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Title: Malnutrition among pediatric oncology patients aged 2-18 years

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MALNUTRITION AMONG PEDIATRIC ONCOLOGY PATIENTS AGED 2-18 YEARS

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Abstract

Background

In developed countries, cancer has become one of the most popular causes of death-related illness in children and is rising in Trinidad and Tobago. Likewise, cancer related malnutrition and cachexia in this particular population is among the most familiar contributors of death among developing nations. Stages of anticancer treatment within the paediatric population can become very energy consuming and may negatively affect their nutritional status and in turn psychological as well as physical aspects of development. Adequately assessing nutritional status and nutritional habits is therefore of major importance for timely and appropriate nutritional intervention and in turn to prevent associated complications arising from malnutrition and its subsequent cachexia in pediatric oncology patients.

Objective

To assess the magnitude of malnutrition and/or prevalence of nutrient deficiencies in pediatric oncology patients aged 2-18 years.

Methodology

A total of 25 (16 females, 9 males) pediatric oncology patients were interviewed as well as their parents, in some instances using convenience sampling. The data collection was conducted at the outpatient clinic, Mt. Hope, (EWMSC), Eric Williams Medical Sciences Complex, including the completion of a food frequency questionnaire and three-day dietary recall. Data was analyzed using Excel and SPSS 20.0 and the statistical test performed was ANOVA.

Results

There were significant deficiencies in the macro- and micronutrients analyzed in all age groups studied. There was also a high prevalence of undernourishment and malnutrition. There was found to be an insufficient intake of foods containing energy yielding nutrients as well as vitamins and minerals as required to compensate for the children's increased level of energy expenditure. The diet consumed by most patients was of poor nutritional value, insufficient amounts and also noted was the absence of dietary supplements.

Conclusion

High prevalence of undernutrition/malnourishment was found in pediatric oncology patients. The employment of various medical nutrition therapies are needed to treat the existing energy and nutrient deficiencies and thereby reduce the increase in cost of care to the patients' family. Appropriate nutrition intervention can increase the quality of life of the patients' and decrease the risk of morbidity.

Introduction

Background

Cachexia is most commonly known as wasting syndrome, where fat and muscle are diminished or depleted due to the existence of a specific neoplasm or inflammatory process. It denotes a state of nutritive inadequacy and is commonly used in describing patients with unmitigated or chronic diseases such as AIDS, and cancer. Patients who are in this state lose weight/appetite and usually become easily fatigued and weak as a result. Exorbitant losses of body mass inadvertently lead to changes in metabolism, one of which is electrolyte balance.

In cancer, cachexia is often present and can be considered as one of the most devastating symptoms in pediatric oncology. Approximately 75% of children diagnosed with cancer suffer from this condition. Most pediatric patients who suffer with cancer cachexia are those diagnosed with particular carcinomas of the gastrointestinal tract including include tumors of the neck, pancreas and abdomen (The Abramson Cancer Centre of the University of Pennsylvania 2004).

Childhood cancer is the most familiar death related illness afflicting children of ages 1 and 14 years. Prognosis may depend on tumor histology, tumor stage, age of the patient, and various laboratory indices. Treatment options may include chemotherapy, surgery, irradiation and marrow, stem cell or cord blood transplantation. Advances in nutritional support have paralleled improvements in treatment, thus allowing these patients to receive optimum care.

Pediatric nutrition support goals in oncology are usually to promote normal growth and advancement, prevent nutritional deficiencies, minimize death and prolong an associated quality of life. Cancer and cancer cachexia, its associated therapies and any other additional complication ultimately affects the nutritional status of the child.

Protein energy malnutrition (PEM) is a common secondary diagnosis in pediatric patients with cancer. At diagnosis, the incidence ranges from 6% in children with leukemia to as great 50% in children with stage four (IV) neuroblastoma. PEM ultimately results from decreased energy intake, increased energy requirements in addition to malabsorption. The systems most readily affected by protein energy malnutrition are the hematopoietic, gastrointestinal and immunologic systems and, in addition are most sensitive to oncologic treatment.

Multimodal treatments can have an additional adverse effect on nutritional status. For instance, antitumor therapies may produce only mild, transient nutritional disturbances or may lead to severe, permanent problems.

The nutritional consequences of chemotherapeutic drugs may affect normal as well as malignant cells in targeting rapidly dividing cells, such as the epithelial cells of the gastrointestinal tract. Nausea and vomiting are among the most common problems preventing adequate oral intake and may occur as a result of a direct central nervous system effect, as drugs are administered. Complications of chemotherapy-induced emesis include weight loss, dehydration, fluid and electrolyte imbalances and metabolic alkalosis.

Alterations in taste and smell as a result of chemotherapy may persist beyond various bouts of nausea and vomiting, and may, in turn, result in prolonged anorexia. In addition, children may develop food aversions that can limit intake (Helm, Lang, and Samour 1999).

Mucositis; inflammation of a mucous membrane (Merriam-Webster Incorporated, 2013), is a major gastrointestinal complication and is usually intensified by concurrent radiation therapy. This condition may affect almost any part of the gastrointestinal tract and lead to

ulceration, bleeding and malabsorption. Rigorous mouth care prevents additional oral breakdown and in effect, hasten difficulty for the child, in consuming various types of foods.

Surgical removal of a tumor may lead to insufficient oral intake over several days during periods of increased requirements. Certain surgeries of the head and neck can lead to chewing and swallowing problems. Massive intestinal resection may cause malabsorption of vitamin B_{12} or bile acids. Nutritional appraisal of children diagnosed with these types of malignancies is of paramount importance, in that it can adequately identify and treat malnutrition, as well as ensure the appropriate provision of nourishment to effectively promote restoration and added long-term health. It has been shown that when a patient is underweight, this is usually identified in conjunction with higher treatment related mortalities. Alterations in the metabolism of nutrients and changes in body composition in pediatric cancer occur often as an aftermath of the ailment and successive therapies. These alterations can complicate nutritional deficits for children experiencing growth spurts. Relatives of pediatric cancer patients emphasize strongly on weight management and nutritive therapies, both for the crucial psychological aspects of a child's consumption pattern and the potential coadjuvant arbitration with iatrical therapies (Helm, Lang and Samour 1999).

Cachexia as stated previously, is defined as a worsened state of malnutrition evidenced by anorexia and/or loss of appetite, wasting of muscle, inadvertent and in some cases, anaemia. Cancer cachexia also describes varied metabolic events such as anergy, hyperlipidemia, hypoalbuminemia, impaired functioning of the liver, hypoglycemia, lactic acidosis, glucose intolerance with insulin resistance, and skeletal muscle atrophy.

Wasting is classified as uncontrolled loss of weight and is present in many children with chronic disease such as AIDS and cancer. Overall fat free mass is lost, in addition to body weight and is due to the existing energy imbalance caused by the illness. Cachexia, as compared to wasting is the uncontrolled deficit of lean body mass even when there is minimal weight loss in a patient. Thus, children of normal adiposity can still be malnourished and/or cachectic due to a reduction in their lean body mass. In a child, his/her appetite and in turn feeding behaviour is both an essential yet complex activity and is usually displaced by the onset of disease, subsequent treatment, and in addition, the psychological impingement that cancer unfortunately brings upon both the child and his/her family (Duggan, Walker and Watkins 2008).

Purpose of the Study

The purpose of this research was to investigate nutritional habits of pediatric oncology patients aged 2- 18 years.

Rationale

The estimated population of Trinidad and Tobago is 1.3 million. For the period 2001-2006 there were 145 new cases of childhood cancers recorded. Of these, 82 (56.6%) cases were male and 63 (43.3%) cases were female. An estimate of the rate of pediatric cancer is approximately 1.9 per 100 000 persons (Bodkyn and Lalchandani 2010). The Dr. Elizabeth Quamina Cancer Registry states that the figures represented for the period until 2001-2006/7 will continue to increase as their data base is continually updated. These statistics allude to the fact that there is an increasing prevalence of pediatric cancer in Trinidad and Tobago, and is of growing concern to the nation as the health and subsequent wellbeing of the pediatric population is of paramount importance not only for them to enjoy a sustained and prolonged quality of life but, in addition, to reduce economic burden on their relatives and furthermore on the financial cost of the state, which is usually incurred with any chronic illness such as this. Children with cancer have special nutrition needs and often suffer from protein energy malnutrition. The disease itself often results in cachexia. All of these put extra demands on the nutrition of the child. Children are not able to eat regularly due to altered taste, nausea, mucositis and the disturbed routine during therapy. If the child acquires infection or undergoes surgery there is even more nutritional depletion (Carachi and Gupta 2007).

This warrants research into the risk of nutritional deficiencies and/or its prevalence, which may contribute to a malnourished or cachectic state, and in turn, the medical nutrition

therapies among the particular study group. Such an investigation will also allow for an intervention as to the specific risk factors which can then be determined and addressed.

Problem Statement

Clinical nutrient deficiencies amid pediatric oncology patients at Mt Hope, and subsequent cachexia are conceivably increasing. Should this continue unchecked and untreated there will be an ascending trend of malnutrition and cachexia in an affected child's associated quality of life and cost of care will persist and in turn increase, thus prevalence of risk factors and in turn the various medical nutrition therapies that should be employed to reduce cachexia in pediatric oncology patients must be determined.

Objectives

General Objective

To determine the magnitude of undernutrition as well as macro- and micronutrient deficiencies among pediatric oncology patients at the EWMSC, outpatient clinic, Mt Hope. Also, to investigate the association between the independent and dependent risk factors of the macronutrients protein, carbohydrate, fat and energy metabolism as well as the micronutrients zinc, selenium, calcium, phosphorous, potassium, vitamin A, C, and E.

Specific Objectives

- To determine the prevalence of undernutrition in pediatric oncology patients, specifically aged 2-18 years at the EWMSC, Mt Hope.
- To determine the prevalence of macronutrient deficiencies namely protein, carbohydrate and fat in pediatric oncology patients at the EWMSC, Mt Hope.
- To determine the prevalence of micronutrient deficiencies namely calcium, selenium, zinc, potassium and phosphorous in pediatric oncology patients at the EWMSC, Mt. Hope.
- To determine the prevalence of vitamin deficiencies including vitamin A, C and E in pediatric oncology patients at the EWMSC, Mt. Hope.

Hypotheses

- There is increasing prevalence of undernutrition in pediatric oncology patients at the EWMSC, Mt Hope.
- Most of newly diagnosed children with cancer will be malnourished or become malnourished during the course of treatment.
- Malnutrition and subsequent cancer cachexia will negatively impact on the course of the disease and its treatment due to changes in body composition.
- Malnutrition, in many cases, impacts on the sustained potential and long-term quality of life of the survivor of childhood cancer.
- Macronutrient deficiencies are prevalent among pediatric oncology patients at the EWMSC, Mt Hope.
- Micronutrient deficiencies exist among pediatric oncology patients at the EWMSC, Mt Hope.

Literature Review

Cancer is the nomenclature given to define malignancies in which aberrant cells divide beyond restraint and are able to attack and infect various other body organ tissues. When cells become cancerous they can advance to other areas of the body via the lymph systems and blood.

Cancer incorporates many diseases. Over 100 different types of cancer exist and are generally named after the specific organ or cell in which they first manifest. An example may be colon cancer which is a type of malignancy that manifests within the colon of an individual (National Cancer Institute 2012).

Malignant cells contend against other various bodily cells for nutriments and place the body in a mode of being hypermetabolic. This state of elevated nutrient requirement which becomes dissatisfied even by an individual's increased consumption of food in cancer is known as cachexia. This condition is very much different from starvation/deprivation, which can be thought of as hypo metabolism with a declined intake of energy and that may be transposed with a sufficient intake of nutrients. Cachexia resulting from cancer on the other hand is distinguished by a loss of appetite or anorexia, loss of weight, advancing wasting of bodily tissues and anaemia. In many cases the patient may experience altered taste changes especially in bitter or sweet sensations.

Proper nutrition is among the most substantial aspects when a child starts treatment for cancer and cancer-related illnesses. Children suffering from this malignancy commonly experience diminished appetite as a result of the radiation or chemotherapy side effects, hospital environment, stages of depression, or changes in cells of the mouth which adjusts the taste of

food and results in an insufficient absorption of calories, and even vomiting and diarrhoea (Pediatric Oncall 2011).

There are close to 1.2 million current cases of obtrusive cancers diagnosed yearly in the United States alone. Of this figure, approximately 12,000 of those diagnosed affect children (Medscape Reference Drugs, Diseases and Procedures 2011).

