Effect of diet counseling on anthropometric indices and dietary intake of the head and neck cancer patients undergoing chemo-radiotherapy

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Abstract : Malnutrition is common in patients with head and neck cancer due to cancer cachexia, anti-cancer therapies, impairment in food intake due to the tumor etc. This study aims at studying the effect of diet counseling intervention on dietary intake and anthropometric indices. Experimental design with only one experimental group was conducted on 14 head and neck cancer patients who were admitted for chemo-radiotherapy. Detailed assessment of anthropometry and diet was done in the before, during and after the diet counseling intervention of 7 weeks. There was mean weight improvement of 2 kg (p<0.001) during the intervention period that can be attributed to a significant increase in the dietary intake of energy (p=0.034), protein (p=0.011), calcium (p<0.001), zinc (p=0.041), vitamin C (p=0.046) and vitamin A (p=0.019). However there was no statistically significant improvement in the mid-upper arm circumference (MUAC). This increase may be a sign of improvement of nutritional status as normally cancer patients tend to show a decrease in MUAC. This indicates the success of the diet counseling intervention. An even greater improvement in these parameters can be achieved if intervention is provided before the initiation of chemoradiotherapy and has to be continued even after the therapy is complete.

IndexTerms - **Head and neck cancer, malnutrition, diet counseling, changes in anthropometric indices, changes in dietary intake.**

INTRODUCTION

Malnutrition is common among the patients with head and neck cancer undergoing chemoradiotherapy (CRT). This is attributed to tumor type, site of the tumor, anti-cancer treatment; various symptoms the patients develop during the treatment which ultimately leads to the reduced food intake and weight loss of the patients. In 2011, there were 6,767 new cases of oral cancer in the UK: 4,510 (67%) in men and 2,257 (33%) in women, giving a male: female ratio of around 20:10.The crude incidence rate shows that there are 15 new oral cancer cases for every 100,000 males in the UK, and 7 for every 100,000 females[ ]. Malnutrition is the most common comorbidity in cancer patient population. Studies have demonstrated that anywhere from 30% to 87% of cancer patients are diagnosed with malnutrition with 30-60% of cancer patients diagnosed with protein calorie malnutrition with higher rates of as much as 80% in esophageal cancer patients[ ]. Anticancer treatments like radiation therapy, chemotherapy or combination therapy i.e. chemoradiotherapy may have an adverse effect like weight loss, xerostomia, loss of taste, impaired swallowing function, mucositis, pharyngitis, nausea and vomiting that can adversely affect the food intake of a person. In a study it shows that the toxic effects can lead to grade 3 or higher mucositis in the majority of patients undergoing chemoradiotherapy (CRT), whilst only 20% to 30% of patients treated with conventional radiotherapy (RT) alone will develop mucositis[ ]. Another study shows that in addition to general symptoms caused by cachexia, such as loss of appetite, early satiety and changes in smell and taste, head and neck cancer patients often suffer from oral symptoms, caused by the tumor, or as a side effect of head and neck cancer treatment. The most common oral symptoms include taste disturbances [ ]. Weight reduction up to 5% or more is mostly conspicuous among the patients due to cachexia as well as due to anti-cancer treatment. A cross sectional study conducted on 112 patients with oral cancer showed that a mean decline of approximately 3kgs of body weight was observed among the patients pre-treatment and they claimed that the weight loss among the patients were mostly caused by the swallowing problem.[ ] Apart from that, reduction in mid-arm circumference (MUAC) which is a great indicator of muscle wasting is noted among these patients. More or less all the patients with head and neck lose weight and have a drop in nutritional status. Thus, nutritional screening is very important for these kinds of patients to detect malnutrition at an early stage. [ ]The Oncology Nutrition Dietetic Practice Group of the American Dietetic Association adopted the Scored PG-SGA as a standard nutrition assessment tool for cancer patients.[ ] A study shows that early nutrition intervention in patients with HNC (Head and Neck Cancer) receiving chemoradiotherapy resulted in an improved treatment tolerance and fewer admissions to hospital[ ]. Thus nutritional counseling seems to be effective in the betterment of the health status of the patient. It helps to replenish the nutrient losses in the body and also helps to gain weight slowly but effectively as it improves the food intake of the patients. The patients' anthropometric as well as biochemical parameters may tend to improve after diet counseling as it improves their intake and ultimately the quality of life yet it takes an extended period of time to show the improvement.

