The nutritional status of oncology patients receiving radiotherapy in an outpatient setting

Clark Chambers

University of Wollongong

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THE NUTRITIONAL STATUS OF ONCOLOGY PATIENTS RECEIVING RADIOTHERAPY IN AN OUTPATIENT SETTING

By

Clark Chambers

Supervisor: Jennifer McArthur

This Major Project is presented as part of the requirements for the degree of Master of Science (Nutrition and Dietetics) of The University of Wollongong.

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Acknowledgements

I would like to extend my appreciation to the Nutrition and Dietetics department of The St George Hospital for their help and support throughout my time there, to the team at the St George Hospital Cancer Care Centre for their co-operation and to Jennifer McArthur for her guidance and support throughout the project.
Abstract

The study investigates the nutritional status of patients receiving radiotherapy for treatment of cancer in an outpatient setting. There were 39 subjects who were divided into four study groups depending on the position of their treatment field. Three patients received treatment to the head and neck area (HN), 17 patients were receiving abdomino-pelvic irradiation (AP), 15 received radiotherapy to the chest (C) and five received treatment to parts of the body not associated with the gastrointestinal tract (O). Anthropometric, clinical and dietary indicators of nutritional status were used, these included measurements of Body Mass Index and weight loss, a subjective questionnaire in which patients reported possible nutrition compromising side effects of treatment and a 24 hour dietary recall to estimate energy and protein intakes before and after treatment.

The anthropometric and dietary indicators altered little with treatment and did not indicate a change in nutritional status. The clinical indicators were most important in detecting changes in the nutritional status of the patients. Clinical indications of declining nutritional status differed between the study groups. The AP group was found to be likely to develop diarrhoea during the course of radiotherapy. The C group was found to be at high risk of developing dysphagia during treatment. The HN group was expected to suffer the most changes in clinical indicators such as anorexia, xerostomia, dysphagia and dysgeusia, however, the number of patients in the group was too small to draw any meaningful results. The study recommends that a number of indicators of nutritional status, including anthropometric, biochemical, clinical and dietary indicators should be used when assessing the nutritional status of cancer patients.
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Chapter 1

Introduction
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Introduction

Background and Statement of the Problem

In July, 1993, the newly opened Cancer Care Centre (CCC) at The St George Hospital, Kogarah, began treating its first radiotherapy outpatients. The CCC had employed a number of full time Allied Health staff including 1.5 Full Time Equivalent (FTE) Dietitians. The number of outpatients receiving radiotherapy was expected to be high (up to 85 per day) and a significant proportion of these patients were expected to encounter nutrition related problems as a consequence of the treatment. It was therefore believed that a screening mechanism would need to be developed and used, thereby enabling the Dietitians in the CCC to more efficiently identify, prioritise and treat those nutritionally at-risk individuals.

This study was developed to describe the nutritional status of the outpatients prior to radiotherapy commencing and to describe the changes in nutritional status as the therapy progressed. Information about the nutritional status of the outpatients would be gathered using anthropometric, subjective and dietary measures. Comparisons of nutritional status between groups of patients with different cancer types and treatment sites would be made. It was hoped that this information could be used to develop parameters for screening patients to identify potential nutritional problems before therapy commenced. This was expected to achieve minimisation of the impact of radiotherapy on the patient's nutritional status.
Definition of Terms

'Cachexia' from the Greek words *kakos*, meaning 'bad' and *hexis*, meaning 'condition'. A syndrome in which patients with malignant disease develop anorexia, weakness and severe weight loss which greatly contributes to the morbidity and mortality of such patients.

'Radiotherapy' The use of radiation (such as x-rays) in the treatment of Cancer and other diseases.

'Gray' The SI unit of absorbed radiation dose, equal to the transfer of 1 joule of energy per kilogram of absorbing material.

'Fraction' The total radiation dose administered to a patient is divided into smaller doses called fractions.
Chapter 2

Literature Review
Literature Review

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2.1 Introduction

The term 'cancer' encompasses a group of neoplastic disorders which are characterised by transformation of normal cells into malignant ones. There is often a marked decline in the nutritional status of patients with cancer (Torosian and Daly, 1986). This deterioration in nutritional status can be caused by the disease itself, the effects of the treatment of the disease or a combination of these factors (Donaldson and Lenon, 1979). The most common treatments for cancer are surgery, chemotherapy and radiotherapy, all of which can have an impact on the patient's nutritional status (Kokal, 1985). This project is concerned with how radiotherapy treatment affects the nutritional status of cancer patients.
2.2 Cancer Cachexia

Cancer cachexia is a syndrome which is characterised by anorexia, severe weight loss, tissue wasting, early satiety and weakness. Cachexia is driven by the presence of a tumour and the effects of cachexia are reversed by removal of the tumour (Norton, et al., 1985). In 1932, Warren noticed a relationship between wasting and mortality in postmortem examinations of cancer patients. He concluded that cachexia was the most frequent single cause of death in cancer patients. Kern and Norton (1988), concluded that most cancer patients have clinically detectable cachexia. This is supported by Nixon et. al. (1980) who found widespread protein energy malnutrition (PEM) in cancer patients based on creatinine-height ratio.

It is unclear whether the weight loss associated with cachexia is due to decreased caloric intake, increased energy requirements or a combination of the two. Numerous factors can be identified that may lead to anorexia and decreased caloric intake in oncology patients. These include intestinal obstruction or fistula formation, radiotherapy or chemotherapy induced nausea, vomiting, altered taste sensations, mucosal damage or anxiety (Fearon and Carter, 1988). Very few attempts have been made to accurately describe the energy and protein intakes of oncology patients. Holroyde and Reichard (1986) believe this is because of the limitations of retrospective dietary analysis and patient recall. They report that daily caloric intakes in groups of adult weight losing oncology patients have ranged from 4800-6500kJ in various studies. Unfortunately, the nutritional requirements of cancer patients are as yet unknown and hence any estimations of energy or protein intakes may only be compared to requirements for populations without cancer.
Another possible reason for the weight loss seen in cachexia is an increased energy expenditure. Some studies (Lindmark et al, 1984) have shown increases in energy expenditure in oncology patients of 5-20%, others (Knox et al, 1983) have shown that some cancer patients are hypermetabolic (26%), some are hypometabolic (33%) and some have normal rates of metabolism (41%), still other studies have shown no difference between energy expenditure rates of cancer patients when compared to controls (Hansell et al., 1986). Clearly, more research needs to be done in this area, however it seems that cancer may have a marked effect on the host's metabolism and this may lead to an increased energy expenditure and contribute to weight loss.
2.3 Effects of Radiotherapy

2.3.1 Introduction

Radiotherapy is the use of high energy radiation to treat malignant disease. Unfortunately, the area of treatment cannot be confined to the malignant target cells and some normal tissue will be effected. If these normal cells are in or near the gastrointestinal tract, nutritional consequences may result from their damage during treatment. The site of treatment is connected to the types of nutritionally related consequences that may result. Hence, in this study, the main sites of treatment likely to have some nutrition related consequences of radiotherapy are the head and neck, chest and abdomino-pelvic areas of the gastrointestinal tract.