For the period 2001-2006 there were 145 new cases of childhood cancers reported in Trinidad and Tobago. Of these 82 were documented to be male and 63 female. It is estimated that the progressive rate of pediatric cancer was 1.9 per 100000 persons (Bodkyn and Lalchandani 2010).

Studies allude to the fact that approximately 46% of children with any type of malignancy suffer from malnutrition as a result of multifarious tumor and therapeutic related factors (Pietsch 2000).

It is widely known that a reduced state of nutrition may be a factor to diminished immune function, disrupted drug metabolism influencing diagnosis and slowed healing of wounds (Tisdale 1997).

Malnutrition is an intangible nomenclature which is used to identify an incompetent state of nutrition. It is differentiated by a deficient or exuberance of energy with calculable negative effects on clinical consequence. Malnutrition therefore, illustrates the consequences of inadequate protein-energy intake. It is necessary to have a satisfactory protein-energy balance as this is a prerequisite for appropriate maintenance and stature for a given age in a child. In a state

of malnutrition, there is also an increased supply of energy, which may result in overnutrition and thereby, an increase in adipose tissue (Bauer, Fruhwald and Jurgens 2011).

The World Health Organization (WHO) advocates the weight-for-height index to determine adequate nutritional status of children. A reduction in body weight of less than or equal to 55 is indicative of acute malnutrition and a height-for-age value below the 5^{th} percentile is reflective of chronic undernourishment in paediatrics (Booth, Smith and Stevens 1991).

Many children and adolescents who are afflicted with cancer and its related effects do not meet these specified standards of criteria. In particular are those with abdominal masses and who may present with a normal weight for age in spite of severe malnutrition. The reduction of minerals and nutrients may be furthermore masked in children who suffer from edema as a result of treatment with corticosteroids. In paediatrics with sufficient or even exorbitant body weight, the loss of lean body mass is usually concealed as fat diminishes or is unchanged while skeletal muscle is usually wasting (Bauer, Fruhwald and Jurgens 2011).

In the progression of wasting in children diagnosed with various neoplastic diseases, energy deficiencies play an all too important role in that there the various hormonal and metabolic alterations, elevated nutrient requirement, elevated use of energy sources as a consequence of aggressive cancer related treatments, alterations in taste and sensations in appetite, e.g. xerostomia, unbearable pain or elevated levels of stress resulting from inevitable procedures and energy wasting which may be caused due to repeated dysfunction of the gastrointestinal system as a result of induced toxicity from cancer therapy (Adiv et al. 2006).

Disruptions in the endocrine system of cancer patients are present usually as insulin resistance and an increased secretion of growth hormone. There is a reduction in thyroid hormone production in malnourished patients with cancer and is brought about by diminished glandular secretion, activation of the sympathetic nervous system, and restriction of nutrients (Burger and Danforth 1989).

The main goals of interventions nutritionally in pediatric oncology patients should encompass the adequate sustenance of body stores as close to the target as possibly can thereby minimizing wasting and the effective promotion of desired growth development and in turn to provide an enhanced quality of life.

Nutrition methods and considerations should be determined for all affected children commencing with the diagnosis of cancer, in order to avert and/or improve anomalies in growth and development, before nutrition and ones' overall status become critically compromised. These nutrition strategies should be interspersed into protocols for cancer treatment and may start immediately after admission separate of a child's initial body weight in order to constitute the vital role of sufficient nutrition in the psyche of not only the child individually, but also the parents and relatives. Assessing the nutritional status is of importance to classify the patient into various nutritional risk groups on the basis of categorical nutritional condition and the actual extent of the illness, taking into consideration both socioeconomic and psychological attitudes in addition to the given multimodal procedures for each type of tumor that is diagnosed (Bauer, Fruhwald and Jurgens 2011).

The disease of cancer and its subsequent treatment modalities on many occasions disturb a child's appetite, willingness to eat, tolerance to various food types and their individual body's

capability to utilize specific nutrients. Consuming the proper types of foods which contain sufficient amounts of macro and micronutrients before, during and after treatment can, in turn, positively benefit the child, by allowing him/her to feel better and remain healthier for a longer period of time.

The way a child's system takes in various foods and utilizes certain minerals can also be negatively affected in cancer and its related treatments. Obtaining the proper amount of nutrients will help the child better tolerate treatment and treatment side effects, heal and have a faster recovery process, undergo reduced risk of infection during various treatment procedures, have greater stamina and increased energy, maintain an appropriate weight and retain their body's supply of nutrients and minerals, have a greater feeling of well-being and enhanced quality of life (American Cancer Society 2012).

Children suffering from cancer need certain amounts of nutrients such as protein, carbohydrates, fat, water, vitamins and minerals. Protein is essential in that it is utilized by the body for growth, maintenance of skin, repairing of tissues, and to enhance the functioning of blood cells, the digestive tract and the immune system.

If children diagnosed and suffering with cancer do not consume the adequate amount of protein for their increased requirements their bodies may eventually begin to deplete muscle in order to obtain the needed "fuel" and contributes to an extended recovery time from disease and can reduce a child's resistance to infection. After a patient has received surgery, chemotherapy or radiation, he/she may require additional protein for tissue healing and to guard against infection (American Cancer Society 2012).

The body's main source of energy are carbohydrates. They provide the calories (fuel) needed for physical activity and appropriate functioning for the organs. Children who get treatment for cancer have a higher requirement for calories in some cases as much as 20-90% more for tissue healing and energy.

Another macronutrient that also plays a major role in the nutritional component is fats, both fats and oils provide an opulent supply of calories (energy) for the body, which then breaks down and utilizes the fat to insulate tissues, stores energy and transports vitamins throughout the bloodstream.

Water and fluids are essential to health and body cells are dependent on water for proper functioning. If the child does not consume a sufficient amount of fluid or in the case of diarrhoea and vomiting in which fluids are lost, he/she is at risk of becoming dehydrated, which in turn may lead to electrolyte imbalances (American Cancer Society 2012).

Currently there are no universally agreed guidelines for nutrition intervention in the pediatric oncology population. In an international survey conducted by the Children's Oncology Group, it was found that no standardized nutrition protocols were being employed for nutrition intervention. Several tools are available to estimate energy and nutrient requirements in children diagnosed with cancer, including age appropriate Dietary Reference Intakes (DRIs) and the World Health Organization's (WHO) equations for basal metabolic rate. The difficulty in estimating nutrient requirements is further augmented by the wide range of pediatric patients and age specific requirements, ranging from an infant weighing about 3 kg with minimal reserves to an obese adolescent weighing 100 kg (Cherry 2011).

The Children's Oncology Group recommends that 1) cancer treatment may increase energy needs by approximately 20% and protein needs by as much as 50%; 2) poor treatment related dietary intake may necessitate a daily multivitamin and mineral supplement to meet daily recommended intake and 3) fluid status should be assessed and monitored to ensure proper hydration (Nieuwoudt 2011).

A child's acceptable psychological and physical growth stems in large, from adequate nutrition during foetal development and development during childhood (Ahmed et al 2008; Coles et al, 2001).

Establishing sufficient nutrition often poses a challenge in anticancer treatment due to the adverse effects of radiation and chemotherapies. Changes include, but are not limited to, taste sensations, anorexia and loss of appetite, nausea, diarrhoea, vomiting, and in many cases mucositis. Thus, pediatric patients receiving anticancer therapy present with an elevated risk for undernutrition as compared to children without the disease.

Malnutrition as defined previously is a status or condition akin to one's nutritional status, and includes an inadequacy of nutrient intake or undernutrition, overnutrition, as well as debilitated metabolism of nutrients (American Society for Parenteral and Enteral Nutrition Board of Directors, 1995).

Immediate malnutrition is associated with an insufficient intake of food, and children who reside in underdeveloped countries are at greater risk for primary malnutrition when diagnosed. Secondary malnutrition is brought about by a diseased condition and a child who

undergoes anticancer therapy becomes at increased risk for this particular classification of malnutrition (Wasting; World Health Organization WHO 1999).

When children are deprived of adequate nutrition for a prolonged period of time, their growth becomes slowed which results in stunting (DeOnis et al 2005).

Protein energy malnutrition which may occur in association with cancer is most often a combination of insufficient consumption in conjunction with stress and catabolism that is brought about by the disease and the subsequent negative effects of the treatment (Barr, Mosby and Pencharz, 2009).

Cancer cachexia is a condition which is well-recognized in causing an accelerated degeneration in body composition. Wasting of lean body mass, skeletal muscle as well as other parts of the body occurs. In addition, there is derangement of whole protein homeostasis with net catabolism, inclusive of a negative balance of nitrogen and a decline in the serum levels of albumin ensues. If left untreated, this condition brings about a quickened deterioration of the child's nutritional well-being and may lead toward a "nitrogen death."In pediatric patients with cancer, cachexia is determined by a few aspects, of which includes the classification of disease, one's socioeconomic position and the various type of treatment involved. Malnourished pediatric patients are at an increased risk complications related to treatment, a diminished lenity toward therapeutic treatments, altered drug metabolism, elevated sensitivity to contagion and feeble clinical aftermath (Betz et al 1995; Donaldson et al 1990). Perdurable physical and mental disablement may accompany malnourished pediatrics as they become older (Kroll 2007).

Food history contains data pertinent to existing dietary orders, diet history (current feeding practices at home, consumption of food patterns, amount and quality of food, type of food preferred, feeding environment and any known allergies to specific foods in addition to various intolerances, if any), and social history (socioeconomic position, caregivers awareness of the patient's status nutritionally and any religious or artistic aspects that may limit food intake). A twenty-four hour diet recall, food frequency questionnaire or a three day food count may be employed to estimate oral intake (Butler, Fraser and Shavlik 2006).

Collecting information via any type of food history data is a low-cost and efficient method of evaluating the child's present feeding habits. It depends upon the caregivers' ability to be able to accurately remember exactly what the child consumes and guesstimates portion sizes. It is of importance to comprehend that fat is classified as being much more energy dense than protein or carbohydrate. Therefore, if energy deficiency becomes problematic, attention should be focussed to the fat content of the child's diet (Barr, Mosby and Pencharz 2009).

In various studies, patients undergoing treatment for cancer has been known to have a diminished capacity of food intake, decreased absorption of nutrients and an elevated demand metabolically (Barocas et al 2005).

In other cases, alterations in taste perceptions have been reported following the application of medications during radiation and chemotherapies and in addition, hematopoietic cell transplantation (Chiodi et al 2000) which leads to malnutrition. Changes in taste perceptions include but are not limited to a heightened level of sourness, bitter or a metallic taste when food is being consumed (Abbas et al 1999; Epstein et al 2002).

One study showed that 82% of patients of all ages undergoing chemotherapy avoided at least one food since starting treatment (Holmes 1993).

Beginning with a diagnosis of cancer, it is imperative to take a multidisciplinary approach among the medical team, along with the patient's family in order to establish an individualized nutrition care plan to prevent or correct nutrient imbalances and growth abnormalities before nutrition status becomes severely compromised. It is important to integrate the nutrition care plan into cancer treatment protocols commencing immediately following admission. (nutrition411.com 2012).

The Pediatric Oncology Clinic in Trinidad and Tobago was formally initiated in the year 2001 and housed at the EWMSC. This clinic is the only established treatment centre for pediatric cancers and serves Trinidad and Tobago as well as neighbouring countries as Guyana and Grenada.

For the period 2001-2006 there were 145 new cases of childhood cancers reported. Of these 82 were documented to be male and 63 female. The prevalence of childhood cancer was found to be 1.9 per 100000 persons (Bodkyn and Lalchandani 2010).

Theoretical Framework

In observing the population being researched there were certain risk factors apparent among the group. The appearance of a malnourished or underweight appearance, low intake of sufficient calories and protein were identified. Even though this is being categorized largely on observation and is yet to be presented as factual, the nutritional intake and malnourished state identify them as being at potential risk for the development of cancer cachexia. Should this occur, it will serve to adversely affect clinical outcome measures, such as the type of treatment and response to it, cost of care and in effect, quality of life in these patients and their families in Trinidad and Tobago. During the period of January 2003 to December 2006 there were 138 reported cases of cancer among the pediatric population, 4 of those cases were cancers of the oral cavity and salivary gland and pharynx (Dr. Elizabeth Quamina Cancer Registry NCR 2012). Thus, nutrition and medical nutrition therapy will play a vital role in the prevention and treatment of malnutrition in all types of cancers diagnosed, and more so, in cancers affecting the oral cavity. Statistics have yet to be published for the period 2007- 2013 however, efforts must be made to stimulate awareness and recommendation of various medical nutrition therapies among the population, their families, and other health care providers about the risk associated with cancer cachexia, what places this particular population and risk and ways in which these risks can be reduced.