METHODOLOGY

Objective: The main objectives of the study are to determine the effect of nutritional intervention on the dietary intake and the anthropometric indices of the affected head and neck cancer patients undergoing chemoradiotherapy.

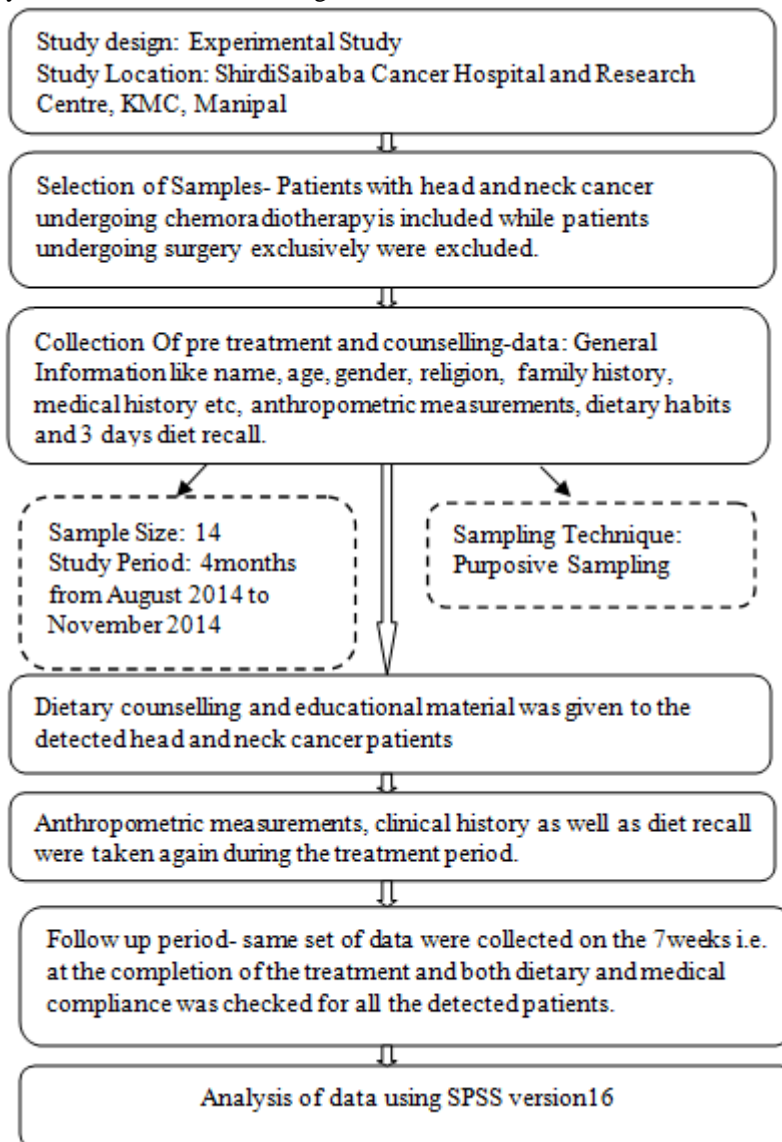The methodology of the study is shown in a schematic diagram below:

Study design: Experimental Study
Study Location: ShirdiSaibaba Cancer Hospital and Research Centre, KMC, Manipal

Selection of Samples- Patients with head and neck cancer undergoing chemoradiotherapy is included while patients undergoing surgery exclusively were excluded.

Collection Of pre treatment and counselling-data: General Information like name, age, gender, religion, family history, medical history etc, anthropometric measurements, dietary habits and 3 days diet recall.

Sample Size: 14
Study Period: 4months from August 2014 to November 2014

Sampling Technique: Purposive Sampling

Dietary counselling and educational material was given to the detected head and neck cancer patients

Anthropometric measurements, clinical history as well as diet recall were taken again during the treatment period.

Follow up period- same set of data were collected on the 7weeks i.e. at the completion of the treatment and both dietary and medical compliance was checked for all the detected patients.

