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KUMASI, GHANA

Assessing the Nutritional Status and Weight Changes of Breast Cancer Patients Receiving Chemotherapy in the Tamale Teaching Hospital

By

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A Thesis Presented to the Department of Biochemistry and Biotechnology

Faculty of Biosciences

College of Science

In Partial Fulfilment of the Requirements for the Award of Master of Science Degree In

HUMAN NUTRITION AND DIETETICS

SEPTEMBER 2018

DECLARATION

I hereby declare that this thesis is the outcome of my own original research and that it has neither, in part nor whole, been presented for another degree in this university or elsewhere.

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ACKNOWLEDGEMENT

To the almighty God, I render my sincere gratitude for the protection and guidance for the successful research. My second most appreciation and thanks go to my supervisor Dr. F. C. Mills-Robertson and Dr. Agartha Ohemeng who have in their various capacities helped achieve a complete research.

I thank everyone, institution or persons who in their diverse ways especially, the clients at the Tamale Teaching Hospital, supported to carry out the study successfully.

DEDICATION

This investigation is dedicated to the Almighty God.

ABSTRACT

Weight of cancer patients including breast cancer (BC) are normally affected due to the effects of chemotherapy on food intake and body tissues from drug toxicity and tolerance or intolerance of chemotherapy as a whole. The aim of this investigation was to assess nutritional status and weight changes of BC patients receiving chemotherapy over the three periods of treatment. A prospective cohort study was conducted on 17 participants diagnosed BC, to collect data on three different occasions. Anthropometric parameters and nutritional food habits and food groups' diversity were assessed using biomedical impudence machine and Food and Agricultural Organizational food diversity questionnaire on dietary diversity (WDDS). Biochemical profile data (haemoglobin and albumin) were obtained from patient's file. The mean age of participants was found to be 43 (13.2) years. Patients were made of 23.5% businesswomen or traders, housewives (29.4%) and majority of 64.7% had no formal education, 17.6% who were educated at the tertiary level. Mean height of participants was 1.64 ± 0.07 m, and the mean weight had increased from 68.5 ± 21.20 kg to 69.3 ± 20.95 kg before chemotherapy and after second cycle treatment. A change in weight with mean of 0.99 ± 1.8 kg was observed. After second cycle of treatment the body mass index of six (6) and waist circumference of eight (8) respondents were at risk for comorbidities, breast cancer recurrence and cardiovascular diseases though thirteen (13) had normal level of skeletal muscle. Association was found between height and

weight change. Means of haemoglobin and albumin were respectively recorded as 11.5 (1.1 g/dl) and 42.1 (9.0 g/l) after second cycle chemotherapy; three and two respondents had haemoglobin and albumin levels lower than normal (< 10.0 g/dl) and (< 35.0 g/l,) respectively after the second cycle treatment. Most (16; 94.1%) respondents consumed grains or starchy staple foods, legumes, nuts and seeds, meat, and 12 (70.6%) used dark green vegetables. Less than half of the sample 29.4%, 23.5%, and 41.1%, respectively, consumed milk and its products, vitamin A-rich vegetables and fruits, and other fruits and vegetables after second cycle chemotherapy. The change in weight after treatment had correlation with some anthropometric parameters such as height, body mass index, waist circumference and body fat.

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ABBREVIATION

ALA	α -LINOLENIC ACID
BF	BODY FAT
BMI	BODY MASS INDEX
DNA	DEOXYRIBONUCLEIC ACID
DHA	DECOSAHEXANOIC ACID
EPA	EICOSAPENTANOIC ACID
FAO	FOOD AND AGRICULTURAL ORGANIZATION

MUFA	MONOUNSATURATED FATTY ACID
SMM	SKELETAL MUSCLE MASS
VF	VISCERAL FAT
WFP	WORLD FOOD PROGRAMME
WHO	WORLD HEALTH ORGANIZATION

CHAPTER ONE

1.0. INTRODUCTION

1.1. Background information

Breast cancer (BC) is a non-communicable disease which is the second cause of morbidity and the leading cause of mortality among cancers in women in the world. Mortality from breast cancer in women in 2010 and 2011 were 425000 and 373000 respectively (Ghartey *et al*., 2016; Mohammed and Daoud, 2013). Studies have shown that, 1.4 million women breast cancers are diagnosed yearly, and for 2012, newly diagnosed cases were 1.7 million, representing 25% of cancers in women worldwide (Ghartey *et al*., 2016; Thomas *et al*., 2017). It is indicated by Cumber *et al*. (2017), BC leads the cause of death among women in Africa, where out of an estimated 882 900 diagnosed cases in low and middle income countries (LICs), 324 300 women died. With regard to the year 2012, incidence of breast cancer cases and yearly mortality is expected to rise to 23.9 and 14.6 million respectively by 2035, representing an increase of 69.5% cases and 78% deaths (Custódio *et al.,* 2016).

Mohammed and Daoud (2013) showed that, the genes BRCA1 and BRCA2 are susceptible breast cancer genes located on chromosome 17, which when mutated become risk for cancer, and known to be responsible of about 5 to 10% patients with breast cancer. Genetic development of BC begins and progresses in two forms of altered genes into oncogenes: 1) ErbB2, MYC and PIK3CA and 2) deactivation of the functions of tumour suppressors as TP53, BRCA1 and BRCA2, RBI and PTEN (Perera and Bardeesy, 2017; Lee and Muller, 2010).

Risk factors of BC have been categorized by Nelson *et al*. (2012), into personal and environmental. Personal risk factors are race or ethnicity, body mass index (BMI), physical activity, family history such as first degree relatives, breast density,

menopausal status, reproductive factors including age at menarche, parity, age at first birth and breastfeeding. The environmental risk factors include alcohol use and smoking, oral contraceptive use, and menopausal hormone therapy, breast procedures such as breast imaging and benign breast biopsy. Other risk factors can be named as older age (older than 55), family history of breast cancer, early menarche, late menopause, first term pregnancy after age 25 years, nulliparity, prolonged use of exogenous estrogen, smoking, alcoholism, high energy intake, and adulthood obesity and weight gain is a risk of postmenopausal breast cancer, during menopause and estrogen (Mohammed and Daoud, 2013; Cumber *et al*., 2017).

Currently, surgery, chemotherapy, radiotherapy and hormonal preparation are used to treat or manage breast cancer. Patients on chemotherapy experience taste and smell changes that could cause food aversion, and may induce weight loss, weight gain, fatigue, nausea, diarrhea, cytopenia, cardiac toxicity, constipation and other metabolic complications by worsening diabetic symptoms (Mohammed and Daoud, 2013). On the management of BC, little is known about the adequate intake of both macro and micronutrients during the chemotherapy culminating in the necessity to determine nutritional status that affects body changes (Custódio *et al*., 2016). There have been reports of weight gain among 50-96% of women undergoing chemotherapy in the 1990s that vary from 2.5 -6.2 kg, with recent report indicating between 1.4 to 5.0 kg in about 35-85% (van den Berg, 2017; Kim *et al*., 2013).