2.3.2 Head and Neck Patients

Radiotherapy to areas of the head and neck create the most nutritionally compromising consequences of any treatment site. Localised effects of radiotherapy to the head and neck which may result in alterations to nutritional status are: sore throat leading to odynophagia (pain on swallowing), dysphagia (difficult swallowing), xerostomia (dry mouth), mucositis, anorexia (lack of appetite), hypogeusia (lack of taste) or dysgeusia (altered taste) and nausea (Donaldson, 1977, Kokal, 1985 & McAnena & Daly, 1986). The severity of these symptoms is related to the dose of radiation administered and the size of the area being radiated (Donaldson, 1977).
The impairment that occurs with a patient's taste may begin as little as two weeks after beginning therapy (Kokal, 1985) and taste may gradually return over one year post therapy (Donaldson, 1977). It is believed to occur due to radiation damage of the microvilli of the taste cells or their surfaces (Conger, 1973 cited in Donaldson, 1977). It can be appreciated that as the sensation of taste disappears, the enjoyment of eating declines and consequently oral intake is likely to fall.

Exposure of the salivary glands to radiation during treatment to the head and neck may also have nutritional consequences. Salivary excretion decreases and the secretion becomes thick and acidic (Donaldson, 1981). The decrease in saliva production may lead to dysphagia, especially of dry foods. The teeth are usually protected by a coating of saliva. When the amount of saliva produced is decreased, the teeth are more susceptible to bacterial attack leading to dental caries (Kokal, 1985). Dysphagia and accelerated rates of carie formation may also lead to decreased oral intake.

A simple method to observe how a patient's nutritional status is altered by the consequences of radiotherapy to the head and neck mentioned above, is to monitor the weight of patients throughout therapy. This technique was used by Donaldson (1977), who found the average weight loss for 122 patients undergoing radiotherapy for cancers of the head and neck for periods of six to eight weeks was 3.7 kg. Fourteen of the group (8.7 per cent) lost greater than 10 per cent of their initial body weight on completion of the therapy. Only 10 (8.2 per cent) of the group of 122 patients remained stable or gained weight. It should be noted that these patients received no specific dietary treatment.
Chencharick and Mossman (1983) studied 74 head and neck cancer patients undergoing radiotherapy. They found that 94 per cent of patients lost an average of five kilograms prior to therapy and that this weight loss did not change throughout therapy. In contrast to Donaldson's study, these patients received nutritional counselling throughout the radiotherapy. Also in this study a subjective questionnaire was completed by the patients throughout the treatment addressing issues such as occurrence of xerostomia, dysgeusia, anorexia and dysphagia.

2.3.3 Chest Patients

Radiotherapy is often used to treat patients with malignancies of the thoracic or chest area, commonly lung or breast cancers. Common side effects of radiotherapy to this area with possible nutritional sequelae are oesophagitis and dysphagia. Oesophageal stricture or fistula formation may appear as late consequences of radiotherapy (Donaldson, 1977 & Kokal, 1985). Complaints of dysphagia are reported to appear after two or three weeks with radiation dose levels of approximately 30 gray. The dysphagia may last for two weeks after radiotherapy has ceased (Donaldson, 1977).
2.3.4 Abdomino-pelvic Patients

Radiotherapy is often used to treat malignancies in the abdominal or pelvic areas. Common cancer types in these areas are small or large bowel malignancies, prostate or bladder cancer. The acute effects of radiotherapy to the abdomino-pelvic region are nausea, vomiting and diarrhoea (Donaldson, 1977 & Kokal, 1985). These symptoms may present on initiation of treatment and persist throughout treatment. Clearly, over the period of treatment these side-effects may lead to a decline in patient's nutritional status.

Irradiation to the abdomino-pelvic area may lead to malabsorption of fat, carbohydrate and protein, as well as electrolyte and fluid disturbances (Kokal, 1985). Choloretic enteropathy may result from abdomino-pelvic irradiation. Choloretic enteropathy is characterised by a malabsorption of bile salts by the irradiated bowel, leading to malabsorption of fat and steatorrhoea. The resulting increase in bile salts in the colon will inhibit water absorption and stimulate colonic peristalsis, causing further fluid and electrolyte disturbances (Kokal, 1985).

To measure alterations to nutritional status of patients undergoing radiotherapy to the abdomino-pelvic region, Donaldson (1977) again used weight loss as an indicator of declining nutritional status. She found that, in a group of 67 patients undergoing whole abdominal radiotherapy for non-Hodgkin's lymphoma over a six week period, 88 per cent of the patients encountered weight loss and the average weight loss was 3.8 kg. The most common radiation dose for this group was 45 Gray. Thirteen per cent of the patients lost greater than 10 per cent of their initial body weight.
Long term complications of radiotherapy to the abdomino-pelvic region include intestinal obstruction, submucosal fibrosis, enteritis, colitis or fistula formation. These complications may appear months to years after the completion of radiotherapy and effect 0.5 to 15 per cent of patients (Kokal, 1985).
2.4 Indicators of Nutritional Status in Oncology Patients

2.4.1 Introduction

Because of the high likelihood of cancer patients being malnourished before treatment or becoming malnourished due to the effects of treatment, screening for nutritional related problems or risk of developing these problems is necessary. To effectively screen for these problems, indicators of nutritional status in oncology patients must be identified. Unfortunately, there is no one indicator of a patient's nutritional status. Many indicators have been developed and those that have been used to describe nutritional status in oncology patients are outlined below. The indicators described below are all tools to help the observer, whether it be a physician or dietitian, describe the nutritional status and likelihood of nutrition related problems of the patient. These indicators do not replace clinical judgment, which many observers believe to be the single most important assessment tool (Jeejeebhoy and Meguid, 1986, Baker, Detsky, et al., 1982 & Grant, Custer, et al., 1981). The indicators are attempts to describe a patient's condition in an objective manner and because of numerous methodological problems, cannot be solely relied on to assess a patient's nutritional status.
2.4.2 Anthropometric Indicators

Of the many anthropometric measures available, body weight is the easiest to measure, most widely used and often the most important indicator of a patient's nutritional status. Body weight can give an indication of nutritional stores such as body fat and protein (Grant, Custer et al., 1981). A patient's relative weight can be described by the Body Mass Index (BMI):

\[
\frac{\text{Weight (kg)}}{\text{Height}^2 (m)}
\]

Definitions of body fatness using the BMI (NH&MRC, 1984) are:

