement were calculated according to the ESPEN 2021 guidelines on cancer patients (Maurizio et al., 2021). The patient's estimated daily energy requirement was calculated by multiplying the patient's actual body weight by 30kcal/kg/day.

The patient's estimated daily protein requirement was calculated by multiplying the patient's actual body weight by 1.5g/kg/day. If the patient was overweight (BMI of ≥ 23 kg/m²), adjusted body weight was used for daily energy and protein requirement calculation. The adjusted body weight was calculated using the following equation:

$$\text{Adjusted Body Weight} = (\text{Ideal Body Weight (IBW)}) + ((\text{Actual Body Weight} - \text{IBW}) \times 25\%)$$

Whereby IBW is the patient's corresponding weight at a BMI of 23 kg/m².

Data on the total energy and protein intake were recorded to compare with the energy and protein requirements of patients. Adequacy of the patient's daily calorie intake and protein intake was calculated by deducting their daily calorie and protein intake from their daily calorie and protein requirement.

The patients who were fed by naso-gastric (NG) feeds and percutaneous endoscopic gastrostomy (PEG) feeds were also analyzed as the method used for normally fed patients. The ingredients they used to prepare congees and soups were inquired from the patients and recorded as per the household serving sizes. One patient of the study population on parenteral nutrition. He had TNA peri 40 cc/hr – 24 hr. His nutritional intake was calculated accordingly.

The Patient-Generated Subjective Global Assessment (PG-SGA) was used to assess the symptoms that affect dietary intake (Balstad et al., 2019). The PG-SGA questionnaire includes a section that asks the patient to mention the symptoms that kept him/her from eating enough during the past two weeks. It directly asks for the patient's responses for no problems eating, no appetite, just did not feel like eating, nausea, constipation, mouth sores, things taste funny or have no taste, problems swallowing, pain, vomiting, diarrhea, dry mouth, smells bother me, feel full quickly, fatigue and other E.g., Depression, money or dental problems. The patient can check on all the symptoms that apply.

Statistical analysis

All responses of this study were presented in the form of frequencies, means, and percentages. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) for Windows, version 27. Pearson's Chi-squared test of independence was used to see the significant differences between lip, oral cavity, and pharynx cancer patients' energy intake and their stage of the disease, and lip, oral cavity, and pharynx cancer patients' protein intake and their stage of the disease. A statistical probability of $p < 0.05$ was considered significant.

RESULTS

Basic characteristics

Most (65%) of the study participants were diagnosed in 2022. The study results showed that majority of the patients with cancers in lip, oral cavity and pharynx were male, which was 89% of the whole population. The mean age of the population was 59 years (SD of 10.8) with a range of 21-94 years old. Fifty-one percent of the study population was belonged to the age of 50-64 years, and 82% of the whole study population was older than 50 years, which means lip, oral cavity and pharynx cancer are prominent among the older age population.

Most of the patients in this study had cheek mucosa cancer (20.92%, $n=59$). Carcinomas of tongue, unspecified (11.35%, $n=32$) and oropharynx, unspecified (9.93%, $n=28$) were also prominent. Most of the study participants were belonged to stage III of the disease (53.55%) and least (3%) belong to stage IV of the disease (Table 1).

Patient-generated subjective global assessment

When we consider the route of feeding, the majority (80.8%) of the study participants were fed by oral route. The use of the percutaneous endoscopic gastrostomy (PEG) feeding (1.42%) and parenteral nutrition (PN) (0.35%) was very minimal. Naso-gastric (NG) feeding was 17.3% from the whole population.

Oral route was used to administer food, 80.43%

in Stage I, 86.84% in stage II, 77.48% in stage III and 88.88% in stage IV. NG feeding was also used, 15.21% in Stage I, 13.16% in stage II, 20.53% in stage III and 11.11% in stage IV.

The nutrition-related symptoms affect the nutrition intake of the patients. In the study sample, the most prominent symptom was the difficulty in swallowing (61.34%). Pain (59.57%), mouth sores (58.86%), dry mouth (50.35%) and not feeling taste (40.43%) were also common symptoms that reduce the food intake (Figure 2).

Dietary intake

The average energy intake of a subject of the study population was 1428.24 kcal/day. The average protein intake of a subject of the study population was 47.69 g/day (Table 2).

Even though the number of patients with adequate calorie intake is higher at stage I and stage II of the disease, the number of patients with inadequate calorie intake is higher at Stage III and stage IV (Figure 3).

At all the stages of the disease, number of patients inadequate in protein intake is higher than adequate patients. Therefore, we can see the protein energy malnutrition among this study population.