Methodology

The target population in this study were children at the Pediatric oncology outpatient clinic EWMSC, Mt. Hope. This included patients aged 2- 18 years. The initial goal as regards to the sample size was to interview as many patients and/or family members as possible, however, the actual number of patients who visit the clinic regularly are few, resulting in the researcher having a sample size of twenty-five (25) subjects to conduct the required study. However, the total number of patients actually registered as diagnosed with cancer in Trinidad and Tobago is one hundred and forty-five; therefore the sample was still appropriately represented.

Sample Selection

Subjects were chosen based on accessibility to the researcher and relatives' openness in participating. The assigned clinic day for pediatric oncology patients was Tuesday between the hours of 8:00 am – 12:00 pm each week and the researcher informed participants and their parents of the study by word of mouth at the clinic itself.

Study Design and Data Collection

The study design was divided into two components; a printed data collection questionnaire and anthropometric measurements. Anthropometric measurements were obtained from the relatives/parents. The questionnaire was further divided into four (4) sections. Section one (1) centred on demographic and anthropometric information and was inclusive of included eight (8) questions. Section two (2) aimed at collecting data on background information about the child's eating habits as well as current medications and medical therapies and consisted of twenty-four questions. Section three (3) was a food frequency questionnaire of twenty (20)

common foods and drinks. Section four (4) consisted of a three- day 24 hour recall. The anthropometric measurements included in the study were height and weight which were obtained from the patients' clinical records and the calculation of BMI using specific growth charts.

Data Collection

The data were gathered over a two month period until the required sample size of twenty-five pediatric patients was met. The questionnaires and subsequent interviews were administered at the clinic itself. Participants' guardians who accompanied them were interviewed.

Interviews were carefully conducted and information obtained about the patients eating habits using a 24 hour dietary recall. This was done for three (3) days, two (2) weekdays and one (1) day of the weekend. All food and drinks consumed during this period were catalogued.

Statistical Analysis

The data gathered was subsequently analyzed using the program Microsoft Office Excel 2007 and the statistical software SPSS 20.0 for windows. A number of statistical tests were used to generate frequencies and calculate means. These tests included ANOVA F test which is commonly used to arbitrate the difference in means. Descriptive statistics were also generated using the SPSS software and these also included statistical tables.

Results

Demographics

Sex

The study consisted of 25 patients with a majority of sixteen (16) females, accounting for 64.0% of all respondents. A total of nine (9) males were recorded in the study accounting for 36.0%.

Ethnicity

As regards ethnicity a majority of 48% (n=12) of the patients were of African descent, while 36% (n=9) were of East Indian descent. Additionally, 16% (n=4) were of other ethnicities.

Age

The majority of 32% (n=8) of the patients were in the age group 1-3 and 4-8 years, 28% (n=7) in the 9-13 group and a minority of 8% (n=2) were between the ages of 14-18 years.

Table 1. Frequencies for anthropometric variable height within sample group

			95% Confidence Int.	95% C.I
Age (yrs)	**Mean (inches)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	26.875	1.823	23.084	30.666
4-8	37.625	1.823	33.834	41.416
9-13	49.714	1.949	45.662	53.767
14-18	39.000	3.646	51.419	66.581

Table 1 shows the mean height of all the patients in the study and are shown to be lower as compared to normal height requirements.

Table 2. Frequencies for anthropometric variable weight within sample group

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (lbs)**	**Std. Error.**	**Lower Bound**	**Upper Bound**
1-3	14.763	3.829	6.800	22.725
4-8	26.375	3.829	18.413	34.337
9-13	51.271	4.093	42.759	59.784
14-18	87.500	7.658	71.575	103.425

Figure 2 shows the comparison of weight amongst the different age groups. It showed that they were all underweight for their approximate ages.

Table 3. Frequencies for anthropometric variable BMI within sample group

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (BMI)**	**Std. Error.**	**Lower Bound**	**Upper Bound**
1-3	14.313	.245	13.804	14.821
4-8	13.150	.245	12.641	13.659
9-13	14.214	.262	13.670	14.758
14-18	17.550	.489	16.532	18.568

Table 3 shows the frequencies for BMI between the different age groups. Patients in age group1-3 had a mean BMI value of 14.313 which showed that they were at the 7th percentile. Although this is not considered underweight, it places them at risk of becoming underweight if intervention is not taken. Patients in both age groups 4-8 and 9-13 had BMI values which fell below the 5th percentile; this indicates that they were underweight. Patients in age group 14-18 both had BMI values that fell below the 10th percentile, which places them at risk of becoming underweight as well.

Table 4. Energy consumption stratified by age (kcal)

			95% Confidence Int.	95% C.I
Age (yrs)	**Mean (kcal)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	1061.500	67.223	921.702	1201.298
4-8	1388.063	67.223	1248.264	1527.861
9-13	1308.314	71.865	1158.864	1457.765
14-18	1338.850	134.446	1059.253	1618.447

Table 4 shows the consumption of energy between different age groups ranging from ages 1-18. Consumption of calories was the highest among age group 14-18, while age group 1-3 consumed the lowest amount of calories.

Table 5. Carbohydrate consumption stratified by age (g/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (g)**	**Std. Error.**	**Lower Bound**	**Upper Bound**
1-3	111.050	3.895	102.950	119.150
4-8	121.038	3.895	112.937	129.138
9-13	120.057	4.164	111.398	128.717
1418	120.000	7.790	103.800	136.2000

Table 5 shows the consumption of carbohydrate between different age groups. Intake of carbohydrate was the highest among age group 4-8, whereas age group 1-3 consumed the least amount.

Table 6. Fat consumption stratified by age (g/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (g)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	71.638	6.223	58.696	84.579
4-8	58.800	6.223	45.859	71.741
9-13	60.343	6.653	46.508	74.178
14-18	68.450	12.446	42.567	94.333

Table 6 shows consumption of fat between different age groups. Consumption of fat was highest among children of age 1-3 and lowest among children aged 4-8.

Table 7. Protein consumption stratified by age (g/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (g)**	**St. Error**	**Lower Bound**	**Upper Bound**
1-3	11.788	1.829	7.985	15.590
4-8	18.713	1.829	14.910	22.515
9-13	23.443	1.955	19.377	27.508
14-18	15.850	3.657	8.244	24.456

Table 7 shows the consumption of protein among different age groups. It was found that children of ages 9-13 consumed the highest amount of protein whereas age group 1-3 consumed the lowest.

Table 8. Fiber consumption stratified by age (g/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (g)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	7.875	2.034	3.644	12.106
4-8	15.550	2.034	11.319	19.781
9-13	16.286	2.175	11.763	20.808
14-18	20.500	4.069	12.039	28.961

Table 8 showing consumption of fiber between different age groups. Consumption of fiber was the highest in age group 14-18, whereas in age group 1-3, it was the lowest.

Table 9. Calcium consumption stratified by age (mg/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (mg)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	403.300	63.573	271.094	535.506
4-8	563.662	63.573	431.456	695.869
9-13	1051.614	67.962	910.280	1192.949
14-18	1188.000	923.587	923.587	1452.413

Table 9 shows consumption of calcium between different age groups. The intake of calcium by children aged 14-18 was shown to be highest, while age group 1-3 had the lowest consumption pattern.

Table 10. Potassium consumption stratified by age (mg/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (mg)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	1.611	.271	1.047	2.175
4-8	1.384	.271	.820	1.948
9-13	2.129	.290	1.526	2.732
14-18	1.895	.542	.767	3.023

Table 10 showing consumption of potassium between different age groups. Consumption of potassium by children aged 4-8 was lower as compared to age 9-13 in which the intake was the highest with a mean value of 2.129.

Table 11. Phosphorous consumption stratified by age (mg/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (mg)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	232.113	39.843	149.255	314.970
4-8	364.175	39.843	281.318	447.032
9-13	899.814	42.593	811.236	988.392
14-18	822.400	79.685	656.686	988.114

Table 11 shows consumption of phosphorous between different age groups. Consumption of phosphorous by children ages 1-3 was the lowest (mean intake 232.113) as compared to age group 9-13 which was found to be the highest with a mean intake of 899.814.

Table 12. Zinc consumption stratified by age (mg/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (mg)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	2.516	.435	1.612	3.421
4-8	1.425	.435	.512	2.329
9-13	2.657	.465	1.690	3.624
14-18	5.750	.870	3.941	7.559

Table 12 showing zinc consumption between different age groups. The mean intake of 1.425 in age group 4-8 was the lowest when compared to the mean intake of 5.750 in age group 14-18 which was shown to be the highest.

Table 13. Vitamin A consumption stratified by age (mcg/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (mcg)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	213.959	31.259	148.952	287.966
4-8	315.213	31.259	250.206	380.219
9-13	267.900	33.417	198.405	337.395
14-18	501.000	62.518	370.986	631.014

Table 13 showing consumption of vitamin A between different age groups. The intake of Vitamin A was the lowest in children of age group 9-13 (mean value 267.900), and was the highest in age group 14-18 (mean intake 501.000)

Table 14. Vitamin C consumption stratified by age (mg/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (mg)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	12.800	6.709	-1.152	26.752
4-8	22.688	6.709	8.735	36.640
9-13	27.286	7..172	12.320	42.201
14-18	76.800	13.418	48.896	104.704

Table 14 showing consumption of vitamin C between different age groups. Consumption of vitamin C was the highest in children of age 14-18 (mean value 76.800), whereas in age group 1-3, showed the lowest intake (mean value 12.800).

Table 15. Vitamin E consumption stratified by age (mg/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (mg)**	**Std. Error**	**Lower Bound**	**Upper Bound**
1-3	3.550	.595	2.313	4.787
4-8	3.650	.595	2.413	4.887
9-13	5.714	.636	4.392	7.037
14-18	10.000	1.190	7.526	12.474

Table 15 showing vitamin E consumption between different age groups. Consumption of vitamin E was the highest in age group 14-18 (mean value 10.000) and lowest in age group 1-3 (mean value 3.550).

Table 16. Water consumption stratified by age (L/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (l)**	**Std. Dev**	**Lower Bound**	**Upper Bound**
1-3	.915	.108	.690	1.140
4-8	1.310	.108	1.085	1.535
9-13	1.737	.116	1.496	1.978
14-18	1.700	.216	1.250	2.150

Table 16: Showing water consumption between different age groups. Ingestion of water was the highest in age group 9-13 (mean value 1.737) and lowest in age group 1-3 (mean value .915).

Table 17. Selenium consumption stratified by age (mcg/d)

			95% Confidence Interval	95% Confidence Interval
Age (yrs)	**Mean (mcg)**	**Std. Dev**	**Lower Bound**	**Upper Bound**
1-3	14.000	1.475	10.934	17.066
4-8	18.138	1.475	15.071	21.204
9-13	21.829	1.576	18.550	25.107
14-18	22.700	2.949	16.567	28.833

Table 17 showing the consumption of selenium between different age groups. It was found that patients in the age group of 14-18 years had the highest intake of selenium in their diet, as compared to patients in the age group of 1-3 who consumed the lowest amount.

Caloric classification (age group 1-3 years)

All the patients studied had energy consumption that fell below the normal range of 1165 kcal for girls and 1230 kcals for boys.

Figure 1 displays the calorie consumption patterns within the subjects.