- Very underweight  $< 18$kg/m$^2$
- Underweight  18-20kg/m$^2$
- Acceptable weight  20-25kg/m$^2$
- Overweight  25-30kg/m$^2$
- Obese  $>30$kg/m$^2$

Using the BMI may give an indication of a patient's nutritional reserves before and during treatment. In a recent study conducted by Carey (1992) investigating the effects of radiotherapy to the head and neck and pelvic regions it was found that prior to therapy 20% of patients had a BMI $< 20$kg/m$^2$ indicating suboptimal nutrition. After treatment the number of patients with a BMI $< 20$kg/m$^2$ had not changed.
BMI cannot describe any recent weight fluctuations the patient may have had and these may be much more important than the current weight-for-height of the patient. Weight loss may be described in a number of ways, in kilograms or as a percentage of usual weight are two common methods. Most studies agree that a weight loss of greater than 10% of usual body weight is an indicator of nutrition related complications (Smith & Mullen, 1991, Zador and Truswell, 1987 & Grant, Custer et al., 1981).

Subcutaneous fat stores can be assessed using skinfold calipers and can accurately reflect total body fat stores. However, large variance in measurements taken between three different observers has been noted using this method and to be considered abnormal it is suggested that measurements be below the fifth percentile of normal (Jeejeebhoy and Meguid, 1986). Baker and colleagues (1982) found that clinical judgment was a better predictor of patient's outcome than triceps skinfold.

The anthropometric indicators of skeletal muscle mass commonly used in oncology patients are mid-arm circumference (MAC) and mid-arm muscle circumference (MAMC). The MAMC is derived from a formula which includes triceps skinfold and MAC. MAC is measured with a tape measure and compared to tables of "normal" to determine the percentile of normal. This leads to two sources of error, first the error involved with attaining the measurement, secondly the error arising when comparing a single measurement to a sample of a population classified as "normal". Because of these errors patients can only be described as having an abnormal MAC if the measurement is less than the fifth percentile of normal.
In Carey's study (1992) it was found that after 6 weeks of radiotherapy to the head and neck or pelvic regions the mean decrease in MAMC was 0.384mm. To be able to detect a true change in arm muscle circumference calculated from MAC and triceps skinfolds, Hall and colleagues (1980) thought the change needed to be at least 2.68cm. Similarly, Macia and colleagues (1991) found that a group of head and neck cancer patients who underwent radiotherapy with an average dose of 61 Gray had a decrease in MAMC of only 1cm over the period of treatment, with no dietary intervention.

### 2.4.3 Biochemical Indicators

The most common biochemical indicators used in studies to describe the nutritional status of cancer patients are the serum proteins, albumin and transferrin. Both of these proteins are synthesised in the liver and the assumption is that depressed serum concentrations of the proteins is due to decreased biosynthesis by the liver as a result of lack of substrate associated with malnutrition (Grant, Custer, et al., 1981). In large population studies decreased albumin concentrations are associated with decreased dietary protein intakes.
Gray and Meguid conducted a study in 1990 investigating 22 patients with cancer, who had initial serum albumin concentrations of <35g/L (normal 40-52g/L), who had been administered total parenteral nutrition (TPN) solutions providing an average of 197% of their predicted basal energy requirements and 1.54g/kg of protein per day for 21 days. Serum albumin and body weight were measured before and after the 21 days of TPN. Body weight over the 21 days increased from an average of 51kg to 54kg, however serum albumin fell from 30.8g/L to 28.6g/L. Gray and Meguid concluded that low serum albumin in cancer patients is not reflective of their nutritional status, but is a consequence of the disease itself.

Carey’s study (1992) found no significant difference in patient’s serum albumin or transferrin levels before and after six weeks of radiotherapy to the head and neck and pelvic areas with dietary counselling available. Macia et al. (1991) found a significant decrease in serum albumin and transferrin concentrations of patients undergoing radiotherapy to the head and neck after treatment with no dietary intervention but no difference in those that did receive dietary counselling throughout treatment. With patients receiving abdomino-pelvic irradiation, however, no significant difference was found in serum albumin or transferrin levels after treatment in both the group who received dietary counselling and those who did not.
2.4.4 Clinical Indicators

As mentioned above, many authors feel that clinical judgment is the most important assessment tool and may be more accurate at predicting complications than objective measurements (Baker et al., 1982). Clinical indicators of nutritional status are signs or symptoms that may present as a result of poor nutritional status or signs or symptoms of conditions that are likely to lead to a decline in the nutritional status of the patient. In cancer patients we know that these conditions may occur as a result of the disease itself or as a consequence of treatment. These indicators have been investigated in cancer patients usually by either objective examination by physicians or subjective questionnaires completed by the patient.

Macia and colleagues (1991) had two doctors assess symptoms and signs in their study group of 93 oncology patients undergoing radiotherapy. They reported the presence of dysphagia, odinophagia, anorexia, diarrhoea, decreased oral intake, mucositis and radiodermatitis in patients undergoing radiotherapy to the head and neck, breast or abdomino-pelvic regions. They found 12 per cent and 43 per cent of head and neck patients suffered worsening dysphagia and odinophagia respectively with treatment, whilst none of the breast or abdomino-pelvic group had any worsening dysphagia or odinophagia. In the head and neck, breast and abdomino-pelvic groups, 61 per cent, 21 per cent and 59 per cent respectively suffered worsening anorexia. Fifty nine per cent of the abdomino-pelvic group suffered worsening diarrhoea. These results were from the control group who received no dietary counselling or intervention.
Nayel and colleagues (1992) studied clinical indicators in head and neck cancer patients undergoing radiotherapy by subjective questionnaire dealing with xerostomia, dysgeusia, hypogeusia, dysphagia, anorexia and food preferences. The questionnaire was completed before the start of radiotherapy and at weekly intervals for six weeks during therapy. After four weeks (40 Gy) of therapy 91 per cent of patients complained of a dry mouth. Before radiotherapy 17 per cent of patients were aware of taste changes and a lack of appetite, after five weeks (50 Gy), 70 per cent were aware of these problems. Twenty-two per cent of patients were aware of swallowing difficulties before therapy, after therapy 82 per cent complained of dysphagia. There was no significant difference in the number of complications patients were subjectively aware of between the group who received no oral nutritional supplementation and the group which did receive supplementation.

Chencharick and Mossman (1983) also used a subjective questionnaire in head and neck radiotherapy patients to assess changes in clinical indicators of nutritional status with radiotherapy. They found 25 per cent of patients complained of dry mouth before radiotherapy and this number increased to 80 per cent by the fourth week of treatment. Fourteen per cent of patients reported taste changes before, by the fifth week 84 per cent complained of dysgeusia. Anorexia incidence increased from 20 per cent before therapy to 60 per cent after the fourth week of therapy.
2.4.5 Dietary Indicators

A declining nutritional status may be due to a decrease in the intake of energy or protein over a period of time. There are many tools available to describe a person's daily oral intake. These measurement tools usually depend on the subject's ability to recall intake or accurately record intake. Very few studies have attempted to accurately describe the usual daily oral intake of oncology patients. Those that have, relied on the 24 hour recall method of describing oral intake.