Association between daily calorie intake and stage of the disease

According to the Pearson Chi-square test statistical analysis ($p=0.389$), there is not enough evidence to suggest an association between lip, oral cavity, and pharynx cancer patients' energy intake and their stage of the disease (Table 2).

Association between daily protein intake and stage of the disease

According to the Pearson Chi-square test statistical analysis ($p=0.755$), there is not enough evidence to suggest an association between lip, oral cavity and pharynx cancer patients' Protein Intake and their stage of the disease.

Among patients 51.42% consumed inadequate energy while 80.85% of them consumed protein

inadequately. In the whole population, mean protein, carbohydrate and fat intake from the total calorie intake is 13.68%, 58.23% and 27.3% respectively (Table 2).

Table 1. Distribution of socio-economic characteristics of patients

Baseline Characteristics		Number (%)
Gender		
Male		251 (89)
Female		31 (11)
Age	Mean $\pm$ SD	
	15-34	3 (1)
	35-49	48 (17)
	50-64	143 (51)
	>65	88 (31)
Site of cancer		
Upper lip, inner aspect		1 (0.35)
Lower lip, inner aspect		2 (0.71)
Malignant neoplasm of base of tongue		23 (8.16)
Border of tongue		14 (4.96)
Anterior two-thirds of tongue, part unspecified		5 (1.77)
Tongue, unspecified		32 (11.35)
Lateral floor of mouth		2 (0.71)
Floor of mouth, unspecified		16 (5.67)
Hard palate		8 (2.84)
Soft palate		7 (2.48)
Palate, unspecified		1 (0.35)
Cheek mucosa		59 (20.92)
Retromolar area		9 (3.19)
Mouth, unspecified		3 (1.06)
Malignant neoplasm of parotid gland		2 (0.71)
Submandibular gland		3 (1.06)
Overlapping lesion of major salivary glands		1 (0.35)
Major salivary gland, unspecified		2 (0.71)
Tonsillar fossa		1 (0.35)
Tonsil, unspecified		10 (3.55)
Vallecula		4 (1.42)
Anterior surface of epiglottis		20 (7.09)
Oropharynx, unspecified		28 (9.93)
Nasopharynx, unspecified		7 (2.48)
Malignant neoplasm of pyriform sinus		18 (6.38)
Posterioricoid region		2 (0.71)
Hypopharynx, unspecified		1 (0.35)
Pharynx, unspecified		1 (0.35)
Stage of the disease		
Stage I		46 (16.31)
Stage II		76 (26.95)
Stage III		151 (53.55)
Stage IV		9 (3.19)

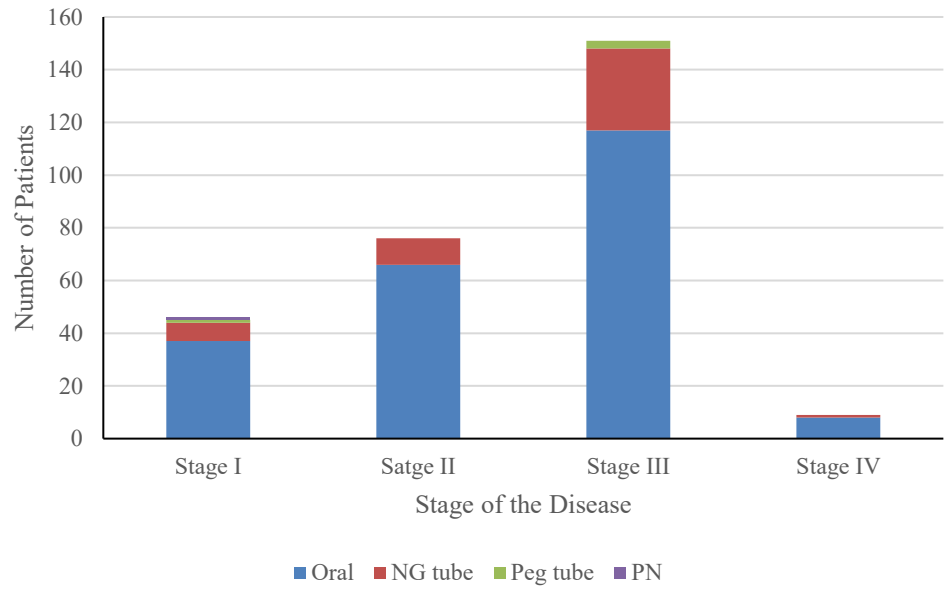


Figure 1. Route of feeding at each stage of the Lip, Oral cavity and Pharynx cancer.