Analysis of data using SPSS version16

Table I Cut Off Range Of Compliance	
Compliance %	**Class**
<40	Low Compliance
40-69	Moderately Compliance
>70	High Compliance

RESULTS

14 patients detected with head and neck cancer were enrolled in this experimental study design. Their age was classified into 3 categories i.e. <35years as young adults, 35-65 years Middle Age and >65 years as old age. Among 14 patients, majority of the patients (6) falls in the Middle age category. About 13(92.9%) patients out of 14 were male, and only 1(7.1%) patient was female who was affected with head and neck cancer. Socio-economic status of the patients was determined using Kuppuswamy scale 2012. Based on the education and the occupation of the head of the family as well as the income of the whole family, the socioeconomic status of the patients has been decided. Majority of the patients i.e. about 6 (42.9%) patients fall under the category

of Lower Middle Class III but only 1 patient falls under the category of Upper Class I. Rest about 2(14.3%) patients fall under Upper Lower Class IV and about 3 patients fall under the category of Upper Middle Class

The cancer treatments i.e. Chemotherapy or Radiation therapy or the combination of both are cost effective. So the affordability of the patients for the cancer treatment can be determined by their socioeconomic status.

Medical assessment of the detected patients includes personal medical problem(s), family history and the treatment they underwent. Majority of the patients i.e. 7(50%) out of 14 were detected with Cancer of Mouth, 5(35.7) of them were having Cancer of Throat whereas the rest of the 2 (14.3%) patients were detected with Cancer of Neck.

Anthropometric measurements mainly Weight, Height and MUAC of all the 14 patients were taken first before treatment, during treatment and after treatment. The mean weight of all the detected head and neck cancer patients was found to be 52.51kg. Majority of the patients i.e. about 10(71.4%) out of 14patients were having Normal BMI whereas only 3(21.4%) patients were categorized as Underweight and only 1(7.1%) patient were categorized as Pre-Obese according to the Asian Classification of BMI. MUAC has been classified into two categories i.e. Malnourished and Normal. The majority of the patients 9 (64.3%) were normal whereas 5 (35.7%) were categorized as malnourished.

Table II. Comparison Between Pre, During, Post Weight Of the Detected Head and Neck Cancer Patients

	Source		Mean±SD	Df	F	P
Greenhouse -Geisser	Weight	Pre	52.51±7.19			
				1.261	6.692	.015*
		During	50.06±6.95			
		Post	50.53±6.39			
Greehouse -Geisser	BMI	Pre	19.83±2.41			
		During	18.92±2.41	1.261	7.142	0.012*
		Post	19.11±2.39			
Greehouse -Geisser	MUAC	Pre	23.52±2.37			
		During	23.21±2.51	1.288	.505	.533[NS]
		Post	23.21±2.13			

Almost all the detected head and neck cancer patients were having clinical signs and symptoms like headache, dizziness, nausea or vomiting, pain in the mouth, throat, neck, chewing and swallowing problem, loss of appetite etc. These clinical signs and symptoms classified based on the degree of severity i.e. Mild, Moderate, Severe & Very severe. The Clinical Symptoms score was calculated by assigning high score to very severe and low score to mild symptoms. The sum total is further classified as <5 points to mild, 5 – 17 as moderate, 18 – 27 as severe and more than 28 points as very severe. Most of the patients i.e. about 8 (57.1%) patients were having moderate signs and symptoms, 5 (35.7%) were having mild symptoms and only 1(7.1%) patient had severe clinical symptoms before the starting of the treatment. The CRT-induced dysphasia, odynophagia, loss of sense of taste, xerostomia, nausea, vomiting and loss of appetite may have a significant negative impact on nutrition and functional ability leading to malnutrition.

The nutritional status of all the detected head and neck cancer patients was determined with the help of a nutritional screening tool i.e. PGSGA (Patient Generated Subjective Global Assessment) tool. The patient were classified under 3 different stages i.e. Stage A – Well nourished, Stage B – Moderately malnourished and Stage C – Severely malnourished. They were classified with respect to their health condition and the scores given to them after assessing their health condition. About 3(21.4%) patients were classified under Stage A. 11(78.6%) out of 14 head and neck cancer patients were classified under Stage B.