Factors that promote breast cancer prevention and treatment is not only detection but, also improved management by chemotherapy or radiation and supported with adequate nutrition. Nutrition is a modifiable factor that is significant in the management of cancer, its diseases circumstances and prognosis as well as improving the quality of life of survivors (Park *et al*., 2018). The only treatment used to manage breast cancer

patients at Tamale Teaching Hospital (TTH) is chemotherapy, and evaluating nutritional status and weight changes associated with chemotherapy will help improve treatment outcome, improve nutrition and reduce nutrition side effects experienced by chemotherapy patients.

1.2. Problem statement

Cancer of the breast is a big public health concern, being the most common cause of mortality among women in Ghana and the world at large. As a leading cause of cancer deaths in the world, breast cancer accounted for 14% and 11.8% mortality of the total cancer deaths in 2008 and 2012, respectively (Akuoko *et al*., 2017).

Records on breast cancer (BC) tend to be limited to those institutions which diagnostically investigate or manage the condition. Registry records on BC at the national level on policies of BC management, if exist, is not publically available for consumption. Investigations have provided information on chemotherapy effects on nutritional statuses and weights changes of patients. Past and recent reports indicate chemotherapy effect on weight change varied from 2.5 -6.2 kg, and between 1.4 to 5.0 kg in about 35-85% (van den Berg, 2017; Kim et al., 2013). Again, studies have shown chemotherapy leads to gain in body mass index, waist circumference (Custódio *et al*., 2016), reduced or increased haemoglobin and albumin levels (Lee *et al*., 2017; Chauhan *et al*., 2016) which could lead to BC recurrence, comorbidities and loss of quality of life. The information on chemotherapy effects on nutritional status and weight changes is scarce in Tamale Teaching Hospital (TTH) and in the region as a whole where chemotherapy is used to manage BC. The absence or limited information of chemotherapy on nutritional status and weight changes has prompted this study

1.3. Justification

This research sought to assess nutritional status and weight changes of breast cancer (BC) patients attending TTH for management. Findings from the research will become a source of information to help policy makers on policy decisions on the management of BC. It will also help improve weight management from nutrition and diet, and probably side effects on weight from chemotherapy. The study will serve as academic document with a potential source of information for learning and further investigation. . Findings from the study will not only help improve treatment of BC patients, it will serve as information source for policy decision at the national level and academia benefit.

1.5. Objectives of the study

1.5.1. Main Objective

To assess nutritional status and weight changes of breast cancer patients receiving chemotherapy at the Tamale Teaching Hospital

1.5.2. Specific Objectives

1. To assess nutritional status of breast cancer patients undergoing chemotherapy, using anthropometric and biochemical parameters
2. Assess the dietary habits and supplement use of participants
3. Determine weights change of patients on chemotherapy after third round of chemotherapy
4. Determine the relationship between initial nutritional status and weight change over a period of treatment.

CHAPTER TWO

2.0. LITERATURE REVIEW

Breast cancer incidence is rising in all regions in the world and is common cause of death among women. It is heterogeneous in its clinical, genetic and biochemical profile with its effects increasing in the developing world (Chauhan *et al*., 2016). Breast cancer is one of the cancers that develops from gene alteration or deletion leading to abnormal cells and tissue development in the breast tissue (Lee and Muller, 2010; Perera and Bardeesy; 2012). The observed process of development involves swelling in the tissues that could proceed into open wound with consequence of necrosis and destruction of affected tissue.

2.1. Breast cancer

Cancer of the breast is a non-communicable disease, a common cancer and the leading cause of mortality in women. Breast neoplasm is found in both sexes but, more women are diagnosed with breast cancer (Ghartey *et al*., 2016; America Cancer Society, 2011). Apart from women suffering more from BC, its increasing rate is shifting from cervical and uterine cancers (Jedy-Agba *et al*., 2016; Ghartey *et al*., 2016). Studies show that globally, 1.4 million women with breast cancers are diagnosed yearly, and for 2012, newly diagnosed cases were 1.7 million, representing 25% of cancers in women (Ghartey *et al*., 2016; Thomas *et al*., 2017). Studies have indicated that, total mortality from BC in 2008 was 14% in the world (Akouko *et al*., 2017) however, Ghartey *et al*. (2016) and Mohammed and Daoud (2013) have stated that breast cancer accounted for 425000 and 373000 among women in 2010 and 2011 respectively. In sub-Saharan African countries there is currently an increase rate and in shift from cervical to breast cancer. According to Thomas *et al*. (2017), half of incidence of breast cancer occurs in

the low and middle income countries (LMICs) with mortality rate reaching 58% in these countries.

Incidence of breast cancer are varied with limited major or direct cause but, may be the result of interaction from genetics, and together with the interplay with other environmental factors such as hormonal, infection, industrial pollution and dietary fat (Wiseman, 2000; Mohammed and Daoud, 2013). While some studies are not substantially consistent and convincing, others are contradictory with regard to etiology and association or correlation supports on evidence of biological and epidemiological risk, of BC. Factors included as risk are age most especially older than 55 years, family history, early menarche, late menopause, first-term pregnancy after age 25 years, nulliparity, prolonged use of exogenous estrogen (Mohammed and Daoud, 2013).

Cancer has impact on the physical which is implicated emotionally and in the cognition, affecting the activities and functions of the affected individual. These signs and symptoms are witnessed in pretreatment periods especially cancer-related fatigue (Neefjes *et al*., 2017). The pathophysiology mechanism of inflammation in the cancer affects metabolism including its effects on the hypothalamus-pituitory-adrenal axis leading to cancer related fatigue, reduced muscle mass and work performance. Koo *et al.* (2017) categorized breast cancer signs and symptoms into atypical and typical. Typical signs and symptoms include lump in the breast or armpit, inverted nipple, bloody nipple discharge, orange peel texture, breast pain, swollen lymph nodes in armpit or neck, and atypical are back pain and weight loss.

2.2. Genes linked to breast cancer

Breast cancer development is the alteration of genetic information due to genes mutation and sequential displacement by proteins, or infection that lead to abnormal

cellular differentiation and deoxyribonucleic (DNA) replication. The mutated genes known as oncogenes and tumour suppressor genes affect abnormal proliferation of cells developing into large tissues. Rb and p53 proteins and papillomavirus for instance affect the sequence, cell differential and DNA replication which result in cancer (Alberts *et al*., 2002; Mohammed and Daoud, 2013).

Breast cancer genes found on chromosome 17 known as BRCA1 and BRCA2 are susceptible genes. According to Mohammed and Dauod (2013), these susceptible genes are responsible for about 5 to 10% of breast cancer in patients. In the beginning the development of breast cancer could initiate in altered genes as 1) oncogenes forms of ErbB2, MYC and PIK3CA, and 2) deactivation of the functions of tumour suppressors form of TP53, BRCA1/2, RBI and PTEN (Perera and Bardeesy, 2017;

Lee and Muller, 2010).