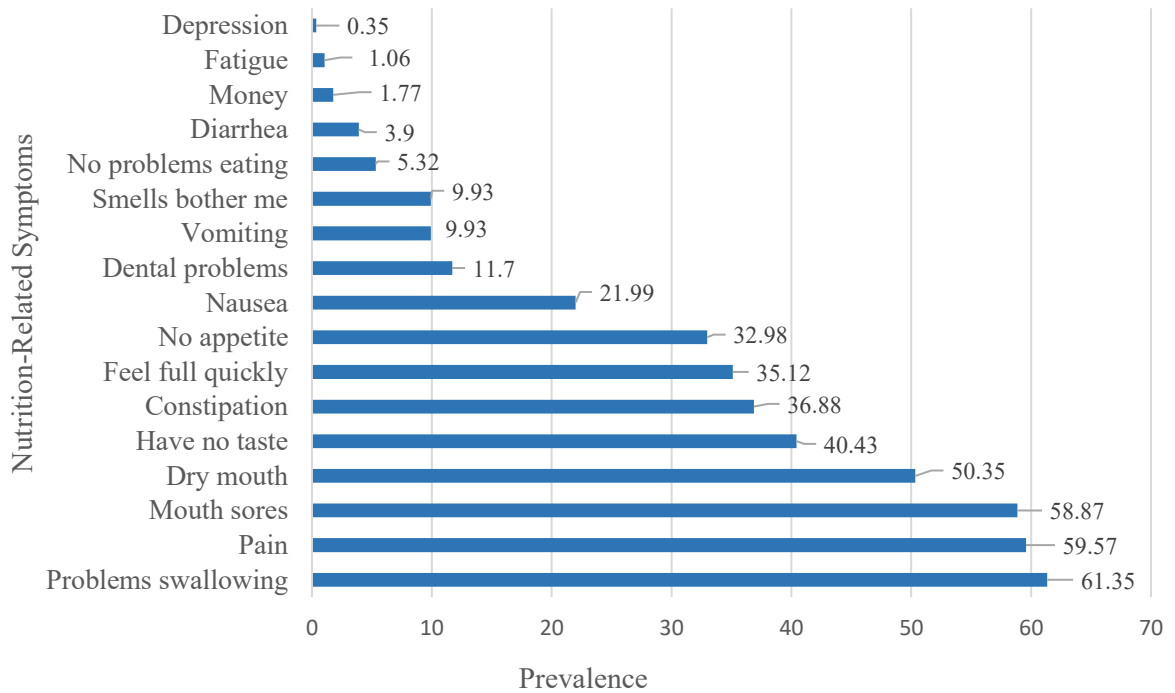


Figure 2. Prevalence (%) of the nutrition-related symptoms.

Table 2. Mean energy and macronutrient intake at each stage of the oropharyngeal cancer

	Mean $\pm$ SD			
	Stage I	Stage II	Stage III	Stage IV
Energy Intake (kcal)	1371.35 $\pm$ 766.81	1563.91 $\pm$ 801.54	1403.93 $\pm$ 711.50	981.33 $\pm$ 615.16
Patients of adequate in energy intake (N)	23	39	73	2
Patients of inadequate energy intake (N)	23	37	78	7
Protein Intake (g)	49.35 $\pm$ 31.12	50.06 $\pm$ 26.29	46.95 $\pm$ 28.39	31.64 $\pm$ 19.42
Patients of adequate protein intake (N)	11	14	29	0
Patients of inadequate protein intake (N)	35	62	122	9
% Protein/Total Energy Intake	14.18 $\pm$ 5.20	13.07 $\pm$ 3.97	13.67 $\pm$ 4.58	13.63 $\pm$ 2.69
Carbohydrate Intake (g)	225.15 $\pm$ 133.98	261.72 $\pm$ 152.36	223.32 $\pm$ 130.84	136.62 $\pm$ 87.53
% Carbohydrate/Total Energy Intake	59.74 $\pm$ 13	61.77 $\pm$ 10.52	59.59 $\pm$ 11.21	51.82 $\pm$ 8.75
Fat Intake (g)	36.34 $\pm$ 25	42.17 $\pm$ 24.65	41.76 $\pm$ 29.02	37.54 $\pm$ 26.82
% Fat/Total Energy Intake	23.69 $\pm$ 9.65	24.95 $\pm$ 8.91	26.48 $\pm$ 10.18	34.08 $\pm$ 9.22

These data were taken from the Foodbase 2000 software analysis of a 24-hr dietary recall.