Effect of dietary counseling has been observed on the following aspects given below:

a.   Anthropometry
b.   Dietary Intake

Effect Of Diet Counseling On Anthropometric Indices Of The Detected Head And Neck Cancer Patients
Table II. shows the comparison between the pre, during and the post anthropometric measurements of all the patients using the test of repeated measures ANOVA.

Table III. shows the pairwise comparison between pre during and post anthropometric measurements of all the patients using the test of repeated measures.

The table depicts that when using ANOVA with repeated measures with a Greenhouse – Geisser correction the mean scores for weight were statistically significant (F(1.261, 16.395) = 6.692, p=0.015) at 5% level where the pre mean weight is 52.51kg, there is a reduction observed in mean weight during the treatment i.e. 50.06kg whereas the mean post weight was slightly increased i.e. 50.53kg than the mean weight during the treatment. The pre mean BMI was 19.83, mean BMI during treatment was seemed to decrease than pre mean BMI i.e.18.92 whereas the post mean BMI has increased than BMI during treatment i.e. 19.11 so the mean

Table III Pair-wise Comparison Of The Anthropometric Measurements

Anthropometry		Mean Difference(I-J)	p-value
Weight			
Pre	During	2.451	P<.001**
	Post	1.976	.112 NS
During	Pre	-2.451	P<.001**
	Post	-0.476	1.000 NS
Post	Pre	-1.976	.112 NS
	During	0.476	1.000 NS
BMI			
Pre	During	.917	P<.001**
	Post	.723	.101 NS
During	Pre	-.917	<.001**
Post	Pre	-.723	.305 NS
	During	.194	.296 NS
MUAC			
Pre	During	.309	.237 NS
	Post	.094	1.000 NS
During	Pre	-.309	.237 NS
	Post	-.214	1.000 NS
Post	Pre	-.094	1.000 NS
	During	.214	1.000 NS

**significant at 1% level, *significant at 5% level, NS Non significant

scores of BMI is also seemed to be statistically   significant (F(1.261, 16.398)=7.142, p=0.012) at 5% level. The BMI changes with the change in weight of the patients. From the pair-wise comparison table of weight it can be seen that the pre weight and the during weight is significantly different (p<0.001) at 1% level as the weight during treatment

had decreased when compared with pre-weight. Though the mean post weight was seemed to increase slightly than the mean weight during treatment thus it is showing non significant.

Effect of dietary counseling has been observed on the nutrients intake of all the detected head and neck cancer patients.

Table IV shows the comparison between the pre, during and the post nutrient intake of all the patients using the test of Repeated Measures Test, ANOVA.

Table V shows the pairwise comparison between pre during and post nutrient intake of all the patients using the test of Repeated Measures Test, Anova.

The table IV depicts that when using ANOVA with repeated measures with Greehouse-Geisser correction, it was seen that the mean scores of energy intake was statistically significant (F(1.578,20.518)=4.350, p=0.034) at 5% level, where the mean energy before treatment was 1491.61kcal, which was decreased during treatment but increased significantly after treatment and diet counseling. The pre mean protein intake was 44.45gm, where the intake had reduced during treatment i.e. 43.60gm and the post intake had increased to58.87gm than pre intake so the mean scores of protein intake was showing a significant difference (F(1.423,18.50)=6.839,p=0.011) at 5% level. Though the mean intake of carbohydrates seemed to increase slightly among the patients, it is not showing any significant difference. As also in case of fat, the intake has decreased post diet counseling but is not significantly different. Among the micronutrients, the mean score of calcium (F (1.667, 21.674) =18.784, p<0.001) is showing significantly different at 1% level where the mean post intake has seen to increase drastically. The mean scores of zinc was showing a significant difference (F(1.284,16.694)=4.521, p=0.041) at 5 % level as well as the intake of Vitamin C was also showing a difference (F(1.432, 18.616)=4.046, p=0.046) at 5% level as the intake of both the nutrients may have increased significantly after counseling. But pairwise comparison of these nutrients (Table V) has not shown any significant difference. The

mean score of Vitamin B2 $(F(1.533, 19.92)=7.080, p=.008)$ is also showing significant at 1% level as well as the pairwise comparison also shown a significant difference at 1% level when pre intake and post intake was compared.
TableIV Comparison Between Pre, During & Post Treatment Intake