2.3. Risk factors associated with the development of breast cancer

Some risk factors of cancer are chronologically and physiologically influential, which are either directly or indirectly involved in the development of breast cancer. These risk factors include environmental impact on lifestyle and physical, and reproductive cycle characteristics. On the other hand risk factors as stated in the study by Nelson *et al*. (2012) are race or ethnicity, body mass index, physical activity, alcohol use, smoking, family history of breast cancer and breast density. Others are breast diagnosis and treatment procedures such as biopsy and radiation, reproduction characteristics and health practices including breastfeeding, oral contraceptive use, menopausal age or status and type, and menopausal hormone therapy. Factors associated with lifespan cycle characteristics are age at menarche, parity, age at birth of the first child and menopausal age.

2.3.1. Age

Ageing in itself has disease related conditions, and cancer is one that the incidence begins in middle age and increases along with increasing age (White *et al*., 2014). Indication has shown that, modifying the limiting environmental and lifestyle factors that promote biological ageing regulatory activities could prevent or reduce cancer development over lifespan from the middle age of 45-64 years to old age (White, *et al*., 2014). As previous studies in sub-Saharan Africa has shown, average age of occurrence of breast cancer (BC) in women is 40 or more (Jedy-Agb *et al.*, 2016), and that of Ghana indicated an average of 38 years (Ghartey *et al.*, 2016). They revealed no record of breast cancer at the age 65 years and above, but reporting 7 cases in ages below 35 years, suggesting the likelihood the lower age group or premenopausal age group becoming more affected. Study on menopausal age influence on BC occurrence has not been categorically stated but, some investigations have categorized it as < 40 years, 40 and above to 49 or 50 years in order to create a suitable condition for their research (Nelson *et al*., 2012). It has shown that, the average natural age of menopausal in United Kingdom is 51 years, with a higher risk connected to developing breast and endometrial cancer at late menopause whiles early menopause protects against it (Dunneram *et al*., 2018).

Due to hormonal influence in tissue development and growth in life and reproductive lifespan in ageing, the linkage to the risk and associated etiology factor in age, should be considered important in breast cancer development. Breast cancer is shown to occur in menopausal women particularly in premenopausal and postmenopausal women, and mostly age above 50 years (White *et al.*, 2014; John *et al*., 2016). Lifespan may favour increase life expectancy that could promote long life in postmenopausal which can prolong the period of risk for breast cancer. In a study by White *et al.* (2014), they

observed that modification of the environment and lifestyle impact and increase life expectancy in 1900 from 47 years. In 2011, life expectancy in

United States (US) for men and women, age of 65 years was expected to increase by 18 years and 20 years, respectively, to 83 years and 85 years. This extended period of life expectancy give chances for increase in population growth and the increase in incidence of cancer, and more menopausal women may be affected with BC

(Custódio *et al*., 2016).

Although, BC tends to be more among adults, children or adolescents equally share the risk of BC development. Evidences are growing in exposure of prenatal, regarding childhood and adolescent risk for breast cancer in puberty. Even though BC in puberty is less understood in susceptibility, menarche is a risk and highly susceptible to early development (White *et al*., 2014; John *et al*., 2016).

2.3.2. Hormonal effect

Breast tissue is sensitive to sex hormones, and the breast play an important role in etiology in response to hormonal influence in cells and tissue differentiation, growth and development, hence, the likelihood of cancer development. Different hormones and their levels in women are not considered as the base for risk of breast cancer but, the period of ovarian cycle exposure at the age of menarche and menopause is a significant determining risk. Reproductive factors and circulating levels of estrogen and androgens are positively related to risk of cancer in post-menopausals with unclear revelation about menopausal women (Endogenous Hormones and Breast Cancer Collaborative Group *et al*, 2013). It is said that sex steroid hormones made of estrogen, progesterone and androgen promote the process of cancer development (Folkerd and Dowsett, 2010; Lange and Yee, 2008). However, response of mammary epithelial cells receptors to estrogen, expresses both estrogen and progesterone at the same time, making it difficult

to isolate progesterone effects. Due to actual limitation in number of epithelial cells containing estrogen receptor and testosterone receptor, 7-

10% of patient's breast cancer cells are restricted or inhibited in proliferation by TGFβ or high levels of p27. TGF-β is transforming growth factor that regulates the proliferation of breast cells or tissue to prevent or abate the progression of breast cancer cells.

According to Travis and Key (2003), time of delay and initiation of exposure of menarche by a year to ovarian hormones is reduced by 5%, while delay in the onset of menopause by 1 year has a 3% association with risk of breast cancer. Investigations in variation in different hormonal levels have shown a potential risk among those with high levels. In a prospective research, high levels of estradiol in menopausal women who developed breast cancer were shown to have association and relative risk (RR) of 2.3 and confidence interval (CI) of 95% 1.6-3.2, compared with those who did not develop (Travis and Key, 2003; Key and Verkasalo, 1999). Indication further showed that while bioavailability of estradiol is strongly correlated with total estradiol, estradiol and estradiol precursor of serum estrone are strongly correlated with each other in postmenopausal women.

Epidemiological study on endogenous testosterone exposure on a collection of the top quintile number of postmenopausal women exposed, had double risk than those in the lowest quintile which might be due to testosterone converting to oestrogen though, the process still remains unclear (Travis and Key, 2003; Hankinson and Eliassen, 2010).

2.3.3. Use of Exogenous Estrogen

Oestrogen as a hormone in an individual act with the influence from the other hormones to expose or to present a risk for breast cancer, occurs in hormone related pathways.

Both endogenous and exogenous stimulate and initiate the proliferation of breast epithelial tissue through mitosis which result in cell differentiation, may present the possibility of genetic errors that could lead to cancer. Although, the risk of estradiol is unclear, the catechol estrogens and reactive semiquinone or quinone intermediates as derivatives or metabolites of estrogen may act as weak procarcinogens, presenting as radicals might cause mutation of direct or indirect damage to DNA (Travis and Key, 2003; Crosignani, 2004). According to these studies, women who ceased 10 years or more to use combined estrogen and progesterone contraceptive pill were not associated with risk of breast cancer. Instead, those who were using or used the oral pill for the past 10 years or 1 to 4 years were at slightly risk of being diagnosed with the disease. The risk for breast cancer associated with hormonal replacement therapy containing both estrogen and progesterone, is high in current studies. The use or exposure of exogenous estrogen-progestin hormonal therapy is carcinogenic to human and, shown more risk in post-menopausals than estrogen alone for BC.

2.3.4. Stage and Parity

Explanation of stage and parity on the developing of breast cancer has been observed to determine and measure the risk for breast cancer. There is more risk in nulliparity for developing breast cancer than first delivery which continue to decrease in increasing multiparity alongside decreasing in years of risk for the cancer. The protective effect associated with a delivery has a long-term increase with a relative risk decrease by 5 years than nulliparity, and shows an average of 7% decrease in every delivery (Travis and Key, 2003; Crosignani, 2004). However, giving first birth at early age of less than 20 years has a 30% risk reduction of developing breast cancer than first delivery after age 35 years. In breast feeding the interplay of the reproductive hormones are suppressed which decreases their activity in the reproductive cycle. As compared to

multiparous, breast feeding has 4% modest reduction in breast cancer per every one (1) year (Travis and Key, 2003).