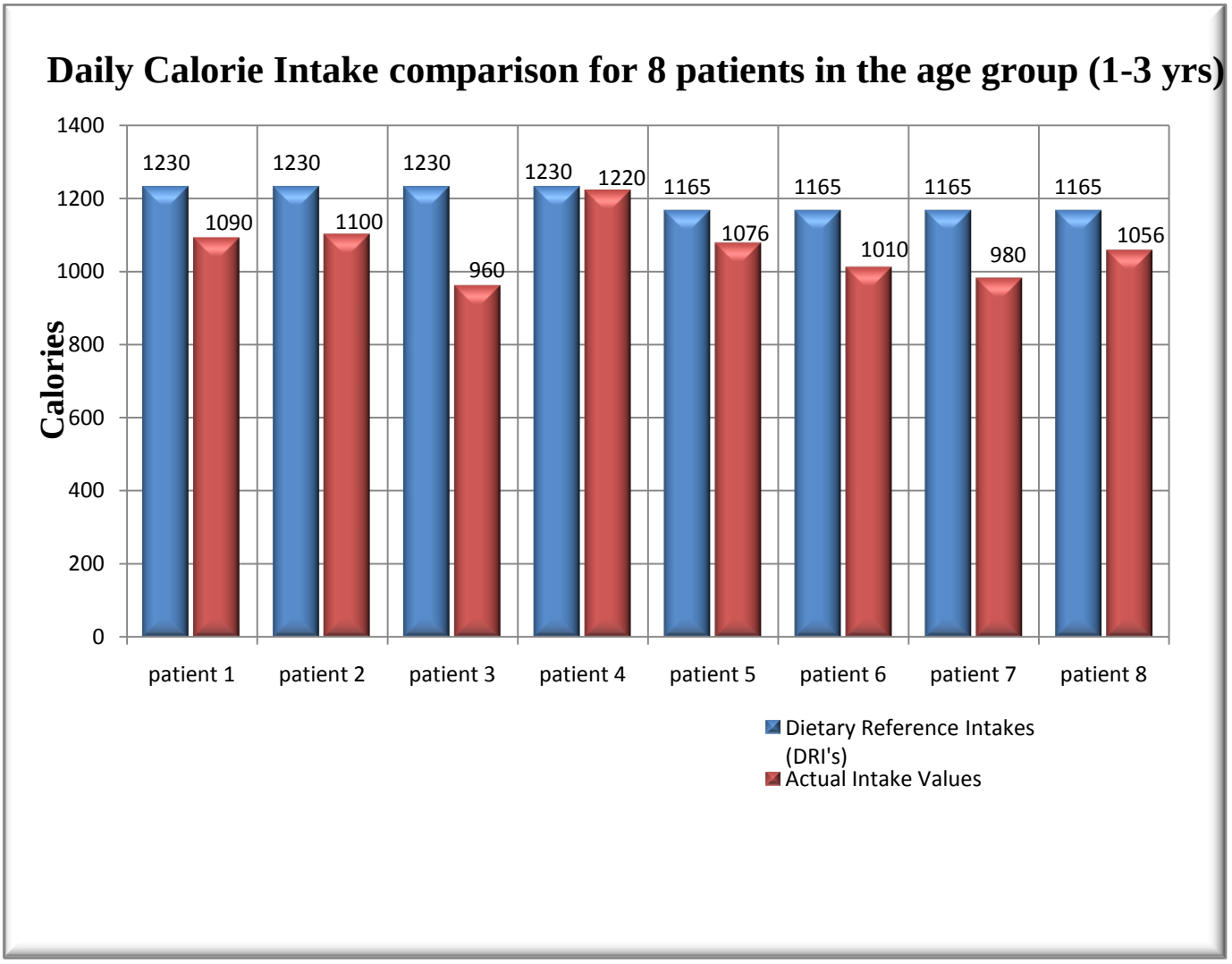

Figure 1: Bar graph showing recommended energy intake compared to actual intake by patients aged 1-3 years

Macro- and micronutrient classification (age group 1-3 years)

All the patients in age group 1-3 had nutrient intakes which fell below the normal range of the daily requirement.

Figure 2 displays the nutrient categories within the subjects.

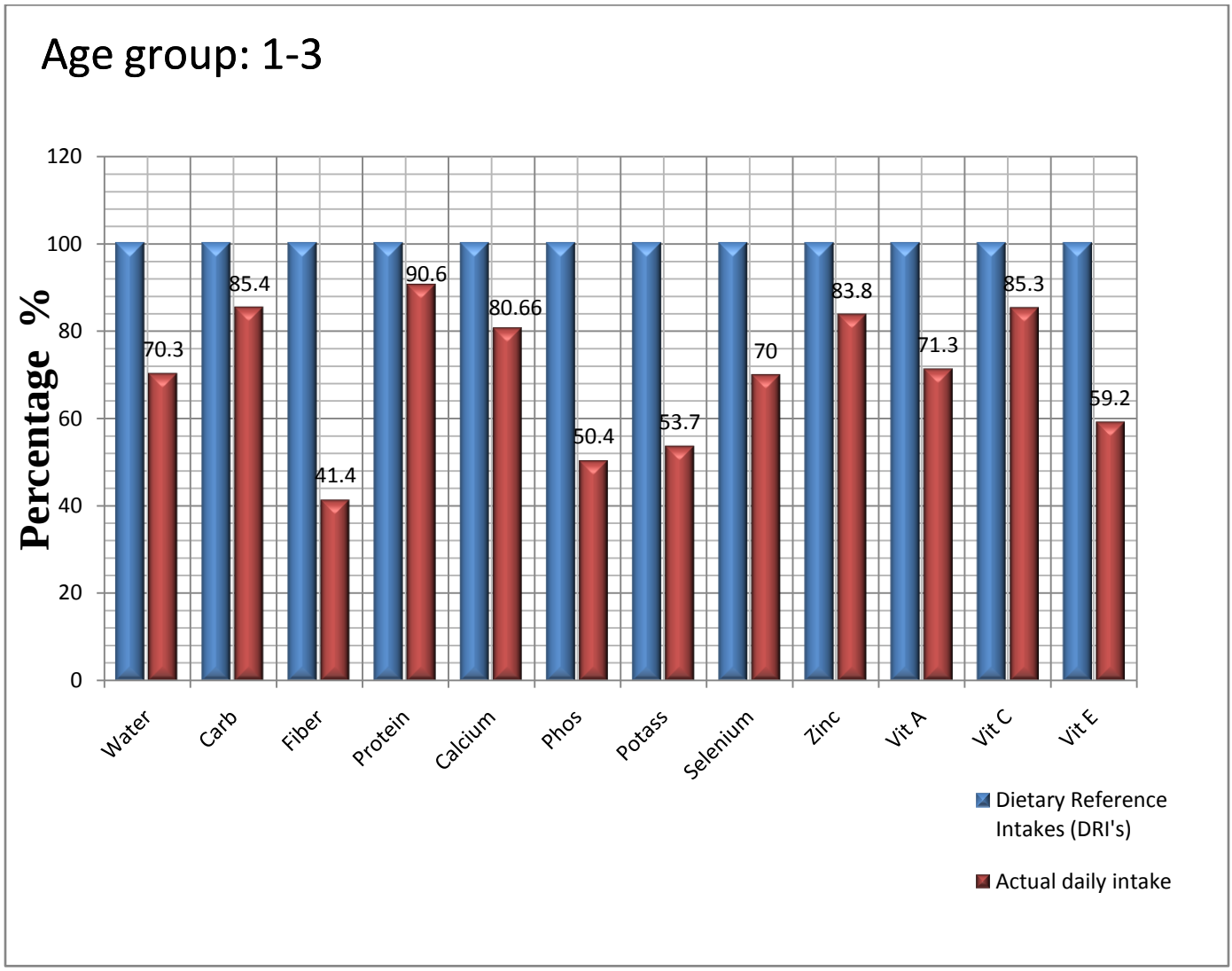

Figure 2: Bar graph showing recommended nutrient intakes as compared to actual intake by patients aged 1-3 years

Calorie classification (age group 4-8 years)

The patients in age group 4-8 consumed a diet that was insufficient of the recommended calorie intake.

Figure 3 displays the caloric classification within the subjects.

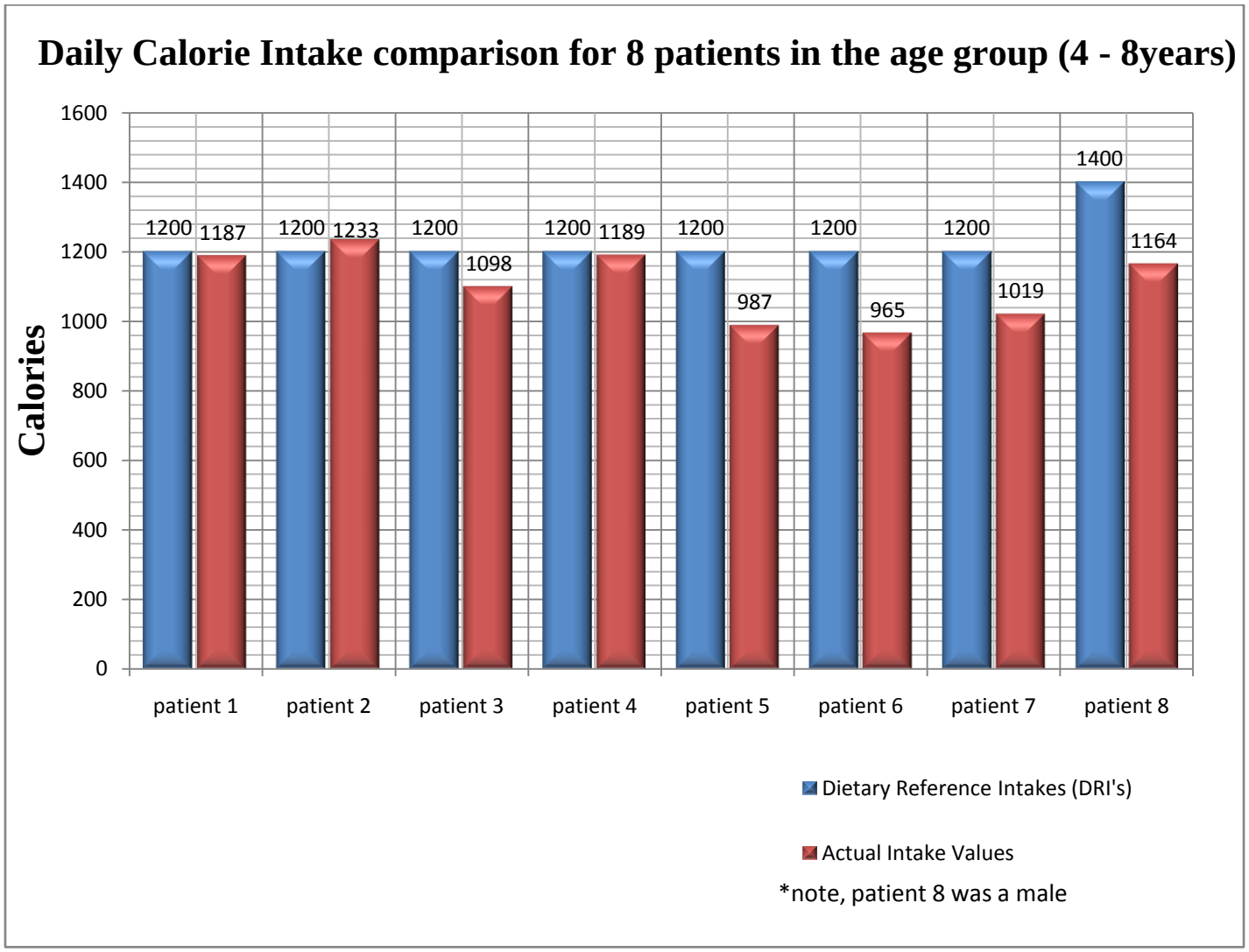

Figure 3: Bar graph showing recommended energy intakes as compared to actual intake by patients aged 4-8 years

Macro- and micronutrient classification (age group 4-8 years)

All of the patients studied had both macro- and micronutrients intakes that fell below the dietary reference intakes: recommended intakes for individuals.

Figure 4 displays the macro- and micronutrient consumption patterns within the subjects.