Table IV Comparison Between Pre, During & Post Treatment Intake					
Source		Mean±SD	Df	F	P
Energy	Pre	1491.61±306.49	1.578	4.350	.034*
	During	1397.59±225.91			
	Post	1674.07±327.69			
Protein	Pre	44.45±12.47	1.423	6.839	.011*
	During	43.60±14.30			
	Post	58.87±19.15			
Fat	Pre	46.27±16.05	1.615	2.381	.125^^
	During	37.67±11.52			
	Post	47.51±19.69			
Carbohydrate	Pre	223.98±50.67	1.972	3.176	.059^^
	During	221.01±40.86			
	Post	252.86±44.04			
Calcium	Pre	596.89±221.78			
	During	664.48±352.61	1.667	18.784	P<.001^-
	Post	1151.13±565.52			
Zinc	Pre	5.17±1.92	1.284	4.521	.041*
	During	4.84±2.49			
	Post	6.89±3.62			
Iron	Pre	9.17±2.64	1.036	2.878	.112^^
	During	8.04±2.56			
	Post	14.96±13.97			
Vitamin C	Pre	70.04±46.23	1.432	4.046	.046*
	During	62.76±43.76			
	Post	113.21±77.69			
Vitamin A	Pre	376.56±652.44	1.319	5.948	.019*
	During	679±1302.92			
	Post	1482.35±1835.84			
Vitamin B2	Pre	0.95±0.44	1.533	7.080	.008**
	During	1.26±.79			
	Post	1.74±1.05			
Folic Acid	Pre	148.23±57.65	1.253	.963	.362^^
	During	140.84±59.44			
	Post	176.52±92.25			

The pre mean intake of Vitamin A was 376.56mcg, mean intake during the treatment was 679mcg and the 1482.35mcg is the mean post intake which has been increased from pre intake so the mean score of Vitamin A $(F_{(1.319, 17.151)}=5.948, p=.019)$ is significant at 5% level. From the pair-wise comparison table, it was showing that the pre intake of Vitamin A when compared with the intake during treatment it was not showing any significance level whereas when pre and post intake was being compared it was showing significantly different (p=0.045) at 5% level where post intake being increased than the pre intake.

**significant at 1% level, *significant at 5% level, NS Non significant

The increase in the intake of almost all nutrients may be due to the B-Protin supplements that were provided to most of the patients. The nutrients like iron and folic acid are not showing any significant difference though their intake has increased slightly post treatment and counseling.

Table V Pairwise Comparisons of Nutrients Intake Pre, During and Post Treatment

Nutrients		Mean Difference(I-J)	p-value
Energy			
Pre	During	94.014	.682 NS
	Post	-182.464	.421 NS
During	Pre	-94.014	.682 NS
	Post	-276.479	.028*
Post	Pre	182.464	.421 NS
	During	276.479	.028*
Protein			
Pre	During	.851	1.000 NS
	Post	-14.419	.039*
During	Pre	-.851	1.000 NS
	Post	-15.270	.051 NS
Post	Pre	14.419	.039*
	During	15.270	.051 NS
Fat			
Pre	During	8.607	.107 NS
	Post	-1.240	1.000 NS
During	Pre	-8.607	.107 NS
	Post	-9.847	.213 NS
Post	Pre	1.240	1.000 NS
	During	9.847	.213 NS
Carbohydrate			
Pre	During	2.971	1.000 NS
	Post	-28.881	.210 NS
During	Pre	-2.971	1.000 NS
	Post	-31.853	13.204 NS
Post	Pre	28.881	.210 NS
	During	31.853	.094 NS
Zinc			
Pre	During	.330	1.000 NS
	Post	-1.725	.156 NS
During	Pre	-.330	1.000 NS
	Post	-2.056	.122 NS
Post	Pre	1.725	.156 NS
	During	2.056	.122 NS
Calcium			
Pre	During	-67.587	1.000 NS
	Post	-554.237	.001**
During	Pre	67.587	1.000 NS
	Post	-486.650	.002**