2.3.5. Adult Obesity and Overweight

Overweight and obesity which are risky for cardiovascular diseases are on the increase across the world. A study has shown overweight of 1.9 billion adults, out of which 600 million were obese in 2014 (Barroso, 2017). These conditions are determined by anthropometric parameters such as body mass index (BMI), waist circumference, waist-to-hip ratio, total body fat and visceral fat percentage. Meanwhile, whiles BMI only indicates body fat deposition in the body, waist and waist-to-hip ratio show the distribution of fat, especially abdominal cavity and lean muscle mass ratio which predicts risk of cardiovascular diseases and metabolic syndrome more clearly (Ramírez-Vélez *et al*., 2017). Body mass index (BMI) and waist circumference (WC) are used to measure and standardize values for normal and unacceptable cut-off points in adults that indicate risk for development of metabolic diseases like diabetes, hyperlipidaemia and cancers. Investigation by Bering *et al.* (2015) showed that 80.2% measured with bioelectric impudence (BIA) had more weight than normal, from overweight and obesity waist circumference. Those identified thresholds of cut-off points of BMI risk for these disease such as obesity was ≥30kg/m^3 and overweight ≥25kg/m^2, and for WC, obese men was ≥102cm and women ≥88cm with overweight men as >94cm and women >80cm respectively (Flint *et al*., 2010; BC Cancer Agency, 2012; Raposo *et al*., 2018). However, not only in over nutrition such as overweight and obesity that are risk for metabolic syndrome or cardiovascular diseases, undernutrition is associated with increased morbidity, mortality in cancer patients and low treatment efficacy (Bering *et al*., 2015). It has been found by World Health Organization (WHO) that, body fat mass (BF%) corresponding obesity of 30kg/m^2 in young Caucasians risk for diseases or

metabolic syndrome were 25% for men and 35% for women (Li *et al*., 2017). According to

National Institute of Health (NIH) and the WHO cited in Kitchlew *et al*. (2017), OMRON BF51 Body Composition Monitor, body fat percent (BF%), visceral fat percent (VF%) and skeletal muscle percent (SMM%) are classified in categories as in Table 2.1. Their investigation categorize these body parameters as low, normal, high and very high are measured according to sex and age groupings.

Table 2.1: Distribution of BF, SMM and VF Parameters and Their Cut-Off Points

Gender	Age	Low (%)	Normal (%)	High (%)	Very High (%)
Females only					
Body Fat for females					
	18-39	<21.0	21.0 – 32.9	33.0 – 38.9	≥ 39.0
	40-59	< 23.0	23.0 - 33.9	34.0 – 39.9	≥ 40.0
	60-80	< 24.0	24.0 – 35.9	36.0 – 41.9	≥ 42.0
SMM for females only					
	18-39	< 24.3	24.3 – 30.3	30.4 – 35.3	≥ 35.4
	40-59	< 24.1	24.1 – 30.1	30.2 – 35.1	≥ 35.2
	60-80	< 23.9	23.9 – 29.9	30.0 – 34.9	≥ 35.0
Visceral Fat for Both Males and Females					
		-	1 – 9	10 – 14	15 – 30

Body fat (BF), Visceral fat (VF) and Skeletal muscle mass (SMM)

For obese women there is no association between premenopausal and risk for breast cancer however, there is an inverse relationship. Study by Kim *et al.* (2009) indicated that, the risk for BC in obese postmenopausal is explained with increase in the levels of blood estradiol and, at the same time due to conversion of androgens to estrone in adipose tissue that impact reduction level of sex hormone-binding globulin.

Risk for breast cancer in alcohol consumption, from moderate to high, could contribute to overweight or obesity, with each having independent risk. It is unclear how the

influence of higher intake of alcohol, impact the risk for the cancer. Studies showed may be due to the effect of high concentration of estrogen during the period, especially additional estrogen produced from adipose tissue in overweight or obesity. A linear increase in risk of 7% from moderate or one drink of alcohol intake a day indicated a risk for breast cancer (Key *et al*., 2004). A further revelation of a body mass index (BMI) of greater than 30kg/m^2 in menopausal women has 30% increase compared to those with normal BMI (Travis and Key, 2003), where alcohol consumption above 40 g a day influence overweight and obesity. Moreover, excess alcohol consumption lead to the production of peroxidants. When there is excess peroxidants than antioxidants, there is more free radicals and peroxides formation, and this promotes damage of DNAs, hence the possibility of causing cancer.

2.4. Nutrition status and vital parameters in breast cancer patients

Nutritional status is one of significant factors in determining an individual's healthy state with regard to screening, diagnosing and prognosis of a condition or disease. To determine nutritional status a number of parameters are factored into measuring it, such as, anthropometric parameters and biochemical profile. Various studies have been conducted to determine the healthy and unhealthy nutritional status using anthropometric parameters.

Investigations on the relationship between health status and some vital parameters of the body have shown to have risk for some disease events. Study across countries and populations or groups findings indicated a strong association between increase in height and tall adult, and the risk of breast, ovarian and other cancers (Willet, 2000; Green *et al*., 2011; Zhang et al., 2015). In Zhang *et al*., (2015) a 10 cm increase in adult height in women was associated with risk for breast cancer. Also, preadolescent height, weight

and rapid growth have strong influence on early menstruation which is well known to predict breast cancer.

In 2008, World Health Organization (2011) assessed and determined cut-off points of anthropometric parameters for normal, abnormal and the risk for some diseases such as cardiovascular diseases including cancer. For body mass index (BMI), underweight was < 18.5, normal 18.5-24.9, overweight 25.0-29.9, obesity 30.0-34.9, very high and extreme obesity were 35.0-39.9 and > 40.0 respectively. Waist circumference was varied among the sex, races and ethnicity but, general range of considerations were made in determining abdominal obesity or visceral fat distribution and the risk of disease. For men, waist circumference of 90-94 cm correspond to normal weight, above 94 cm and 102 cm represent overweight and obese, respectively, which are risk for cancer increase and highly or substantially increased risk. For women, 80-88 cm is normal but, and > 88 cm was corresponding to overweight is risk for cancer. Regarding waist-hip ratio, ≥ 0.90 cm for men was substantially risk, and for women 0.85 cm was substantially risk for metabolic diseases and cancers. In assessing nutritional status of an individual body mass index (BMI), which is the ratio of weight to height square, is mostly considered influencing factor in determining the risk for cancer. It is shown in some studies that overweight and obesity are risk for breast and endometrial cancers and serve as prognosis for recurrence and mortality compared with normal weight (Key *et al*., 2004; Deluche *et al*., 2018). However, BMI alone is not sufficient satisfactory in these determination especially, where muscle is masked by excess fat in sarcopenia obesity. Therefore, another way of determining these parameters in addition is use of computed tomography (CT) scan (Rier *et al*., 2016). This helps to elucidate among others skeletal muscle mass (SMM), visceral adipose tissue (VAT), subcutaneous adipose (SAT) and muscle fat infiltration or intermuscular adipose areas (IMAT).