Chencharick and Mossman (1983) took 24 hour dietary histories from eight patients after one week of radiotherapy and after six weeks of therapy. They found that early in therapy, patient's average daily energy intake was 7300 kilojoules. Late in therapy this had decreased to 7100 kilojoules per day. The average protein intake at week one was 72g per day, whilst after six weeks of therapy it was 66g per day.
Carey's 1992 study on head and neck and pelvic radiotherapy patients had 24 hour dietary recalls taken from each patient at weekly intervals for six weeks. Protein intake fell from 74g per day in the first week of therapy to 64g per day in the last week. The estimated protein requirement for the group was 86g per day. Average daily energy intake fell from 7610 kilojoules to 5710 kilojoules over the six weeks of treatment. The average daily energy requirement for these patients was calculated to be 10,150 kilojoules. This requirement was obtained from a 1979 paper by Long et al. who estimated requirements using indirect calorimetry and nitrogen balance. The requirements were not developed for cancer patients specifically. As already mentioned, cancer effects the host's metabolism in ways not fully understood and no daily energy or protein requirements have been specified for cancer patients at this time.
2.5 Use of Alternative Treatments in Oncology Patients

A study by Feigen and Tiver (1992) at Westmead Hospital showed that in a group of 202 cancer patients 27 per cent had used unconventional dietary supplements, consulted alternative health practitioners or both. Another 24 per cent of the group were using minor dietary modifications or low dose vitamin supplementation. Of those using major dietary supplements the most common types were high doses of vitamins, usually A, B, C and E and herbal extracts, mostly in the form of herbal tea. The most popular types of alternative practitioners were naturopaths, faith healers and meditation group leaders.

The study found no consistent trend between the use of alternative and the type of conventional treatment received, the site or stage of their cancers, the patient's prognosis or the clinical course of the disease. Feigen and Tiver (1992) report that although there is strong epidemiological evidence that diet may be a factor in the aetiology of cancer, there is little evidence that changing diet after cancer has developed will change the course of the disease. Excessive doses of vitamins or other supplements may be toxic, may interfere with conventional treatment and confound diagnostic tests. To my knowledge there has been no study of this type conducted with cancer patients receiving radiotherapy.
2.6 Selection of Diet Survey Methods

To describe oral intake before and after radiotherapy, a 24 hour dietary recall was used. This was the preferred method of describing patient's intakes in similar studies by Carey (1992) and Chencharick and Mossman (1983). The method was chosen primarily because of the speed and ease with which the survey could be completed. A study by Gersovitz, Madden and Wright (1978) showed that for a group of elderly subjects the 24 hour recall gave a relatively valid estimate of their mean daily intake.

There are several limitations with the use of the 24 hour recall method. It has been found that the method tends to overestimate low intakes and underestimate high intakes. There is also a danger of false negatives (failing to detect an actual difference between groups) when comparing dietary intakes of groups of people (Gersovitz, Madden, et al. (1978). Beaton and colleagues (1979) concluded that the precision of the estimate of an individual's usual intake based on one 24 hour recall, is relatively low. However if the focus of attention is on the mean intake of a group, as in this study, the low precision may not be as important as it is with observations of a single subject.

2.7 Conclusion
It is reasonably well established that patients presenting for radiotherapy for treatment of cancers of the gastrointestinal tract, especially those with head and neck cancers may have compromised nutritional status before beginning treatment. Radiotherapy to regions of the gastrointestinal tract can produce side effects that are likely to have a negative effect on the cancer patient's nutritional status. The aim of this study is to investigate the changes in nutritional status in patients undergoing radiotherapy by observing the changes in anthropometric, clinical and dietary indicators of nutritional status.
Chapter 3

Method
Chapter 3
Method

Ethics

Ethics approval was sought and granted by the University of Wollongong Human Experimentation Ethics Committee under Category 1.2: Collecting individually unidentifiable data by survey from informed consenting adults. No ethics approval was sought from St George Hospital after consultation with the Director of the CCC. It was felt that the study did not impede on the subjects enough to warrant attaining approval. All patients were fully informed and gave written consent to their participation in the study (refer appendix 1).

Subjects

The population for this study consisted of 45 consecutive patients that presented for radiotherapy planning at the St George Hospital CCC over a six week period. During the study two patients died. Three patients were missed when completing the final questionnaire due to sickness of the researcher. A total of 40 patients completed both initial and final questionnaires. One patient was excluded from the study because they were receiving radiotherapy to both head and neck and chest region. Fifty nine per cent (23) of the population were male, 41 per cent (16) were female. The population was divided into four main categories depending on the site of their treatment. There were three Head and Neck (HN) patients (8 per cent), 17 Abdomino-pelvic (AP) patients (43 per cent), 14 Chest (C) patients (36 per cent) and five Other (O) patients (13 per cent). Only two patients initially approached refused to take part in the study.
Research Design

Subjects were approached when they presented for radiotherapy planning and asked if they would participate in the study. After completing the consent form (see appendix 1), the sole researcher read the questions on the initial questionnaire (see appendix 2) to the patient and recorded the answers on the questionnaire. This avoided any ambiguity with questions as the researcher was on hand to explain any questions which the patients found difficult. The questionnaire had been pilot tested on a small group of patients before the study was commenced and minor changes were made to its structure. After the questionnaire was completed, a 24 hour dietary recall with checklist was conducted, again with the researcher recording the patient's intake on an answer sheet (see appendix 3). The patient's height and weight were measured and recorded. The initial consult took between 10 to 15 minutes.

Treatment usually commenced two to three days after the planning session. Subjects were seen again on or about their last day of treatment, usually four to six weeks after treatment commenced. On this occasion they were again weighed and asked to answer the second questionnaire (see appendix 4), which was read out by the researcher who also recorded the answers. A second 24 hour dietary recall was conducted and the results recorded by the researcher. The final consult took between five and ten minutes. At this stage patient contact ceased.
It should be noted that approximately nine final consultations were conducted by telephone the week after the patients had finished their treatment, due to the researcher becoming ill. Patient's weights on or about their last day of treatment were obtained from nursing notes. Questions on the questionnaire as well as the 24 hour recall appeared to be understood and answered appropriately over the telephone by patients.