Post	Pre	554.237	.001**
	During	486.650	.002**
Iron			
Pre	During	1.130	.295 NS
	Post	-5.786	.406 NS
During	Pre	-1.130	.295 NS
	Post	-6.915	.295 NS
Post	Pre	5.786	.406 NS
	During	6.915	.295 NS
Vitamin C			
Pre	During	7.276	1.000 NS
	Post	-43.173	.136 NS
During	Pre	-7.276	1.000 NS
	Post	-50.449	.159 NS
Post	Pre	43.173	.136 NS
	During	50.449	.159 NS
Vitamin A			
Pre	During	-302.434	.334 NS
	Post	-1105.791	.045*
During	Pre	302.434	.334 NS
	Post	-803.357	.158 NS
Post	Pre	1105.791	.045*
	During	803.357	.158 NS
Vitamin B2			
Pre	During	-.302	.201 NS
	Post	-.784	.008**
During	Pre	.302	.201 NS
	Post	-.482	.245 NS
Post	Pre	.784	.008**
	During	.482	.245 NS
Folic Acid			
Pre	During	7.395	1.000 NS
	Post	-28.286	1.000 NS
During	Pre	-7.395	1.000 NS
	Post	-35.681	.924 NS
Post	Pre	28.286	1.000 NS
	During	35.681	.924 NS

**significant at 1% level, *significant at 5% level, NS Non significant

Table VI. Evaluation Of The Diet Compliance As Well As Medical Treatment Compliance Of All Detected Head And Neck Cancer Patients

Compliance	Frequency(%)		
	Low	Moderate	High
Dietary Compliance	-	9(64.3)	5(35.7)
Medical Compliance	1(7.1)	-	13(92.9)

The above table shows that majority of the patients i.e. 9(64.3%) out of 14 patients detected with head and neck cancer were moderately compliant to the diet therapy and 5(35.7%) patients were highly compliant to the diet therapy. On the other hand,

majority of the patients i.e. 13(92.9%) were highly compliant and only 1(7.1%) patient had been shown low compliant to medical treatment i.e. chemoradiotherapy.

Table VII. Relationship Between Dietary Compliance (%) And PGSGA Score

		COMPLIANCE (%)	
		r-value	p-value
Post score	PGSGA	-.602	.023*

The diet compliance (%) has been correlated with that of post PGSGA score, where the Pearson's correlation (r) value was showing that they negatively correlated (r=-.602) with each other and showing significantly different (p=.023) at 5% level. This means that if diet compliance is high then the PGSGA score will decrease which is an indication of improved nutritional status of the patients.

DISCUSSION

The result showed that though there was a decrease in weight and MUAC of all the patients during the treatment, a slight improvement has shown in their weight after the dietary counseling was given to all the patients and MUAC also remain unchanged pre and post treatment which was a positive sign of improvement in muscle mass among the patients as these kind of patients tend to lose weight and muscle mass after anti cancer treatment and also due to cancer cachexia. The immediate improvement in weight was not possible to achieve, thus extended study period could have generated better results. This result is supported by a study which indicates that the patients who were receiving individual dietary counseling had a maximum of 3% unintended weight loss 2 weeks after the treatment [ ]. However another study indicates that this weight loss cannot be completely prevented by nutritional counseling [ ].

The significant changes have also been noticed in the dietary intake of the patients after the counseling been given. The intake of macro nutrients like energy and protein has shown to increase after diet counseling and post treatment and has also shown a significant difference. The result is supported by a research study which proves that there was a significant increase in the caloric and protein intake for the three groups i.e. oral group, naso-enteral tube group & supplement group irrespective of the type of nutritional intervention[ ]. This result is also supported by a study showing that whether the patients were on exclusive oral diet or enteral feeding there was a significant increase in calorie ingestion through supplemented oral diet.[ ]   And among the micronutrients the intake of calcium, zinc, vitamin C, vitamin A, vitamin B2 has increased significantly. The intake of zinc may have increased due to the increased animal protein intake among the patients. The increased intake of these nutrients is also due to the fact that majority of the patients were adviced to take additional nutritional supplement i.e. B-Protin for normal patients and D-Protein for diabetics along with the normal diet which has helped to replenish the lost nutrients from the body and help to build up the muscle mass again. In addition, to that multivitamin tablets given to all patients by the physician. Certain nutrients like carbohydrates, folic acid, and iron did not show any significant difference, though their intake seemed to increase post treatment and dietary counseling. The depletion of folic acid may be attributed to the anti-cancer treatment the patient undergoes during the treatment.[ ] Though better results could have obtained with extended study period, the nutritional counseling have a significant impact on the nutritional status of the detected head and neck cancer patients which further helped in the betterment of the health condition of the patients.