Apart from assessing anthropometric parameters such as BMI from weight and height, waist circumference, hip-ratio, other important nutritional parameters that need to determine nutritional status of patients is biochemical profile including haemoglobin (Hg) and albumin levels.

The rise in metabolic rate in cancer patients, tend to demand an increased in nutritional needs of the patients. However, because of loss of appetite food intake is inadequate to meet the nutrient requirement of the individual. This inadequate food intake lead to reduction in body weight particularly body mass index (BMI). Insufficient nutrient supplied from the inadequate food result in nutrient deficiencies that cause other nutrient deficiency complications such as anaemia and hypoalbunaemia.

In cancer treatment there is the need for healthy physical or anthropometric parameters in order to have effective cancer therapy because the treatment process destroy some cells that require to be replaced hence the need for adequate nutrition before and after therapy. Report on malnutrition prevalence range from 15% to 80%, and loss of weight, are some of the initial sign and symptom that can be witnessed in cancer patients (Norshariza *et al*., 2017).

2.4.1. Muscle and Fat Status in Breast Cancer Patients

In the normal healthy non-obese individual, muscle mass makes up 40-50% of the total body mass and being the largest body organ. Not only clinical evidence has shown the emerging of cachexia or muscle wasting, malnutrition and systemic inflammation but, oncology observational study indicates, reduction in muscle mass is associated with cancer, independent of the stage and nutritional state. A healthy person's muscle mass is strong independent predictor of all cause of cancers and cardiovascular diseases and its dysfunction measures the degree, causes and clinical implications of these diseases (Christensen *et al*, 2014). Distribution and body composition of muscle and adipose

tissue is important in the determination of efficacy, toxicity of therapy and prognosis of patient under therapy. Due to increased metabolic rate, loss of appetite and inadequate food intake, cancer patients normally lose weight involving the fat and muscle tissue which normally contribute to weight of an individual. Furthermore, patients put on therapy whether radiation and chemotherapy experience the effects of further weight loss or lean body mass (LBM) as a result of therapy toxicity (Rier *et al*, 2016). Understanding the state of muscle mass in cancer is, therefore, imperative to determine effective therapy to reverse dysfunctions including physical exercise that improves muscle and its strength (Christensen *et al*, 2014). The process of loss of muscle tissue is known as sarcopenia which occurs in cancer patients although the decline in normal muscle mass is a process in ageing, particularly, from age 50 years. As stated in Pagotto and Silveira

(2014), the European Working Group on Sarcopenia in Older People (EWGSOP) and International Working Group on Sarcopenia (IWGS) (2011) defined sarcopenia as a syndrome characterized by the progressive and generalized loss of muscle mass, strength, performance and also exclusively associated with the aging process. Apart from assessing anthropometric parameters such as BMI from weight and height, waist circumference, hip-ratio, other important nutritional parameters that need to determine nutritional status of patients, there is biochemical profile including haemoglobin (Hg) and albumin levels. The rise in metabolic rate in cancer patients, tend to demand an increase in nutritional needs of the patients. However, because of loss of appetite, food intake is inadequate to meet the nutrient requirement of the individual. This leads to reduction in body weight particularly body mass index (BMI). Insufficient nutrient supplied from the inadequate food intake result in deficiencies that cause other nutrient deficiency complications such as anaemia and hypoalbonaemia.

In cancer treatment there is the need for healthy physical or anthropometric parameters in order to have effective therapy because, the treatment process destroys some cells that require to be replaced hence the need for adequate nutrition before and after therapy. Report on malnutrition prevalence range from 15% to 80% and loss of weight is one of the initial sign and symptom that can be witnessed in cancer patients (Norshariza *et al*., 2017).

2.4.2. Haemoglobin and Albumin Status in Breast Cancer Patients

A level of haemoglobin is maintained both in healthy and in disease by erythropoietic and haemopoietic tissues and the diet intake of the individual. In cancer, multifactorial causes of reduction in haemogloin level results from deficiency in erythropoiesis, haemolysis and red cell destruction, marrow infiltration by cancer invasion, nutritional deficiencies, chemotherapy and radiation-induced myelo-suppression and cytokine-mediated anemia (Edgren *et al*., 2010; Lee *et al*., 2017). Anaemia from direct effect of cancer may be due to blood loss, infiltration of bone marrow by cancer, nutritional deficiency and cancer effect of cytokine-mediated response. To prevent, reduce or treat effectively the occurrence of anaemia and hypoalbumenia, anaemia is categorized, < 7 g/dl for severe anaemia, 10-10.9 g/dl for moderate anaemia and < 35 g/dl for Albumin according to WHO, Lee *et al*. (2017), Liu *et al*.

(2017) and Buyukcelik *et al*. (2012) cut-off points. A study at TTH, Tamale Teaching Hospital, recorded a range for normal Hb and albumin (Alb) as 12 – 16 g/dl and 35 – 55 g/l (TTH BC patients folders laboratory results), respectively.

In addition to already discussed anthropometric parameters, albumin is the major source for binding and carrier of plasma substances such as water, calcium, sodium, potassium, fatty acids, hormones, thyroxine (T4) and pharmaceuticals. It is the most abundant

extracellular fluid protein with long life and responsible for about 70% plasma colloidal osmotic pressure (oncotic pressure). In breast cancer liver function and blood chemistry analyses are done to determine the production of substances of metabolism (Chauhan *et al*., 2016). This indicate healthy states of certain organs affected by cancer cells such as bone, liver and kidney, and also suggest potential for treatment and extent of treatment. Human albumin and globulin are constituents of protein with serum albumin accepted level of 35-55 g/L with its varying levels associates with prediction of nutritional status and prognosis in cancer. Low levels of serum albumin is said to be associated with poor prognosis in cancers (Liu *et al*., 2017, Chauhan *et al*., 2016; Buyukcelik *et al.,* 2012). Albumin has a half-life of 14-20 days and serum albumin is important in the diagnosis of nutritional status of malnutrition and cancer patients due to its long life. It shows an inverse relationship between low albumin level and mortality of seriously ill cancers patients. High serum albumin which is found in non-cancer patients, prevents estrogen responsive breast cancer cells proliferation, and low level of < 3.7 g/L is a marker of poor prognosis and mortality of even non-operable cancers (Buyukcelik *et al*., 2012). Protein-energy malnutrition shows hypo-albuminaemia, which is a risk of nutritional complication and mortality factor in anticancer therapy (Al-Joudi, 2005; Gupta and Lis, 2010). Albumin which represents 50-60% plasma protein, is normally determined together with globulin as total protein where globulin level is increased with decreased level of serum albumin in breast cancer (Fatima *et al*., 2013). This study compared breast cancer patients with healthy individuals and former to have decreased albumin level by 20%, indicating lower survival and increased mortality among all stages of the disease. However, Fujii *et al*. (2014) study found slightly or no serum hypoalbuminaemia in breast cancer patients, even those having metastasis.