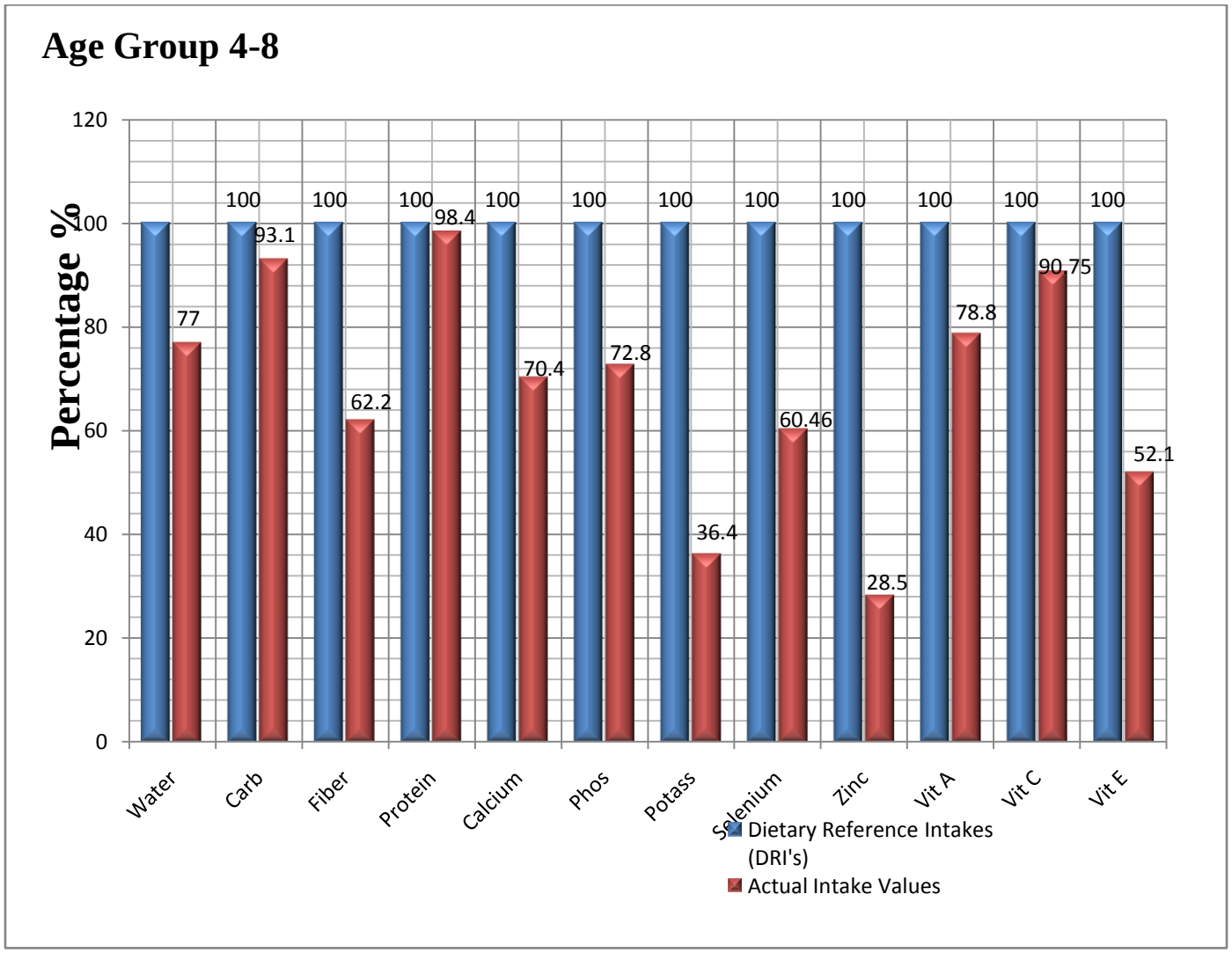

Figure 4: Bar graph showing the intakes of nutrients as compared to the recommended dietary allowance (%)

Calorie classification (age group 9-13 years)

All the patients had a calorie consumption that fell below the recommended daily requirement, with the exception of patient 6 who met his requirement.

Figure 4 displays the caloric consumption within the subjects.

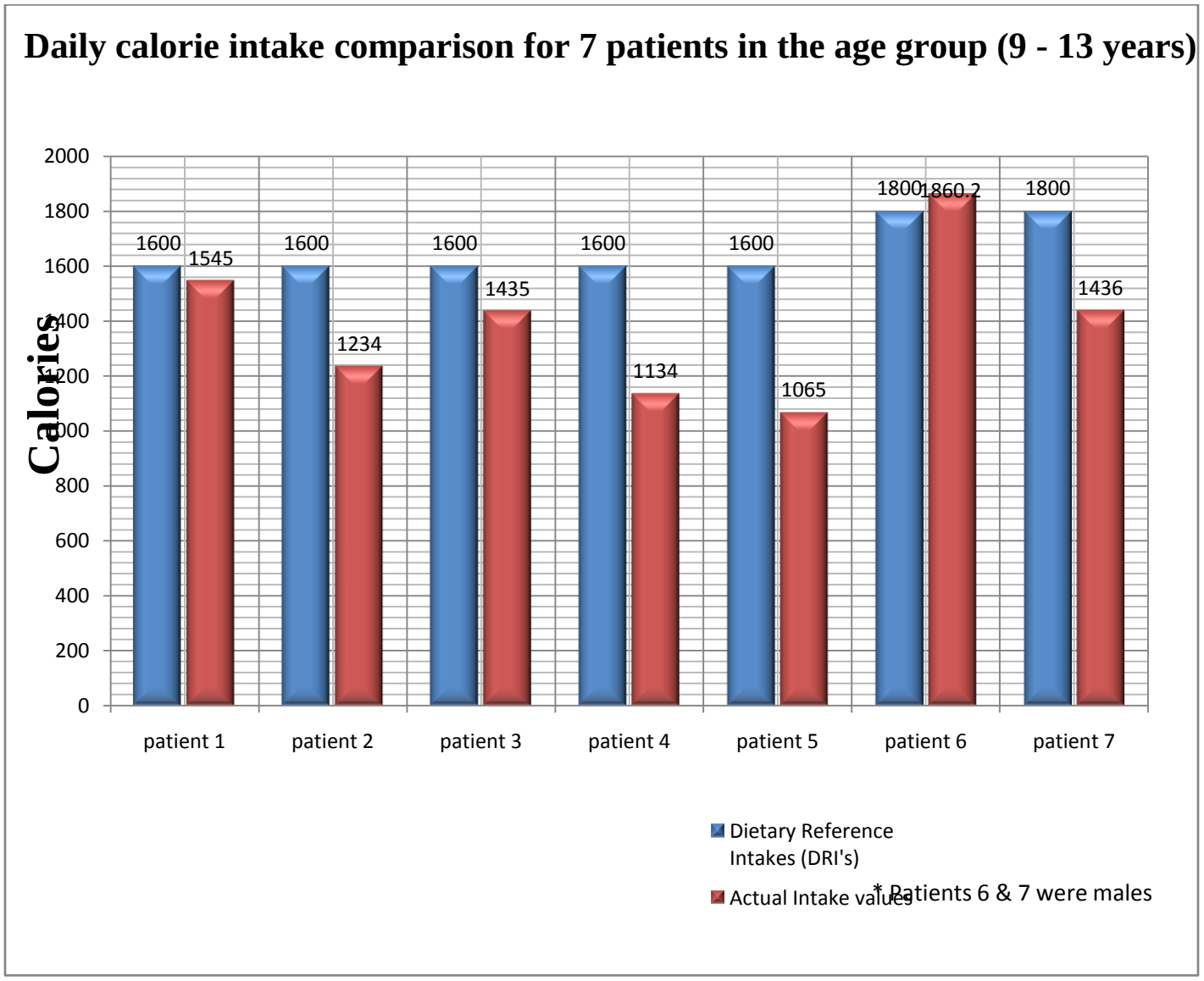

Figure 4: Bar graph showing intake of energy by patients of each classified age group

Macro- and micronutrient classification (age group 9-13 years)

All of the patients had both macro- and micronutrient intakes that fell below the dietary reference intakes: recommended intakes for individuals.

Figure 5 displays the macro- and micronutrient classification within the subjects.

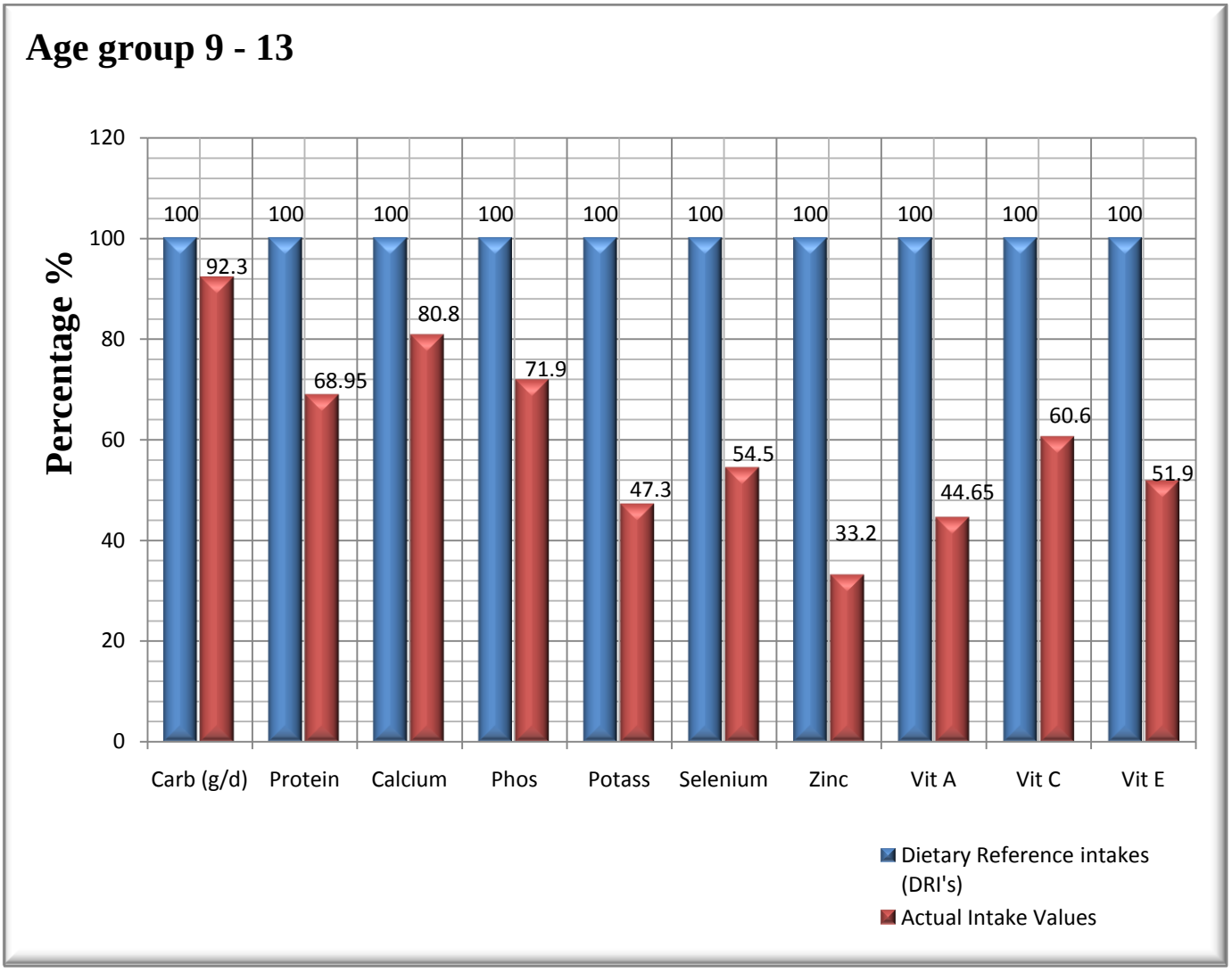

Figure 5: Bar graph showing consumption of nutrients as compared to the recommended dietary allowance (%)

Comparison of water intake (age group 9-13 years)

All of the patients in age group 9-13 had a water intake that fell below the dietary reference intake: recommended intakes for individuals.

Figure 6 displays the water consumption within the subjects.