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REFERENCES

[1] (Cancer Research UK) Cancer Research UK. (n.d.). Retrieved from http://www.cancerresearchuk.org/cancer-info/cancerstats/types/oral/incidence/uk-oral-cancer-incidence-statistics: http://www.cancerresearchuk.org/cancer-info/cancerstats/types/oral/incidence/uk-oral-cancer-incidence-statistics

[2] (National Cancer Institute, 2012) National Cancer Institute. (2012, January 2). Retrieved from http://www.cancer.gov/cancertopics/factsheet/Sites-Types/head-and-neck: http://www.cancer.gov/cancertopics/factsheet/Sites-Types/head-and-neck

[3] (Agostino Paccagnella, 2010) Agostino Paccagnella, M. M.-R. (2010). Early intervention improves treatment tolerance and outcomes in head and neck cancer undergoing concurrent chemoradiothera.

[4] (Harriët Jager-Wittenaar & Pieter U. Dijkstra & Arjan Vissink & Rob P. van Oort, 2010) Harriët Jager-Wittenaar & Pieter U. Dijkstra & Arjan Vissink & Rob P. van Oort, B. F. (2010). Malnutrition in patients treated for oral or oropharyngeal cancer—prevalence and relationship with oral symptoms: an explorative study. 1675-1683.

[5] (Roodenburg, 2010) Roodenburg, H. J.-W. (2010). Malnutrition in patients treated for oral or oropharyngeal cancer—prevalence and relationship with oral symptoms: an explorative study. 1675-1683.

[6] (Ji-Yeon Kim, 2011) Ji-Yeon Kim, G. A.-A.-Y.-M.-H.-J.-H. (2011). Development and validation of nutrition screening tool for hospitalized cancer patients. Clinical Nutrition , 724-729.

[7] (J.Bauer, 2002) J.Bauer, S. (2002). Use of Scored Patient Subjective Global Assessment(PG-SGA) as a nutrition assessment tool in patients with cancer. European Jaounal of Nutrition .

[8] (Manon G. A. van den Berg, Comparison of the effect of individual dietary counselling and of standard nutritional care on weight loss in patients with head and neck cancer undergoing radiotherapy, 2010). Manon G. A. van den Berg, E. L.-C.-L. (2010). Comparison of the effect of individual dietary counselling and of standard nutritional care on weight loss in patients with head and neck cancer undergoing radiotherapy. British Journal of Nutrition , 872-877.

[9] (Manon G. A. van den Berg, Comparison of the effect of individual dietary counselling and of standard nutritional care on weight loss in patients with head and neck cancer undergoing radiotherapy, 2010) Manon G. A. van den Berg, E. L.-C.-L. (2010). Comparison of the effect of individual dietary counselling and of standard nutritional care on weight loss in patients with head and neck cancer undergoing radiotherapy. British Journal of Nutrition , 872-877.

[10] (Michele, 2009) Michele, A. P.-R. (2009). Early nutritional intervention improves treatment tolerance and outcomes in head and neck cancer patients undergoing concurrent chemoradiotherapy. Support Care Cancer , 837-845.

[11] (M. C. Gonçalves Dias, 2005) M. C. Gonçalves Dias, M. d. (2005). Nutritional intervention improves the caloric and proteic ingestion of head and neck cancer patients under radiotherapy. Nutricion Hospitalaria , 320-325.

[12] (McCarthy D, 1999) McCarthy D, W. D. (1999). The effect of supplementation on food intake in patients undergoing radiotherapy. Oncol Nurs Forum , 897-900.

[13] (M.Dicato, 2010) M.Dicato, L. M. (2010). Anemia in Cancer. Annals of Oncology , 68.