2.5. Dietary Risk Factors for Breast Cancer and Nutritional Status of Patients

Diet in cancer patients plays a significant physiological function of the body and can not be disregarded. Many epidemiological interpretation on the relationship between diet, nutritional status and the development of cancer though, are based on animal models there are some facts in humans on how foods and nutrients are used individually or combined to manage the condition. In order to differentiate healthy nutritional status and other related states associated with nutrition such as age, sex, race, diet, metabolism, and disease, malnutrition must meet two criteria in adults including both hospitalized and non-hospitalized adults (Zhang *et al*., 2017). The six criteria include insufficient energy intake, weight loss, loss of subcutaneous fat, loss of muscle mass, localized or generalized fluid accumulation that may sometimes mask weight loss, and diminished functional status. To determine nutritional status of a cancer patient, anthropometric parameters and biochemical profile are significant in measuring nutrition health level and hence, the nutritional requirement. The Food and Agricultural Organization (2010) has established methods with the use of food composition of various groups and their levels or proportional intake to show possible adequate nutrient consumption by individual or household.

2.5.1. Consumption of Excess High Energy Foods

Fats and carbohydrates are foods that provide energy for maintenance, growth and development with the consequence of diseases in an event of under or over intake. Studies in Ghana and in the northern part of the country have indicated that nearly all individuals and families used starchy foods as carbohydrate source all the time for meals which in its excess intake may result in overweight and obesity and may likely to be accompanied metabolic syndrome and cardiovascular diseases (WFP, 2012; Hall *et al.*,

2009). According to Pal *et al*. (2012), methods of investigations on the individual and population or group diet-related risk for cardiovascular diseases and cancer is not well established, and documented results may be erroneous. Meanwhile, other studies have established some facts about the linkage of consumption of diet containing unsafe nutrients, and that refined or excess energy foods are risk for cancers including breast and endometrium. However, individual food nutrients or components are found to prevent, promote or protect the physiological and anatomical development of normal or cancer tissues and therefore, become important in nutrition in cancer patients.

There is an established strong correlation between consumption of high level of saturated and n-6 polyunsaturated fatty acids with low fibre, and the development of kinds of cancers particularly, breast cancer (Edwards *et al*., 2004; Pal *et al*., 2012; Lupton and Chapkin, 2004). In obesity, nutrient-deficient foods like refined sugars and flour, and products which could contribute to impaired glucose metabolism leading to diabetes, and also incorrect proportion of omega 3 and omega 6 fats all contribute to cancer risk (Donaldson, 2004; Beeken *et al*., 2016). Although, the connection between fat and cancer is not clear, the influence of fat in increasing oestrogen hormones levels in blood is thought to hold the development and recurrence of breast cancer.

2.5.2. Consumption of Meat, Vegetables and Fruits

There has not been any established certainty about consumption of red meat and the risk of developing breast cancer. Reports gathered from studies showed varied risk or association of intake of meat, processed or red meat with no or reduced risk for breast cancer. On one hand, Taylor *et al.* (2007) indicated association between total, processed and red meat intake and breast cancer in postmenopausal women. On the other hand, association was between increased intake of total meat and non-processed meats in pre-menopausal. Meanwhile, a high consumption of red meat by menopausal women was

1.27 more associated with risk for BC with reference to taking lower or none (Rezaianzadeth *et al*., 2018).

Consumption of red meat, low vegetables and fibre, and bioengineering modification of food and vegetables for safety reasons, all are without doubt sources of development and progression of human cancers. Vegetables and fruits contain minerals, vitamins and fibre that serve as sources of antioxidants from consumed diets which protect and neutralize radicals and carcinogens in diets and oxidative stress peroxides. Adequate intake of these foods, provide sufficient amounts of

micronutrients to counteract effects of these harmful oxidants in the body (Hall *et al*., 2009). Studies, including WFP (2012) indicated that, consumption of fruits and vegetables among Ghanaian women, individuals and families within the northern sector especially, were as low as 38% and 22% where these levels of consumption were risky for comorbidities and cardiovascular diseases. Whilst others found no link, a link was found that enough intake of plant-based good dietary pattern with sufficient whole grains, fruits, vegetables, fish including high in cooked greens, legumes and sweet potatoes or Mediterranean diets were associated with BC risk reduction (Zhang *et al*., 2011; Link *et al*., 2013). The study showed this relationship of derived results of risk ratio (RR): 0.85; 95 and % CI: 0.76, 0.95 with P = 0.003 comparing the highest intake with the lowest. Zhang *et al*. (2011) indicated a link between refined grain meat prickle pattern and increased risk of BC.

2.5.3. Effects of Some Nutrients Levels in the Blood

The consumption of excess calories, natural contaminants, food containing-natural occurring carcinogens and other elements in the body such as high levels of phosphorus and glutamate are linked to the development of cancers.

High concentration of high density lipoprotein (HDL) cholesterol seen to correlate with estrogen metabolism, is a risk for breast cancer. This is said to be related to age in women above 59 years old, and of premenopausal with low basal metabolic rate or, of postmenopausal with early menopause. Some studies showed increased estrogen levels with low HDL-cholesterol in premenopausal women, and increase in BMI of > 25 kg/m^2 in postmenopausal were associated with increased risk for breast cancer (Kucharska-Newton *et al*., 2008).

The amino acid glutamine (α-aminoglutaric acid), known to be the most abundant in the blood and tissue which mark metabolism change, is shown in carcinoma patients. In breast cancer or other tumours, glutamate is known to be produced or secreted in the use of glutamine for metabolism. Where and when there is inadequate nutrients like in tumour patients, tumours tend to depend on glutamine as alternate source for biosynthesis of protein, lipids, nucleic acid and ATP energy generation, and continuous increase growth in tumour has indicated a reduced level of glutamine (Lampa *et al*., 2017; Fazzari *et al*., 2015).

2.6. Effects of Breast Cancer on the Nutritional Status

As stated earlier, cancer in general raises metabolic rate which affects the statuses of muscle and fat and their distribution in the body with the consequence change in nutritional status. Loss in appetite and subsequent insufficient intake of food in cancer patients including breast cancer contribute to malnutrition. Level of albumin in the body predicts nutritional status hence, the level of malnutrition that arises is related and considered important in cancer patient's survival. According to Fujii, *et al*., (2014), and Gupta and Lis (2010), the normal range level of albumin stated for an adult is 3.5 to 5.0 g/dl and, less than 3.5 g/dl is regarded as hypoalbuminaemia. In some states of cancer, malnutrition and inflammation suppress albumin synthesis, induce systemic response

to tumour in the production of pro-inflammatory cytokines and growth, thus increasing catabolism. In the effects, interleukin-6 is produced in reaction to acute phase to affect C-reactive protein and fibrinogen in fasted or fed state, which influence the demand for certain amino acids. When these amino acids are insufficient or lack in the diet, skeletal muscles are broken down to compensate the demand.