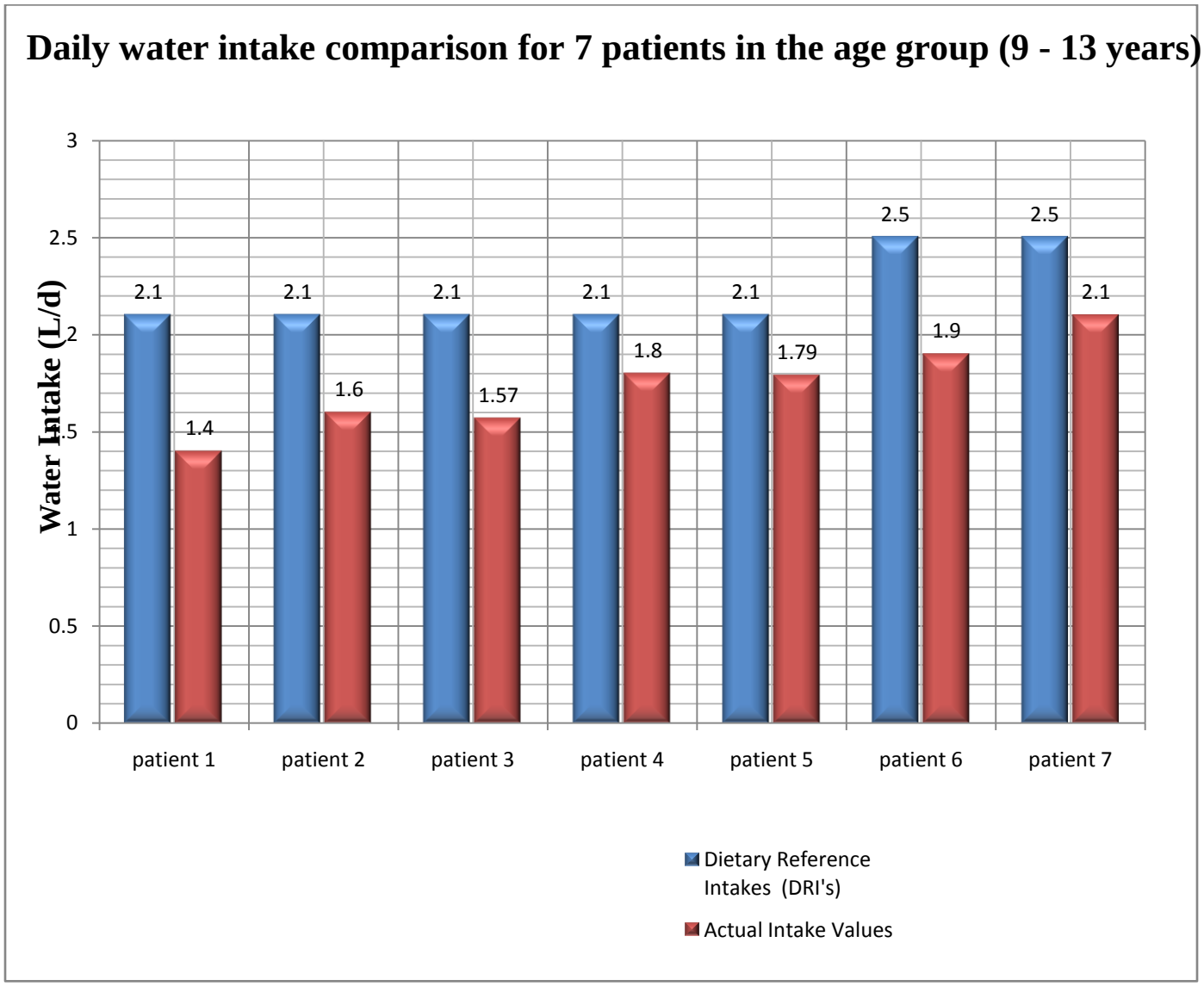

Figure 6: Bar graph showing water intake of patients in the age group 9-13 years

Comparison of fiber intake (age group 9-13 years)

All the patients had a fiber intake that fell below the dietary reference intake for fiber.

Figure 7 displays the fiber comparison within the subjects.

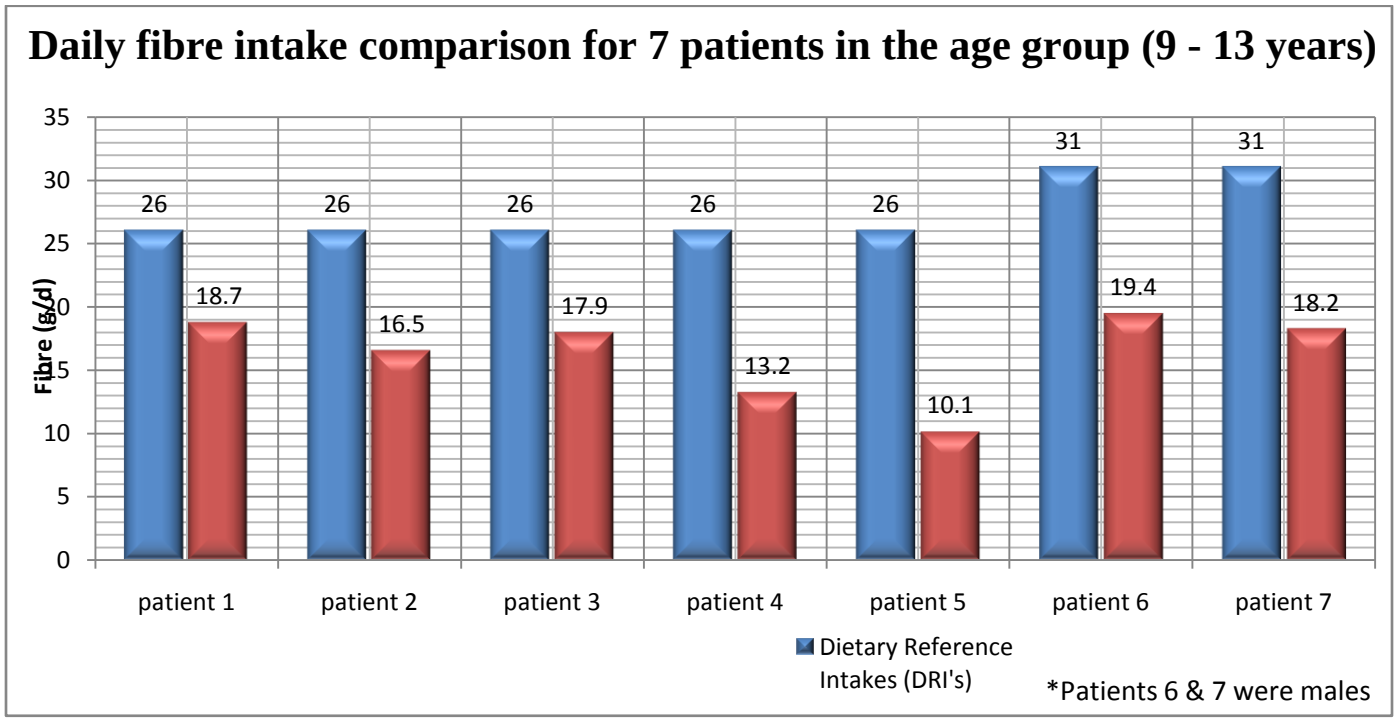

Figure 7: Bar graph showing intake of fiber by patients in each classified BMI group

Calorie classification (age group 14-18 years)

The patients had a daily calorie intake of less than the recommended amount.

Figure 8 displays the calorie classification within the subjects.

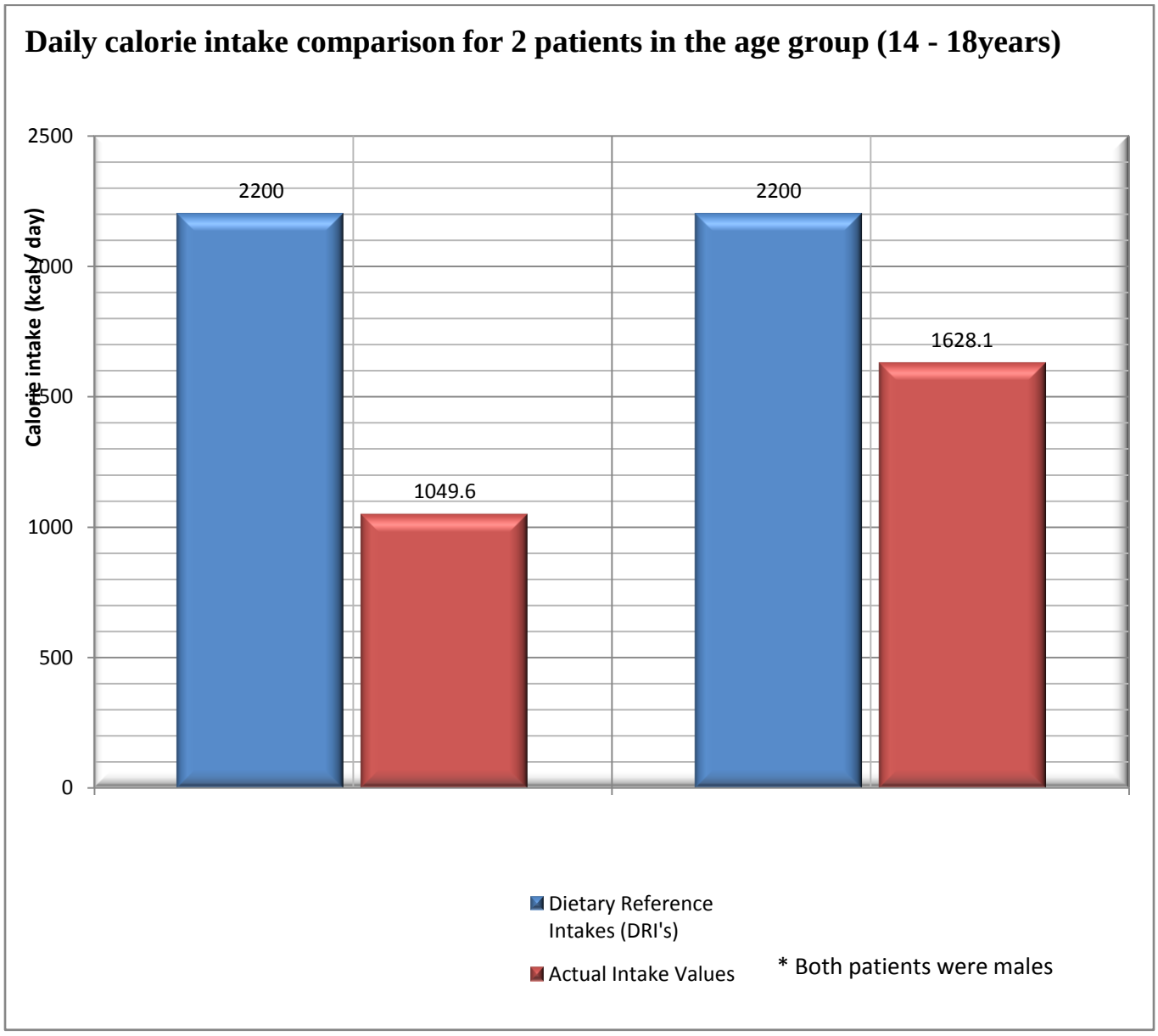

Figure 8: Bar graph showing energy intake in the classified group

Macro- and micronutrient classification (age group 14-18 years)

All the patients had an insufficient intake of both macro- and micronutrients with the exception of vitamin C and fat intake.

Figure 9 displays the nutrient classification within the subjects.

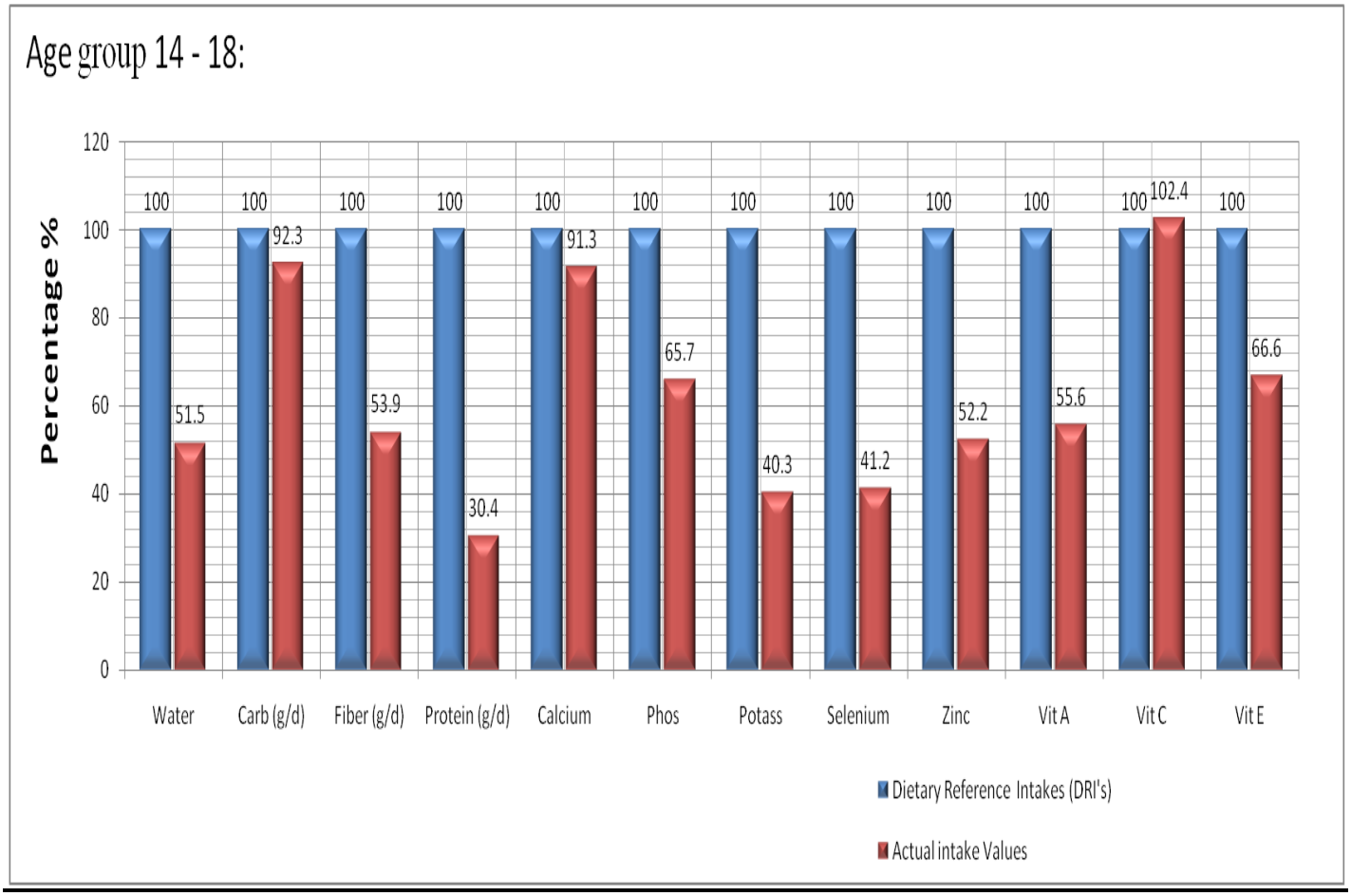

Figure 9: Bar graph showing macro- and micronutrient intake in the classified group as compared to the recommended dietary allowance (%)

Classification of fat intake (all age groups)

All the patients studied had a fat intake that was higher than the recommended amount.