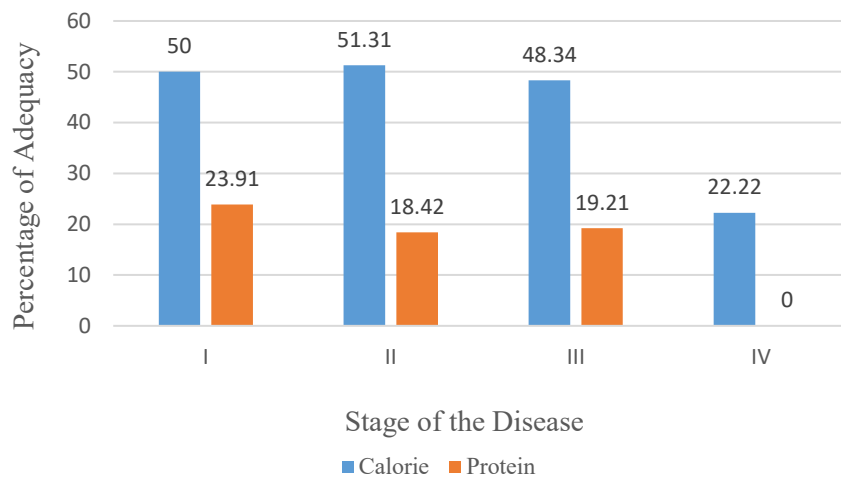


Figure 3. Percentage of adequacy of the daily calorie and protein intake.

DISCUSSION

This study did not observe a statistically significant association between the patients' daily calorie intake and their stage of the disease. This may be due to the good nutritional support provided for the patients when they deteriorate nutritionally. Therefore, this study highlights the importance of proper nutritional interventions for this group of patients not only after they deteriorate nutritionally but also at the diagnosis of the disease.

There was no association between daily protein intake and this study sample's disease stage. The study found that protein intake was suboptimal across all stages of the disease, a finding that is particularly alarming given the critical role of protein in immune function, wound healing, and overall well-being (Laviano et al., 2005). This calls for immediate educational interventions focusing on economical and accessible protein sources, including vegetarian options.

The most prevalent nutrition-related symptoms found in this group of patients were dysphagia, oral pain, mouth sores, and xerostomia (dry mouth) which were prevalent in more than 50% of the study sample. The study advocates for early intervention through alternative feeding routes like NG or PEG feeding to prevent malnutrition because of less nutritional intake due to these symptoms. This recommendation is supported by literature indicating the efficacy

of enteral feeding in maintaining nutrition during cancer treatment, particularly in head and neck cancers (Arends et al., 2017; Bauer et al., 2002).

The study underscores the need for a multimodal approach to managing patients with Lip, Oral cavity, and Pharynx cancer. This includes symptom management, and protein intake optimization. Medical nutrition therapy provided by registered dietitians and the provision of oral nutrition supplements have been shown to improve nutritional status, quality of life, and treatment tolerance (Arends et al., 2017; Bauer et al., 2002). Furthermore, the study suggests that practitioners should consider other factors that affect nutritional status, such as the appearance of nutrition-related symptoms, rather than solely focusing on energy and protein intake.

This study accentuates the need for a multi-pronged approach in managing Lip, Oral cavity, and Pharynx cancer patients. It advocates symptom management, and protein intake optimization as key components of a holistic care plan. The high prevalence of malnutrition and weight loss further underscores the urgency for early and aggressive nutritional interventions. These collective insights lay a robust foundation for the formulation of evidence-based nutritional guidelines tailored for the demographic of this specific group of patients.

CONCLUSION

The results of this research revealed that the stage of lip, oral, and pharynx cancers does not directly influence dietary energy or protein consumption. Because of that, when planning nutritional interventions for this group of patients it does not associate with their stage of the disease.

The study identified common nutrition-impact symptoms, including dysphagia, oral pain, mouth sores, xerostomia, and taste changes, which significantly affect the ability to maintain adequate nutrition.

The consistently low protein intake observed across all cancer stages is particularly concerning, considering protein's vital role in recovery processes such as wound healing and immune response. This necessitates prompt educational efforts to inform patients about diverse, cost-effective protein sources, ensuring they can enhance their dietary protein effectively.

Overall, the study advocates for a holistic approach to treating patients with oropharyngeal cancers, integrating symptom management with early intervention of nutritional support. The insights gained lay a solid foundation for establishing precise nutritional care guidelines, aimed at improving the health outcomes and quality of life for this patient group.

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