Reports about weight change in breast cancer have not been consistent with regard to conducted researches. According to Marinho (2001), both weight gain and loss are predisposing factors to the occurrence, diagnosis and reoccurrence of breast cancer. It is further stated that, weight loss may be said to be associated with metastasis of the disease. Studies have shown that effects of cancer on body in general with particular reference to BMI, is lower in cancer patients than non-cancers (Buyukcelik *et al*., 2012).

2.7. Management of Breast Cancers

To effectively improve the management of breast cancer and cancers in general, clinical and biological markers response status are significant, apart from the tumour size, lymph nodes and tumour history. The management of the cancer of breast involved the use of surgical, cytotoxic, hormonal chemotherapy and sometimes radiation and nutrition therapies. The therapy of cancer follows a number of rounds or cycles when chemotherapy is used, with the full regimen for treatment lasting within six cycles, according to Tamale Teaching hospital treatment protocol for breast cancer.

2.7.1. Chemotherapy Management

Using drugs to manage cancers follows a regimen consisting of cycles in order to provide effective and efficient treatment and care. In the use of chemotherapy for management of these cancers, the drugs tamoxifen, raloxifine, 5-flourouracil (5-FU), methotrexate, adriamycin and cyclophosphamide have shown to be potent anticancers

(Travis and Key, 2003; Fatma *et al*., 2013; Tatlow, 2017). Whilst tamoxifen and raloxifine are potent anti-estrogen, 5-flourouracil (5-FU), adriamycin and cyclophosphamide are three drugs used in combination in chemotherapy regimen. Indications of drugs showed fluorouracil interferes in the growth and proliferation of cell through its antimetabolic action of incorporation into DNA or RNA. Another way is that, it acts to compete for binding sites on enzymes. Whiles adriamycin acts as antibiotic, cyclophosphamide acts to form covalent bond by donating alkyl group into nucleophiles on other molecules. For now, the only preventable risk factor relating to estrogen is obesity reduction and maintaining normal body weight of below 25 kg/m^2, minimizing alcohol intake and having regular physical exercise (Travis and Key, 2003).

2.7.2. Diet Management

The use of knowledge on diet and cancer relationship based on observational and clinical investigations on the interplay among genetic, epigenetic, metabolic and gutmicrobial processes should be the foundational approach to diet management in cancers. However, to achieve success in the management, lifestyle and dietary prevention could take 30 to 40 % across all cancers management but, may be higher in some specifics (Donaldson, 2004). Recent recommendation in reducing breast cancer risk aimed towards weight management, diet modification and exercise, reduction in alcohol consumption, and modification in hormone replacement therapy regimen in menopausal women (Chucharska-Newton *et al*., 2008).

Evidence and observational studies available on lifestyle changes on limited intake of high caloric foods, red meat and processed meats with the ratio of low-fat to high fibre diet could prevent and protect against the development and progression of breast and endometrial cancers (Beeken *et al*., 2016). Change of dietary lifestyle with the modification of plant-base diet from whole grains, fruits, vegetables, beans and lentils

with desirable amount of phytochemicals of fibre, vitamins and other compounds limit the risk of cancer (BC Cancer Agency, 2012). It is found that fruit juices, processed vegetable juices, orange peel, green tea, vitamins, flavonoids, and trace materials have cancer inhibitory and chemo-protective properties. Plant-based diet does not completely eliminate animal source of meat, poultry, dairy products or fish, but should be encouraged on limited proportions initially to gradually develop a scarce intake of them. Whole grains and foods made from grains are oats, corn and pop-corn, brown of wide rice, beans and dried peas (kidney beans, black beans and chickpeas), lentils, bread, pasta and whole wheat flour.

The intake of fat is important as it plays its role in providing additional energy and vital components of cell membranes, enzymes and hormones. Saturated and transfatty acids can trigger the occurrence of breast cancer, while polyunsaturated fatty acids offer protection to cancer development. A study by BC Cancer Agency (2012), in Women Intervention Nutrition, over a five year period, revealed that women who lost weight from overweight and consumed 20% of calories from fat as low-fat diet, lowered risk of breast cancer recurrence. Apart from exercise which should accompany loss of weight and consumption of low-fat diet, it promotes positive effects of reducing fatigue, helps lymphedema management, and prevents osteoporosis from treatment effects. This recommendation, also contribute to maintaining normal weight within the range of 18.5 to 24.9 kg/m^2 alongside intake of high vegetables, fruits and whole grain, and an average of four (4) hours of physical activity a week. A gradual loss of weight by 0.5 - 1 kg a week could improve and maintain desirable weight reduction over a period (BC Cancer Agency, 2012). To encourage appropriate calorie intake, one needs to take the right portions, avoid fatty meat or added fat, fried foods, sweet, pop, coffee and flavour drinks solids or liquid drinks.

It has been found that, a population has a low risk for breast cancer and cancer in general from consumption of high levels of sea fish which contain long chain polyunsaturated omega-3 fatty acids that offer protection (Pal *et al*. 2012; LeMay-Nedjelski, 2018; Chapkin, 2008). Apart from fish, α-linolenic acid (ALA), eicosapentanoic acid (EPA) and decosahexanoic acid (DHA) all induce protective effect against and reduce the growth of breast cancer. Fish oil omeg-3 fatty acids, ALA, EPA, DHA, and other marine sources, offer beneficial effects in improved insulin sensitivity and reduction in free radicals. Investigations have shown that consumption of olive oil that contains monounsaturated fatty acids (MUFA) at the high level and vis a vis at the low level has a 2-fold beneficial, and relative risk for breast cancer with RR (2.15) and 95% confidence interval (CI) (1.68-2.74) (Khodarahmi and Azadbakht, 2014). There have been contrasting results from other studies with some others revealing no association in the intake, and others showing inverse relations. Source of MUFA is olive oil and its role helps in reducing breast cancer may be connected to effects on improved insulin sensitivity.