Data Analysis

The results of the 24 hour dietary recall were analysed using the "Diet 1" (NutTab 1992 database) Dietary Analysis Package. Daily intakes of energy (kJ) and protein (g) were analysed and recorded. Statistical tests were used to determine if there were any differences between the four study group's demographics (including age, initial BMI and amount of radiation received) weight loss, energy and protein intake and symptoms following radiotherapy. The statistics were analysed using the JMP statistics package. All tests were carried out using parametric analysis of variance, where the distribution of scores were thought to be not normal, a non-parametric Wilcoxin-Signed Rank test was used.
Chapter 4

Results
Chapter 4
Results

Description of Study Groups

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* HN = Head and Neck, AP = Abdomino-pelvic, C = Chest, O = Other.

Table 4.1. Description of Study Groups.

Table 4.1 shows the number of patients in each study group, the distribution of gender, the group's average age, average BMI and average amount of radiation absorbed during treatment and the number from each group who had either surgery, chemotherapy, radiotherapy or some combination of the three before presenting for radiotherapy.

From Table 4.1 we can see that the HN and O groups contain very small numbers and hence conclusions from results of these groups will be very difficult to make. The AP group is dominated by males usually with rectal or prostate cancer. The C group contains a majority of females usually with breast cancer (See appendix 5 for full breakdown of cancer sites among the study groups).
The AP group appears to be older on average than the other groups, however, Analysis of Variation showed no significant difference between ages in all groups (F Ratio=2.35, Prob>F=0.09) (Prob>F must be <0.05 to be significant). There was also no significant difference between the initial BMIs of the groups (F Ratio=0.83, Prob>F=0.49). It was interesting to see that the average BMI of the groups before therapy exceeded the recommended level of 20-25kg/m² and classified in the overweight range. Only two patients had a BMI of less than 20kg/m² (i.e underweight), they were both females from the Chest group. The average radiation (Gray) absorbed by the patients in the groups over their periods of treatment was also not significantly different (F Ratio=2.53, Prob>F=0.07).

Weight Fluctuations Before and During Treatment

![Weight Fluctuations](image)

Figure 4.1. Weight Fluctuations Before and During Treatment.
Figure 4.1 shows the weight fluctuations before treatment and during treatment of the four study groups as well as the study population as a whole. Subjects were asked what their weight was prior to being diagnosed with cancer in the initial questionnaire. From this weight was subtracted the weight obtained by the researcher at the initial consult to give the weight fluctuation before treatment. From Figure 4.1 it is obvious that the HN group had lost by far the most weight before treatment. Overall, the AP group had actually put on an average of one kilogram from the pre-diagnosis weight they gave. The C and O groups and the group as a whole had no fluctuation in weight before therapy.

During their treatment the group as a whole lost an average of 0.4kg. On average, the AP group lost 0.7kg, the C group lost 0.3kg, the HN group had the largest weight fluctuation of -1.7kg and the O group actually put on 1.1kg overall over their course of treatment. In order to see if there was any difference in weight due to treatment, an analysis of variance with weight before treatment was carried out. No significant difference in weight fluctuations during treatment was found between each group (F Ratio=2.2, Prob>F=0.087).
Figure 4.2 shows the number of patients in each group who had weight loss before and during treatment and the average amount of weight loss in each study group. Before treatment, three (100 per cent) of the HN group had lost an average of 6.7 kg. Seven (41 per cent) and six (43 per cent) patients in the AP and C groups had lost an average of 3.0 kg and 2.6 kg respectively before treatment. During treatment the HN group had the largest weight loss with two (67 per cent) of the subjects losing an average of 2.5 kg each. The AP group had the next largest weight loss with eight (47 per cent) of the patients losing 2.3 kg each. Seven of the C group lost an average of 1.4 kg each during treatment. Three (60 per cent) of the O group had lost 3.4 kg before treatment, however none of the O group lost any weight during treatment.
Reported Side Effects of Treatment

Appendix 6 contains full analysis of the side effects reported by the HN, AP and C groups before and after treatment. The Other group was not included in these analyses because side effects reported by this group cannot be attributed to the effects of radiation on the gastrointestinal tract.

Two side effects were found to be significantly different between groups. The first was diarrhoea where 13 patients (76 per cent) in the AP group complained of diarrhoea after treatment. This was significantly higher than any other group (F Ratio=10.52, Prob>F=0.00). The other reported side effect of significance was dysphagia. Before treatment none of the C group had reported dysphagia. After treatment, seven of the C group (50 per cent) reported dysphagia which was significantly higher than the other groups, except the HN group (F Ratio=4.95, Prob>F=0.01).

Supplement Use

Patients were asked if they were using any dietary supplement at the time of treatment. Supplements commonly used were vitamins, usually B or C, herbs such as garlic or herbal tea. Three patients were drinking Sustagen or a similar high protein, high energy supplement. Overall 18 of the group (46 per cent) were using some dietary supplement.
Table 4.2 Supplement Use Among Study Groups.

Table 4.2 shows the use of dietary supplements among the study groups during treatment. From Table 4.2 we can see that the Chest group has the greater percentage of patients using some dietary supplement. Compared to the abdomino-pelvic group, these patients were typically younger, female and tended to be more liberal in their use of vitamin and herbal supplements.

Energy and Protein Fluctuations with Treatment.

<table>
<thead>
<tr>
<th></th>
<th>HN*</th>
<th>AP</th>
<th>C</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Energy</td>
<td>7250</td>
<td>8600</td>
<td>6200</td>
<td>6300</td>
</tr>
<tr>
<td>Intake (kJ/d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Energy</td>
<td>6950</td>
<td>8000</td>
<td>6050</td>
<td>5800</td>
</tr>
<tr>
<td>Intake (kJ/d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference (kJ/d)</td>
<td>-300</td>
<td>-600</td>
<td>-150</td>
<td>-500</td>
</tr>
</tbody>
</table>

* HN = Head and Neck, AP = Abdomino-pelvic, C = Chest, O = Other.
Figure 4.3 shows the average daily energy intake of the four study groups before beginning radiotherapy, after radiotherapy had ceased and the difference between the two intakes. All groups consumed less energy after treatment had ceased than before radiotherapy commenced, however, none of these decreases in intake were statistically significant (F Ratio=0.35, Prob>F=0.79).

Although there are no specific daily dietary requirements set for oncology patients, it is interesting to compare the above results, especially of the AP and C groups, to the Australian Recommended Daily Intakes (RDI) for men over 64 years (the bulk of the AP group) and women over 54 years (the majority of the C group) as described by the National Health and Medical Research Council. The RDI of energy for men over 64 years is 10,600 kJ and for women over 54 years, 8,000 kJ. Both the AP and the C group consumed less energy than the RDI before and after treatment.