Figure 10 displays the classification of fat within the subjects.

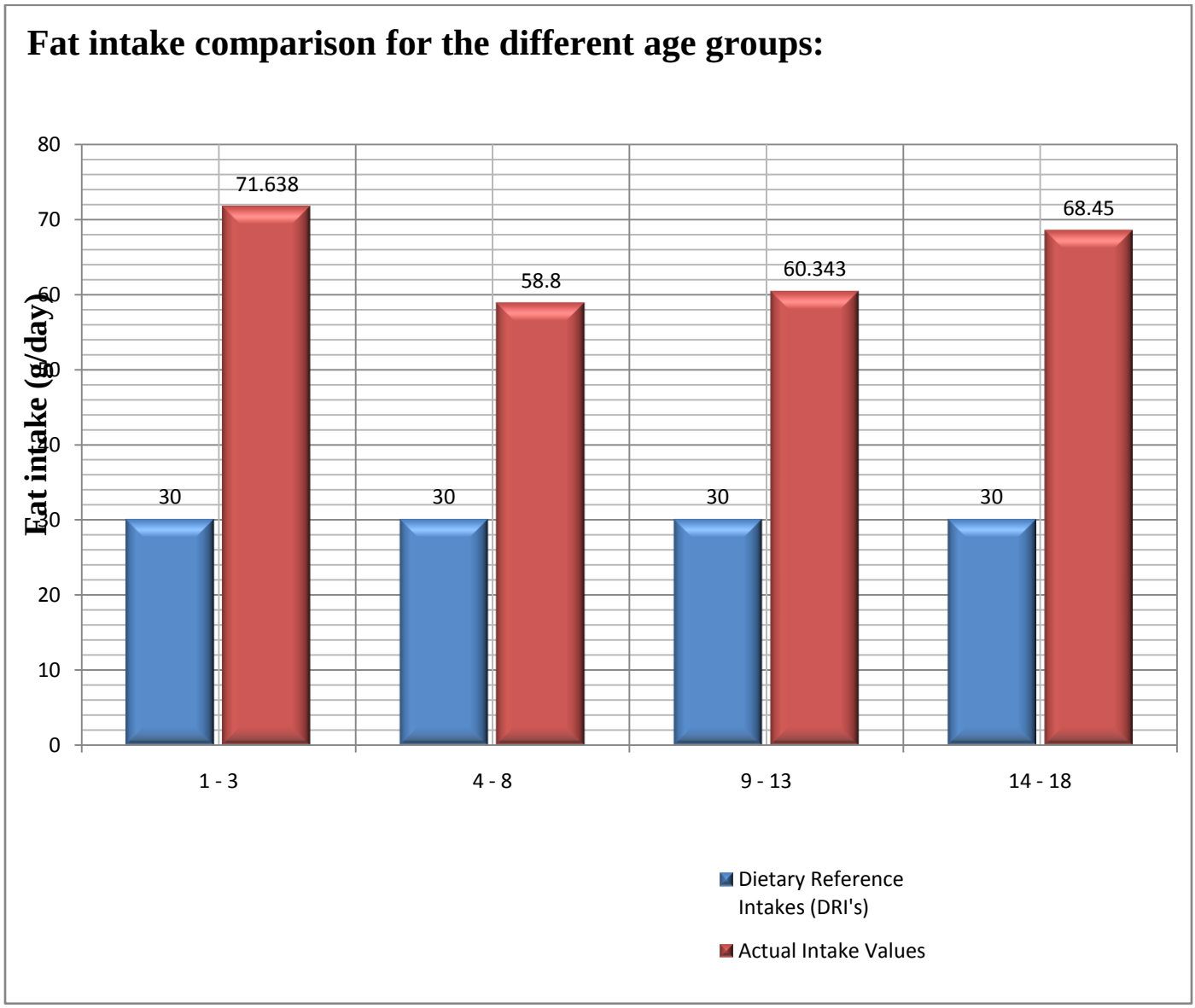

Figure 10: Bar graph showing fat intake by patients

Discussion

The mean weight of oncology pediatric patients examined in this study was 14.763 for age group 1-3, 26.375 for age group 4-8, 51.271 for age group 9-13 and 87.500 for age group 14-18. These values are below the normal weight as compared to healthy children of comparable ages. No additional weight loss was observed in these patients during the period of study which was completed over a two (2) month duration however, this time period was not sufficient to adequately observe significant weight loss. There have not been any studies of this kind to date in Trinidad and Tobago, and is a pioneer research in this critical area. Loss of weight and inability to gain weight regularly in childhood cancer are attributed to a negative balance of energy and changes in metabolism and are frequent adverse effects of cancer. Energy balance is negative due to diminished intake, elevated expenditure, or a combination of both. Alterations in the metabolism of carbohydrate may include uptake of glucose by tumor and relative insulin resistance. Changes in the metabolism of protein involve the uptake of amino acids by the tumor itself. As a result, these changes in metabolism end in growth failure in pediatric oncology patients. In cancer patients, either reduced caloric intake or increased caloric expenditure or a combination of both results in negative energy balance, cessation of growth and weight loss. Based on observation and initial interviews with the parents of the study population, it was seen that, risk factors, such as protein energy malnutrition and subsequent cancer cachexia might have been present; prompting the need to intervene with appropriate medical nutrition therapies among these subjects.

On average, the subjects in this study do not follow very healthy dietary patterns. None of the children met the dietary requirements of macro- and micronutrients that were analyzed with

the exception of fat. This may be due to socioeconomic reasons as well as higher energy requirements of the children due to their malignancies.

The findings from this study suggest that currently there is an insufficient intake of energy among the pediatric cancer patients at the EWMSC who were studied. Food consumption may be considered to be insufficient either in absolute terms or in terms relative to an increased energy use. The increased energy expenditure of cancer patients includes energy expenditure within the tumor and energy demands placed on host by the presence of the tumor. If increased amounts of food need to be ingested and digested, this may increase energy utilization within the digestive system (DeWys 1982).

According to the analysis, it was shown that the patients were consuming more fat than the required 30% recommended in their diets, however, not in epidemic amounts. During interviews it was surprisingly found that the patients consumed a fair amount of fast foods than traditionally home-cooked meals. Information from the National Food Consumption Survey indicates that children coming from low socioeconomic backgrounds consume a large proportion of daily calories as fat. Present U.S. dietary guidelines advise a value of no greater than 30% of dietary energy from total fat. In 1991, these guidelines were endorsed by the NCEP report of the Expert Panel on Cholesterol Blood levels in adolescents and children. The National Cancer Institute, the American Cancer Society and others are of the view that it is imperative to have a diminished level of total and saturated fat in childhood.

Children suffering from malignancy show loss of body fat; free fatty acid turnover and lipolysis is increased. Lipogenesis is decreased in these children. Hence, sufficient dietary fat is important to provide essential fatty acid deficiency and to provide energy as fats help to increase

the caloric density of food. Fat malabsorption may occur in malnourished children (Carachi and Gupta 2007).

After the initial mutagenic steps, mitotic activity is stimulated by dietary fat and in effect, promotes cancer growth. Spontaneous mutations can also be locked in by dietary fat (Duggan, Walker and Watkins 2003).

Alterations in the metabolism of carbohydrate, protein and fat have been evidenced in the host bearing cancer. Neoplasms seem to absorb glucose by anaerobic glycolysis generating lactic acid, in which the patient's liver metabolizes and then converts once again to glucose. This becomes a cycle of energy-loss (Picton 1998). These changes can result in diminished stores of lipids, and changes in the metabolism of carbohydrate, thereby resulting in a loss of energy. There is also an elevated protein turnover rand a deficit of the routine compensatory mechanisms normally identified in starvation. The end result is a loss of weight, and in particular, lean body mass, which clinically manifests clinically as malnutrition or protein energy malnutrition (Barr, Pencharz and Sala, 2004).

When analyzed by ANOVA, it was shown that for all age groups their intake of carbohydrate and protein were insufficient. This might have been due to and inadequate intake of foods such as wheat, potato, legumes and insufficient foods of animal origin. In addition, in cancer patients glucose is converted into lactate by the sarcoma. The lactate then becomes reused by the liver, at an abundant cost of energy. This process, also known as the Cori cycle, is greatly increased in patients with advanced cancer (Holroyde and Reichard1981). It requires the use of muscle proteins, as well as a large proportion of amino acid intake, for gluconeogenesis. Additionally, there is an inexorable decline in total body fat which may also be attributed to the

formulation of cachectin and tumor necrosis factor by the common macrophages in reaction to the tumor (Theologides 1986). Individuals with cancer often present with an energy imbalance, elevated disintegration of fat and protein inclusive of energy-consumptive alterations in the metabolism of carbohydrate. The end result is a net energy loss. The consequence is weight reduction, and in particular lean body mass including breakdown of protein and decreased synthesis of albumin (Picton 1998), (Bistrian 1986). These deficiencies of both carbohydrate and protein may be corrected by educating the parents to introduce foods that are of higher carbohydrate and protein value such as, foods of animal origin, yogurt, nuts and seeds, oatmeal, bran muffins etc.

When the mean intake for total water and fiber were compared, it was shown that all age groups consumed less than the dietary reference intakes recommended. These findings are also in collaboration with current estimates of dietary fiber intake which shows that they are much lower than recommended levels for a large portion of the US pediatric population (Baldwin 2006).

The low intake of water and fiber in the study population was most likely to be due to the minimum amount of fruit and vegetable intake was consumed as well as water. Many frequent scenarios in the treatment of cancer may lead to an alteration of electrolyte imbalance and hydration status. When there is prolonged illness or diarrhea related to treatment effects and in addition episodes of nausea accompanied by vomiting, hydration status most often becomes compromised (Eremita 2001). Pain, both chronic and acute can also negatively affect appetite and furthermore the desire to eat and drink. One of the primary signs of dehydration is fatigue and is a frequent complaint in cancer patients (Newton 2001).

Less than three bowel movements each week is classified as constipation (Vickery 1997). Among pediatric cancer patients, this is a very recurring problem and in many instances is brought about by inadequacy of sufficient fluids or dehydration, deficiency of fiber in the diet, immobility or being physically inactive, chemotherapy and various other anticancer treatments, and certain medications that are used to treat the adverse effects of anticancer therapy. Examples include opioids and antiemetics (Aapro et al 2002). Additionally, frequently used pharmacologic agents may contribute to constipation including minerals, for instance, calcium and iron, antihypertensives and various other nonsteroidal anti-inflammatory drugs (Vickery 1997).

The mean values for all age groups showed a deficient intake in specific micronutrients analyzed namely calcium, selenium, zinc, phosphorous, potassium, vitamin A, E and vitamin C.