<table>
<thead>
<tr>
<th></th>
<th>HN*</th>
<th>AP</th>
<th>C</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Protein Intake (g/d)</td>
<td>63</td>
<td>90</td>
<td>62</td>
<td>68</td>
</tr>
<tr>
<td>Final Protein Intake (g/d)</td>
<td>72</td>
<td>79</td>
<td>62</td>
<td>66</td>
</tr>
<tr>
<td>Difference (g/d)</td>
<td>9</td>
<td>-11</td>
<td>0</td>
<td>-2</td>
</tr>
</tbody>
</table>

*HN = Head and Neck, AP = Abdomino-pelvic, C = Chest, O = Other.

Table 4.4 Protein Fluctuations with Treatment.
Figure 4.4 shows the average daily amount of protein consumed by each group before treatment, after treatment and the difference between the two. Compared to the RDI of protein for men over 64 years of 55g per day and for women over 54 years of 45g per day, the AP and C group are consuming more protein than is deemed necessary by the NH&MRC. The differences between the protein intakes before and after treatment in all study groups are very small.
Chapter 5
Discussion

Anthropometric indicators

If nutritional status was measured using the Body Mass Index (BMI) alone, this sample of radiotherapy patients would be classified as having good nutritional status due to overconsumption, not necessarily what one would expect in a group of people with cancer. The mean BMI for the study population was 27kg/m², thus, the study population appears to have large nutritional reserves. This result falls between results in two other similar studies. Macia and colleagues (1991) found abdomino-pelvic and breast groups had an average BMI of 30kg/m² before treatment. The 1992 study by Carey, found the average BMI of her study population, made up of 20 head and neck and pelvic radiotherapy patients, was 24kg/m² before treatment.

Only two out of the 39 patients (5 per cent) in this study had a BMI less than 20kg/m² i.e. were classified as underweight. In contrast, four of 20 patients (20 per cent) in Carey's study had a BMI of less than 20kg/m² when starting treatment. There is obviously some difference between the two populations. Probably the main difference is that, this study investigated all patients presenting for radiotherapy, not only those receiving treatment for HN or AP cancers.
As a group, the population of this study had no decrease in weight prior to their diagnoses with cancer until the time they started treatment. Thus, on average, their weight had been stable for some time. After treatment, the group had lost an average of 0.4kg. Nineteen of the study population (49 per cent) had lost weight before treatment, with the average loss being 3.5kg. During treatment, 17 of the group (44 per cent) lost weight with the average loss being 2.0kg.

Donaldson (1977) found 92 per cent of 122 HN patients lost an average of 3.7 kg during six to eight weeks of radiotherapy. Chencharick and Mossman (1983) found that their group of 74 HN patients had an average weight loss of 5 kg before treatment and this weight loss did not change during treatment. It is difficult to compare these results to this study where 67 per cent of the group (2 patients) lost an average of 6.7kg before and 2.5kg during treatment due to the very small size of the HN group.

The result in the AP group compares more closely with Donaldson's study, where the 88 per cent of the AP group lost an average of 3.8kg compared to 47 per cent per cent of the AP group losing 2.3kg in this study. Had numbers in the groups been closer, there were 67 in Donaldson's study, 17 in this study, the results may have been in more agreeance.

Donaldsons's study was conducted in 1979 (and is still the most comprehensive of its type), and no patient received any dietary intervention. At the St George Cancer Care Centre nutrition advice is now an integral part of the patient's care and this, along with improved methods of treatment may lead to less weight loss in radiotherapy patients now than over a decade ago.
If we now took weight loss as the sole indicator of nutritional status, then this study population appears to have had good nutritional status before radiotherapy and this changed little with therapy. Certainly no patient lost greater than ten per cent of their body weight, the level at which most authors agree (Smith & Mullen, 1991, Zador and Truswell, 1987 & Grant, Custer et al., 1981) demands dietary intervention, during therapy and only two had lost greater than ten per cent (10.4 and 11.8 per cent) before treatment, however this was based on the patient’s recall of their weight before diagnosis of cancer.

Clinical Indicators

There is substantial evidence that patients experience significant nutritional problems as a result of cancer and that radiotherapy and other cancer treatments may exacerbate these problems. Subjective questionnaires have been used to identify these problems in HN patients undergoing radiotherapy (Nayel et al., 1992, Chencharick and Mossman, 1983). A subjective questionnaire was used in this study to identify changes in these clinical indicators of nutritional status.
Very few comparisons can be made between the results of the subjective reports of side effects of the HN group in this and the two studies mentioned above because of the small number of patients in the HN group. If the group was larger, however, we would expect the HN group to complain of side effects in a manner that reflects the findings of the studies done in this area. That is, we would expect a percentage of the subjects to have swallowing difficulties, anorexia and some taste changes before therapy, and these percentages would increase markedly with treatment. Xerostomia, which may not be present before radiotherapy would probably effect 80 to 90 per cent of patients at some time during treatment (Nayel et al., 1992, Chencharick and Mossman, 1983).

Macia and colleagues (1991) found that in a group of abdomino-pelvic patients undergoing radiotherapy, 59 per cent had worsening anorexia, 59 per cent had worsening diarrhoea and there were no complaints of dysphagia during treatment. The results of this study compare well with Macia's findings in that the number of patients in the AP group complaining of diarrhoea increased from two before treatment to 13 after treatment, therefore 65 per cent of the group had worsening diarrhoea. There were also no complaints of dysphagia before or after treatment in the AP group and none were expected given the area in which the radiation was absorbed. Complaints of anorexia did rise from three before treatment to five after but this was not reflective of the increase in lack of appetite that Macia found. This was perhaps due to the fact that none of the group in Macia's study received any dietary intervention and six of the AP group in this study had been referred to the oncology dietitian during the course of their treatment.
The most significant clinical indicator of nutritional status that appeared during treatment in the C group was dysphagia. In Macia's study, a group of breast cancer patients had no complaints of dysphagia during radiotherapy. Dysphagia is not necessarily expected in breast cancer patients as the field that is irradiated does not usually include the oesophagus. In the C group in this study, which was 64 per cent breast cancer patients, seven (50 per cent) of the patients complained of dysphagia after treatment, with no dysphagia reported before treatment. Of the nine breast cancer patients in the group, two (22 per cent) reported dysphagia after treatment.

It would be interesting to have a larger population of breast cancer patients to see if this trend is consistent. If it is, questions would have to be raised about the placement of treatment fields in the breast cancer patients, as we would not anticipate 22 per cent of the women with breast cancer undergoing radiotherapy to develop dysphagia.

Of the HN, AP and C study groups, it appears that the HN group is likely to suffer the greatest decline in nutritional status due to clinical factors such as anorexia, xerostomia, dysphagia and dysgeusia however the results of this study, because of the small numbers in the HN group cannot be used to add weight to this argument.

Patients receiving radiotherapy to the abdomino-pelvic area are likely to develop diarrhoea during treatment. This was shown in this study and adds weight to the arguments in the literature. Diarrhoea in these patients may be an indicator of declining nutritional status as malabsorption of fat and other nutrients is likely to occur (Kokal, 1985).
Patients receiving radiation to the chest area, especially those with lung cancer, are likely to develop dysphagia during treatment as a result of the proximity of the treatment field to the oesophagus and the consequent effect of radiation on the mucosa of the oesophagus (Donaldson, 1977). This was supported by this study and it was also found that two of nine breast cancer patients developed dysphagia with treatment. This was not expected, as the treatment field in breast cancer would not be expected to include any part of the oesophagus. Dysphagia has an obvious detrimental effect on nutritional status by limiting patient's food intake.

**Dietary Indicators**

The energy and protein fluctuations seen in this study from before treatment to after treatment, although indicating a downward trend, were not significant. Carey (1992) found the average daily energy and protein intake in a group of HN and AP patients before radiotherapy was 7600kJ and 74g respectively. This compares closely with the results from this study where the average daily energy and protein intakes for the study population as a whole before treatment were 7350kJ and 75g respectively. Both studies used the 24 hour dietary recall method to obtain these results.
There are no dietary requirements established for cancer patients at this time but when compared to the Australian RDIs the patients in this study were consuming significantly less energy than recommended. Usually, this would mean that the population would be losing weight due to poor energy intake. However it was found that this population had stable weight for some time prior to treatment. This apparent contradiction is probably best explained by the data collection method, i.e. the 24 hour dietary recall, not accurately describing the individual's usual intake. It may also be due to the effects of cancer on the metabolism of the host which are not fully understood at this time.

If a declining oral intake is indicative of a declining nutritional status in cancer patients, then one would have to say that radiotherapy had little effect on the intake and hence the nutritional status of the patients in this study using the 24 hour recall method to describe intake.

Supplement Use

Use of supplements may or may not effect the nutritional status of a cancer patient. However, it is helpful for nutrition professionals to know the incidence of supplement use among cancer patients. In this study, patients in the C group were the biggest users of supplements which were commonly doses of the "antioxidant" vitamins, A,C and E, or herbal preparations such as teas or garlic tablets.
Chapter 6

Conclusions, Recommendations and Limitations of the Study
Chapter 6
Conclusion

The nutritional status of a cancer patient is affected by many things. In this study anthropometric, clinical and dietary indicators of nutritional status were used to try and determine if radiotherapy made any difference to the nutritional status of the patient, or if nutritional status differed between groups of patients receiving radiotherapy to different regions of the gastrointestinal tract. This study found that anthropometric and dietary indicators of nutritional status did not indicate poor nutritional status in this group of subjects and did not change significantly with treatment. The results of this study show that clinical indicators of nutritional status that were subjectively reported by patients after treatment had ceased, were most important in detecting possible declines in nutritional status.

The significant difference between the two largest study groups in these clinical indicators was that abdomino-pelvic patients are likely to develop diarrhoea during treatment and patients undergoing radiotherapy to the chest area are likely to develop dysphagia during treatment. Both dysphagia and diarrhoea may lead to declines in nutritional status. Patients receiving radiotherapy to the head and neck area are likely to develop numerous clinical indicators of declining nutritional status during treatment, however, due to the small number of subjects in this group of the study, no weight can be added to the argument present in the literature.
Recommendations

Future research in this area should take into consideration a number of recommendations. Firstly, strive for as large a population size as possible. Whilst the AP and C groups in this study had just sufficient numbers to draw meaningful results from, the HN group certainly did not. This was disappointing as most of the research in this area had been done using head and neck cancer patients.

The use of a 24 hour dietary recall to obtain usual daily intakes of patients, whilst quick and easy to carry out, should be discouraged. I believe a three day food record would be significantly more accurate and may produce a result that does show a significant difference in intakes before and after treatment.

Try to evaluate as many indicators of nutritional status as possible. The major omissions from this study were biochemical measures such as serum proteins. The more indicators that are evaluated, the clearer the overall picture one will obtain of the actual nutritional status of the patient.
Limitations of the Study

1. Small sample size in some study groups such as the HN and O groups made it difficult to draw meaningful results from these groups and impossible to compare them with other studies.

2. Use of 24 hour dietary recall to estimate energy and protein intakes before and after treatment. Use of a three day food record may have yielded a much more accurate result.

3. No food models were used during the 24 hour recall to more accurately judge the actual amounts of food consumed.

4. No biochemical indicators of nutritional status such as serum albumin or transferrin were used in this study because they were not routinely obtainable from the patients in this setting.

5. Data entry errors. When entering food intake data into the Diet 1 software package, various assumptions had to be made when full details of a particular food were not given.
References
References


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Appendices

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Appendix 2  Questionnaire 1
Appendix 3  24 Hour Dietary Recall Record Sheet
Appendix 4  Questionnaire 2
Appendix 5  Distribution of Patients by Cancer Site
Appendix 6  Reported Side Effects of Treatment
Appendix 1
CONSENT FORM

NUTRITION STUDY IN ONCOLOGY PATIENTS

This research is being conducted as part of a Master of Science (Nutrition and Dietetics) degree at the University of Wollongong under the supervision of Ms J McArthur. The aim of the study is to determine how an oncology patient’s nutritional status is altered after undergoing radiotherapy.

I agree to participate in this study. I understand that it requires a survey to be completed, my height and weight to be measured and a dietary record to be taken.

Participation or non participation will not effect the treatment that I receive now or in the future. If at any time I wish to cease participation I understand that I am able to do so.

Any enquiries regarding conduct of research may be forwarded to:

The Secretary
University of Wollongong
Human Experimentation Ethics Committee
Telephone: (042) 213079

Signature: ____________________________

Date: ______________
NUTRITIONAL STATUS SURVEY (1)

Have you ever had any of the following treatments for cancer?
- Radiotherapy ☐
- Chemotherapy ☐
- Surgery ☐
- Other ☐ Please Describe..........................................................................
- No ☐

Have you ever seen a dietitian before?
- No ☐
- Yes ☐ When?....................................................................................................
  Why..................................................................................................................

Have you ever sought or been given dietary advice from anyone other than a dietitian (eg Doctor, Naturopath, books, etc)?
- No ☐
- Yes ☐ Doctor ☐  Wt. Loss Centre ☐
  Naturopath ☐ Friend ☐
  Books ☐ Other ☐

Would you describe your appetite now as:
- Good ☐
- Fair ☐
- Poor ☐
Since being diagnosed with cancer, has your appetite been:

- Remaining Stable  ☐
- Increasing  ☐
- Decreasing  ☐

Are there any foods which you find difficult to eat in any of the following food groups?

- Fruit & Vegetables  ☐
- Meat & Meat Products  ☐
- Breads & Cereals  ☐
- Fats & Oils  ☐
- Milk & Dairy Products  ☐
- No  ☐
- Other  ☐

In which of the following food groups have you detected any taste changes?