The metabolism of zinc is frequently displaced in patients with cancer. Zinc redistribution can be mediated by the acute-phase response and can accumulate in skeletal muscle tissue and thereby contribute to the stimulation of the ubiquitin - proteasome pathway that is involved in the regulation of the catabolism of protein. Zinc becomes deprived in various tissues and organs in this chronic readjustment and in turn critical physiological functions in the patient's body becomes compromised. The defining symptoms of Zn deficiency include loss of appetite or anorexia, failure to thrive in children, systemic inflammation, and hypogonadism. Cancer cachexia is also classified by these symptoms (Siren 2010).

As stated, in pediatric patients suffering from cancer, the metabolism of certain metals, most notably zinc, is compromised. Urinary zinc is increased along with a variety of neoplasms, such as lung cancer and melanoma. Decreased levels of zinc were documented in the serum and tissues in pediatric patients diagnosed with lymphoma, sarcomas of the central nervous system,

malignant bone neoplasms and leukemia (Arnaud, Burtschy and Malvy 1997). In cases where nutrient intake is insufficient zinc deficiency may occur.

Deficiencies in the mineral selenium have also been documented in diagnosed patients with cancer, and in particular those who are chronically malnourished or may be in a state of dependence on nutrition support at home. Among pediatric patients who are newly diagnosed selenium deficiency is frequently found, even if malnutrition is absent at the time of diagnosis (Cunzhi et al 2003).

The mean intake for calcium and phosphorous levels were all insufficient. Calcium and phosphorous are important minerals which are depleted. Many children may develop milk aversion or cannot tolerate a high milk diet and thus miss one of the most important sources of calcium and phosphorous (Carachi and Gupta 2007).

Gastrointestinal disorders, cancer and heart disease are all associated with low potassium levels. The results from the study showed that there is low intake of potassium in the diet of the population and deficiencies exist. Children who suffer with inadequacies of potassium often present with weakness of the muscles and even muscle paralysis, which interfere with normal breathing mechanisms, thereby causing respiratory failure. Benign symptoms are of more prevalence and involve aching muscles, drier than normal skin, cramping, and lethargy (Livestrong.com 2010). Treatment may involve, administering a potassium supplement to the child, or increasing the intake of high potassium foods in the child's diet, such as bananas, nuts, and green, leafy vegetables (WebMD 2010).

The mean intake for all age groups was insufficient for vitamin A, E, as well as for vitamin C. However, the age groups of 1-3 and 14-18 met the required dietary reference intake of vitamin C. Studies on vitamins acknowledge decreased levels in association with similar

malignancies. Diminished levels of vitamins and minerals were present in various cancer sites mentioned; vitamin A levels in pre-treatment pediatric leukemia and lymphoma (Arnaud et al 1997); vitamin E in pediatric leukemia, malignant bone tumors, lymphoma, and central nervous system neoplasms (Arnaud et al 1997).

The adequate intake of vitamin C in age group 1-3 and 14-18 might be due to higher consumption of fruit and vegetables.

An appropriate multivitamin and mineral supplement commensurate to the patient's nutritional needs may be advised and recommended for any patient presenting with insufficiencies of vitamin and mineral intake.

Limitations

In conducting this study the researcher encountered several limitations which may have inadvertently affected the findings of the research. Some of these limitations are listed as follows;

- The research conducted was the first of its kind therefore comparison groups in Trinidad and Tobago could not be located.
- Many interviewees and family members became frustrated with the prospect of conducting a survey with their child.
- 95% of the study population interviewed did not have a clear understanding of the type of questioning involved and the researcher had to spend extra time explaining the different questions, its relevance and use in the study.
- The researcher was met with hostility by some of the patients' family members, most of whom were distraught by the illness of their child, thus care had to be taken to explain the value and relevance of the questionnaire.
- The operating hours of the pediatric oncology clinic is only once per week for two (2) hours, thus time was a very limiting factor in trying to conduct several interviews in a short period of time.
- The researcher was met with various time constraints resulting in a reduced period in which to collect necessary data.
- The researcher was met with financial constraints.

Recommendations

- Oral nutrition is considered to be the preferred method of feeding and should be encouraged whenever possible in pediatric oncology patients.
- In order to improve the satisfaction of foods and to expedite weight gain in the existence of marked anorexia, appetite stimulants may be recommended.
- To help maintain nutritional status, foods that are abundant in protein content, energy and micronutrients may be suggested for consumption during treatment. This is of paramount importance in children with anorexia, early satiety, xerostomia, nausea, alteration in taste sensations and diarrhea. Eating regularly and the inclusion of high protein and energy snacks under many of these conditions may help to improve overall intake.
- Once the extent of malnutrition has been computed, the choice to lend nutritional support and in which form of support is the most appropriate to utilize must be decided by the healthcare professional and any other parties involved. To decrease the risk of malnutrition and interferences in anticancer therapies which may have an effect on outcome enteral and parenteral nutritional support may offer a usable choice. There are advantages and disadvantages to each form of nutritional support and is critical to assiduously appraise the prognosis, diagnosis, gut function, extent of malnutrition, and ease of delivery before commencing on a plan of nutritional support. Attention must also be executed to avoid refeeding syndrome, which is commonly known as the metabolic complication caused by rapid saturation of magnesium, potassium and phosphorous, in a critically malnourished or cachectic patient.

Conclusion

It is important that dietary intake is continued to be monitored. It is evident from this study that children are not following the guidelines for healthy eating given in the Six Caribbean Food Groups and in addition have deficiencies resulting from inadequate intake of foods and resulting malnutrition. Children have lower energy reserves and higher metabolic demands than adults and this becomes increased in illness such as cancer, therefore are more likely to experience nutritional depletion particularly during growth spurts.

The parents of these children are also not educated in the importance of providing foods from the Six Caribbean Food Groups. These healthy eating guidelines are provided as a preventative measure against added disease risk and future research should address the health outcomes of following the recommended intake. Following dietary guidelines can reduce the risk of development of cancer cachexia. A remedy for promoting knowledge of healthy-eating guidelines in these patients may include educational sessions for parents which may be conducted at the clinic on specific days. This would act not only towards increasing the parents' awareness of the quantity and quality of foods being served to their children but would also help to prevent increased disease risk.

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APPENDICES

Appendix A- Sample Questionnaire used

Participant Code #:_____

Dear parent: The following is a questionnaire which is specifically aimed toward collecting appropriate data for the purposes of conducting a final year research project at the University of the West Indies, Faculty of Science and Agriculture, Programme type: Clinical Nutrition and Dietetics. The aim is to collect data on food and beverage consumption patterns in pediatric oncology patients with a focus on identifying those at risk, or, suffering from cachexia, and various appropriate Medical Nutrition Therapies that may be recommended in addition to specific health indices. Any information provided will be regarded as strictly anonymous and of highest importance.

The questionnaire contains three (3) sections which include demographic and anthropometric information: food frequency questions; and other relevant questions. Please answer all questions by placing a tick ( ) in the relevant spaces provided.

Your cooperation and time is greatly appreciated and valued.

Section I – Demographic and Anthropometric Data Sheet.

1. Gender : a) Male b) Female

2. Age : a) 1-3yrs b) 4 – 8yrs c) 9- 13yrs

   d) 14- 18 yrs

3. Ethnicity : a) African b) East Indian d) Chinese

   c) Hispanic d) Caucasian e) Other

4. Height (cm) : _____

5. Weight (lbs) : _____

6. BMI (kg/m^2 : _____

7. Weight loss – less than or equal to 5% over 1 month _____

8. Weight loss – less than or equal to 2% over 1 month for infants _____

Section II : Background Information.

9. How many meals does the child consume per day?

   1- 2

   2- 4

   3- 5

10. Does the child consume breakfast? Yes ___ No __

11. Does the child consume lunch? Yes ___ No __

12. Does the child consume dinner? Yes ___ No __

13. Any current allergies to a particular food?

14. How often does he/she consume fluids?

    Every hour

    1-2 hrs

    3-4 hrs

    On a continual basis throughout the day

    Hardly.

15. Does he/she have difficulty swallowing fluids? Yes ___ No ___

16. If yes, please identify which types of fluids are most difficult.

    _____

17. Does he/she consume snack foods? Yes_____ No_____

18. What types of snack food are being consumed? Please identify.

    _____

19. Is it easier for the child to chew/swallow snacks as compared to his/her intake of food?

    Yes ____ No ____

20. Any current dietary restrictions or modifications to the child's diet?

_____

21. Is he/she on any prescribed vitamin supplementation? If yes, please identify.

_____

22. Do you as the parent in your capacity give certain vitamin remedies at home? If yes, please state what types.

_____

23. What medications are currently being taken?

_____

24. What treatment therapies are currently being used, if any (chemotherapy, radiotherapy etc)

_____

25. How does the child feel before treatment therapies?

_____

26. How does the child feel after treatment therapies?

_____

27. Any nausea or vomiting within the past two months?

_____

28. Poor oral intake within the past two months or NPO?

Yes_____ No____

29. Has there been any Total Parenteral Nutrition or tube feedings within the past two months?

Yes_____ No_____

30. Has the child been experiencing diarrhea?

    Yes _____ No ____

31. Has the child been experiencing or complained of constipation?

    Yes ____ No ____

32. Does he/she complain of fatigue/tiredness/lethargy/lack of interest in playing?

    Yes____ No ____

***NPO: Nothing to eat or drink by mouth**

Section III – Food Frequency Questionnaire.

#	Food Item	Always 7 times/wk	Most times 5-6times/wk	Sometimes 2-4times/wk	Rarely 1-2times/mth	Never
1	Freshly squeezed Juices					
2	Fruit juice drink e.g. Orchard, Fruta etc)					
3	Milk-sweetened milk or tea (Soy, Almond's milk, Cow's milk, Rice Milk)					
4	Milk Beverages (Supligen, Nesquick etc)					
5	Sodas (Busta, Coca-Cola, Sprite etc)					
6	Hot Beverages (Tea, cocoa)					
7	Baby Formulas					
8	Currently being breastfed					
9	Solid foods (Rice, provision)					
10	Soft foods (mashed potatoes, eggs)					
11	Meats (chicken, beef, lamb)					
12	Fish					
13	Roti (Dhalpourie, Paratha, Sada)					

14	Burgers					
15	Pizzas					
16	Fried Meats (KFC, Royal Castle)					
17	Pastries					
18	Sandwiches (cheese)					
19	Vegetables					
20	Fruits					

Three Day Food Log

Please write down everything the child consumes for 3 typical days including at least one weekend day - Saturday or Sunday.

- Record this in the column marked FOOD and BEVERAGES.
- Record only amounts EATEN.
- Record the brand name and method of cooking in the "METHOD OF PREPARATION / BRAND NAME" column.
- Under 'AMOUNT'**,** record in 'teaspoons', 'cups', or fractions of these.'Slices' or 'pieces' may be used when necessary. If something eaten has a specific measurement on the label, record that amount. For example: Coke - 12 ounce can.

It is important to remember the following while recording different types of food:

- Milk: State if whole, skim, fortified, powdered, liquid, evaporated, or chocolate
- Liquids: Record amount of milk and all beverages in 'cups'.
- Bread: Specify white, rye, whole wheat, raisin, etc.
- Meats: Give the thickness of the portion
- Cereals, rice, and pasta: Record amount of cereals, rice, and pasta in 'cups' or fractions of cup. Do not record in 'BOWLS'. List anything added e.g. fruit, sugar
- Fruits and Vegetables: Specify, fresh, frozen, canned, dried, or freeze dried.
- Canned foods: Record what food is packed in – oil, water, syrup, etc.

24 hour Diet Recall

Participant Code ____

Date _____

Day of the week: Monday Tuesday Wednesday Thursday Friday Saturday Sunday

Does this day represent the child's typical eating habits? Yes__ No___

Please be as specific as possible.

DAY 1

Time	Food/Beverages	Method of Preparation – (baked, fried, boiled, canned etc.) Brand Name	Amount/Serving size.

24 hour Diet Recall

DAY 2

Day of the week : Monday Tuesday Wednesday Thursday Friday Saturday Sunday

Does this day represent the child's typical eating habits? Yes__ No__

Time	Food/beverages	Method of Preparation – (baked, fried, boiled, canned, etc.) Brand Name	Amount/Serving Size

24 hour Diet Recall

DAY 3

Day of the week: Monday Tuesday Wednesday Thursday Friday Saturday Sunday

Does this day represent the child's typical eating habits? Yes__ No__

Time	Food/Beverages	Method of Preparation – (baked, fried, boiled, canned, etc) Brand Name	Amount/Serving Size

Thank you for your kind co-operation.