- Fruit & Vegetables  ☐
- Meat & Meat Products  ☐
- Breads & Cereals  ☐
- Fats & Oils  ☐
- Milk & Dairy Products  ☐
- No  ☐
- Other  ☐

Are there any particular foods or food groups you avoid in your diet?

- Fruit & Vegetables  ☐
- Meat & Meat Products  ☐
- Breads & Cereals  ☐
- Fats & Oils  ☐
- Milk & Dairy Products  ☐
- No  ☐
- Other  ☐
Have you used any methods to change the consistency of any of your foods?

- Mincing
- Pureeing
- Juicing
- Other

Are you taking any regular dietary supplements?

- No
- Vitamins
- Minerals
- Herb Preps
- Others
- Skim Milk Powder
- Canned Supplements
- Amino Acids
- Others

Since being diagnosed with cancer:

Do you have any feelings of nausea?

- Never
- Sometimes
- Often
- Always

To what extent does this interfere with the enjoyment of your life?

0

1 1 1 1 1 1 1 1 1
Not at all
Intense Interference

Do you have any episodes of vomiting?

- Never
- Sometimes
- Often
- Always
Do you have any episodes of diarrhoea?

Never □
Sometimes □
Often □
Always □

Do you have any episodes of constipation?

Never □
Sometimes □
Often □
Always □

Do you have any difficulty swallowing foods?

Never □
Sometimes □
Often □
Always □

Do you have feelings of a dry mouth?

Never □
Sometimes □
Often □
Always □

Do you experience a lack of appetite?

Never □
Sometimes □
Often □
Always □
# 24 Hour Dietary Recall (1)

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<tr>
<th>Breakfast</th>
<th>Morning Tea</th>
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<tbody>
<tr>
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<table>
<thead>
<tr>
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<th>Afternoon Tea</th>
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<table>
<thead>
<tr>
<th>Tea</th>
<th>Supper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Checklist

A. Red meat, White meat, Milk, Cheese, Eggs, Fish, Legumes.
B. Free Vegetables, Fruit - Fresh, Dried, Juice.
C. Potato/Rice/Pasta, Bread, Cereals, Biscuits, Cakes.
D. Butter/Margarine, Cream, Oil, Salad Dressings.
E. Chocolates, Lollies, Icecream, Desserts.
F. Drinks - Alcohol, Soft drinks, Cordial, Water, Tea, Coffee

Activity Level?..........................................................................................................................
Appendix 4
Would you describe your appetite now as:

- Good
- Fair
- Poor

Since commencing radiotherapy,

has your appetite been:

- Remaining Stable
- Increasing
- Decreasing

Are there any foods which you find difficult to eat in any of the following food groups?

- Fruit & Vegetables
- Breads & Cereals
- Milk & Dairy Products
- Meat & Meat Products
- Fats & Oils
- No
- Other

In which of the following food groups have you detected any taste changes?

- Fruit & Vegetables
- Breads & Cereals
- Milk & Dairy Products
- Meat & Meat Products
- Fats & Oils
- No
- Other
Are there any particular foods or food groups you avoid in your diet?

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit &amp; Vegetables</td>
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<td></td>
</tr>
<tr>
<td>Meat &amp; Meat Products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breads &amp; Cereals</td>
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<td></td>
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<tr>
<td>Fats &amp; Oils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk &amp; Dairy Products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
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<td></td>
</tr>
</tbody>
</table>

Have you used any methods to change the consistency of any of your foods?

<table>
<thead>
<tr>
<th>Method</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mincing</td>
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<td></td>
</tr>
<tr>
<td>Thickening</td>
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</tr>
<tr>
<td>Pureeering</td>
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<tr>
<td>Mashing</td>
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<tr>
<td>Juicing</td>
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<td></td>
</tr>
<tr>
<td>Other</td>
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</tbody>
</table>

Are you taking any regular dietary supplements?

<table>
<thead>
<tr>
<th>Supplement</th>
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<th>No</th>
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</thead>
<tbody>
<tr>
<td>No</td>
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<tr>
<td>Vitamins</td>
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<tr>
<td>Herb Preps</td>
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<td>Sustagen</td>
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<td>Skim Milk Powder</td>
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<td>Canned Supplements</td>
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<td>Amino Acids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Do you have any feelings of nausea?

Never  □
Sometimes □
Often □
Always □

Do you have any episodes of vomiting?

Never  □
Sometimes □
Often □
Always □

Do you have any episodes of diarrhoea?

Never  □
Sometimes □
Often □
Always □

Do you have any episodes of constipation?

Never  □
Sometimes □
Often □
Always □

To what extent does this interfere with the enjoyment of your life?

0 10
Not at all Intense Interference

0 10
Not at all Intense Interference

0 10
Not at all Intense Interference

0 10
Not at all Intense Interference
Do you have any difficulty swallowing foods?

Never ☐
Sometimes ☐
Often ☐
Always ☐

To what extent does this interfere with the enjoyment of your life?

0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10
Not at all | Intense Interference

Do you have feelings of a dry mouth?

Never ☐
Sometimes ☐
Often ☐
Always ☐

Do you experience a lack of appetite?

Never ☐
Sometimes ☐
Often ☐
Always ☐
Appendix 5
Distribution by Cancer Site.

Breast 8
Rectum 8
Prostate 5
Lung 4
Brain 2
Groin 2
Bladder 1
Back 1
Arm/Hip 1
Abdomen 1
Endometrium 1
Chest Wall 1
Minimantle 1
Femur 1
Sigmoid 1
Tonsil 1

Total Patients = 39
Appendix 6
Diarrhoea

<table>
<thead>
<tr>
<th>Study Group (No. in Group)</th>
<th>Before Treatment</th>
<th>After Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head &amp; Neck (3)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Chest (14)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Abdomino-pelvic (17)</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
</table>

Pts reporting side effects

- Before Treatment
- After Treatment
Dysphagia

![Graph showing the number of patients reporting side effects before and after treatment for different study groups.](image)
Anorexia

Study Group (No. in Group)

- Head & Neck (3)
- Chest (14)
- Abdomino-pelvic (17)

Pts reporting side effects

- Before Treatment
- After Treatment
Xerostomia

![Bar chart showing the number of patients reporting side effects in different study groups.](chart.png)
### Taste Changes with Therapy

<table>
<thead>
<tr>
<th>Study Group (No. in Group)</th>
<th>Before Treatment</th>
<th>After Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head &amp; Neck (3)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Chest (14)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Abdomino-pelvic (17)</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

- **Pts reporting side effects**

- **Study Group (No. in Group)**
  - Head & Neck (3)
  - Chest (14)
  - Abdomino-pelvic (17)

- **Before Treatment**
- **After Treatment**
Food Avoidance with Therapy