A dietary supplement of glutamine is beneficial and has been shown that increasing tumour size in patients is linked to reduced glutamine level (Pal *et al*., 2012). Fruits and vegetables contain beneficial food substances including carotenes, ditthiolthiones, indoles, isothiocyanides, selenium, folic acid, dietary fibre, vitamin C and E, certain diphenolic lignans and isoflanoid, phytoestrogens, glucosilates, indoles, phenols among others that that have potential anticarcinogenic properties. They contain vitamin A, C, E and selenium that act as antioxidants, and their high intake in cancer patients are potential free radical scavengers and inhibit N-nitrosamine formation on interaction between cells, that serve to protect patients from cancers. A vast amount of epidemiological evidence has proposed that a relatively high fruit and vegetable

consumption is associated with a reduced risk of breast cancer (Potter, 2005: Kapil *et al*., 2013). They contain minerals and vitamins that act as antioxidants that neutralize and activate enzymes in carcinogen detoxification. This prevents and protects cells from reactive oxygen species that damage DNA and cause of oxidative stress that may lead to risk of cancer cells. The cruciferous vegetables especially contain micronutrients and other components that have cancer protective properties including breast cancer inhibitory properties (Pal *et al*., 2012). Some of the vegetables and fruits are cooked drumstick, neen, onion; green leafy vegetables; and the fruits, amla, jackfruit and pomegranate are all protective against cancers. Compounds in grape fruits are said to be potential chemo-preventive agents against breast cancer and act in inhibiting aromatase or eostrogen biosynthesis. Consumption of adequate vegetables and fruits of not less than 400 mg a day, allium and cruciferous vegetables, the lignin fraction of flax seed and broccoli sprouts as sources of sulforophane, lower risk of

cancer. Furthermore, intake of selenium, folic acid, vitamin $B_{12,}$ vitamin D, chlorophyll, and antioxidants such as α-carotene, β-carotene, lycopene, lutein, cryptoxanthin protect and prevent cancer, with ascorbic being highly beneficial intravenously and limited orally (Levi *et al*., 2001; Pal *et al*., 2012). A complete knowledge about micronutrient source, total micronutrient consumption level, and investigation methods are important to prevent discrepancies in reports and for a consistent and acceptable research results for use (Saquib *et al*., 2011). The variation in study methodologies could explain the lack of consistencies across these studies. The major differences include the micronutrient source (food versus supplement), total micronutrient intake level and approach to measurement.

To improve muscle functions in sarcopenia, diet is not the only major factor in the determination of healthiness; muscle mass and work performance are used in reversing

cancer related-fatigue. Aerobic and resistance exercise intervention provides pathophysiological mechanism that has positive effects in sarcopenia with improve muscle mass and performance (Neefjes *et al*., 2017).

Principles guiding nutrition in palliative cancer care may take the following into considerations: (1) ensuring an adequate amount of calories, (2) reducing foods and dietary habits that have been specifically linked to modifiable risk factors for cancer reoccurrence, (3) creating a diet that minimizes inflammation, insulin resistance, and oxidative stress, (4) ensuring an adequate amount of specific nutrients and selective nutritional supplementation linked to cancer prevention or recurrence.

2.8. Effects of Chemotherapy on the Nutritional Status of Breast Cancer Patient

To reduce or prevent dose effect of free drug in the body of cancer patients receiving chemotherapy, the determination of their weight, height, renal function and albumin level are important indicators in limiting side effects. Drugs used in the treatment of cancers induce nausea and vomiting which tend to influence the selection of foods to consume. The same level of toxicity is experienced in both normal and abnormal parameters in patients therefore, to enhance good outcome, decrease cost and limit complications from side effects, it is necessary to evaluate these parameters before and in the process of therapy (Tatlow, 2017). However, the individual experiences from the effects might differ due to toxicity and tolerance levels. This makes it difficult to predict the adequacy of both micronutrient and macronutrient intake and therefore, its quantity and quality. Impact from the inadequate intake will influence weight and other nutritional indicators including signs and symptoms that may be produced. In breast cancer the extent to which diet intake is affected is not consistently explained due to different experiences exhibited by patients with different methods and times used to collect data on dietary intake before or during therapy (de Vries *et al*., 2017).

Individuals affected by chemotherapy may have one or more experiences of decline in taste perception, appetite and hunger and dry mouth, difficulty chewing, lack of energy and nausea which is associated with decrease in energy intake.

2.8.1. Therapy Effects on Signs and Symptoms

Following breast cancer development, a number of signs and symptoms may be exhibited before the initiation of chemotherapy. A number of signs and symptoms are experienced by patients during the treatment with chemotherapy regimen. These signs and symptoms include reduction in quality of life, nausea, vomiting, loss of appetite, loss or gain in weight, dry mouth or xerostomia, fatigue, sarcopenia, diarrhoea or constipation and, brittle and loss of hair (Pagotto and Silveira, 2014; de Vries *et al*., 2017).

The development of sarcopenia as one of the signs of chemotherapy has come about from some level of drug toxicity. While there is poor prognosis in high body mass index in pretreatment, there is evidence of weight gain following adjuvant chemotherapy which is beneficial and improves patient outcome (Atalay and Küçük, 2015). On the other hand, Lønbro *et al*. (2017) reported that, decreased muscle mass happens frequently due to cancer impact itself and or its chemo or hormone therapy effects which is related to tumour progress, treatment intolerance and response with poor survival.

2.8.2. Effects of Therapy on Nutritional Intake of Patients

Counselling and recommendation on nutrition during therapy is important to maintain patient's adequate intake of vegetables, fruits, whole grains, poultry and fish with less but, adequate energy from combined carbohydrates and various fats. According to Custódio *et al,* (2016), patients under chemotherapy have been observed to have experienced change in their diets which need modification during the period. Symptoms are not the only characteristics shown by patients but, also increase, decrease or no

change in energy intake can impact the quality of life. It has been shown from research on therapy effects on nutrition from data collection methods which are narrowed on energy and macronutrient, without consideration of food groups or items gave variance in life experiences (de Vries *et al*, 2017). These lead to inconsistent explanation on the level of food intake, loss of appetite, loss or gain in weight and risk for cardiovascular and diabetic diseases where there is increase in weight above normal.

2.8.3. Effects of Therapy on Weight of Patients

Women are known to be affected by changes in body composition in the breast cancer state with the development of sarcopenia accompanied with increase in fat deposition which could lead to comorbidities. As a result of chemotherapy effects of nausea, vomiting and loss of appetite or changes in food choices, it may lead to inadequate intake of nutrients with the consequence loss of weight. However, due to adjuvant chemotherapy and antiemetic relieving effects from nausea and vomiting, there is increase in food intake, decreased physical activity and changes in basal metabolic rate, culminating in positive weight change. Use of corticosteroids in premenopausal in chemotherapy is a contributory factor in influencing positive weight gain. There is weight gain which is not only found in the initial development of the disease, and this varies between 50 to 96% of patients on chemotherapy with 20% or more gaining more than 10 kg and the gain continues in the months and years after treatment (Costa *et al*., 2002; Kim *et al*., 2013; Custódio *et al.,* 2016; van den Berg *et al.*, 2017). Within first year after diagnosis, the increased weight assumes the values from 1.0 kg to 6.0 kg (Custódio *et al.,* 2016; van den Berg *et al.,* 2017). The weight gain could contribute to comorbidities such as arterial hypertension, diabetes mellitus and osteoarthritis, affecting individual quality of life and life span. Custódio *et al.,* (2016), researched on the assessment of the nutritional status in chemotherapy, and observed that 56% (n=31)

of patients were overweight of three different treatments. The affected anthropometric parameters were weight, BMI and waist circumference which had increased significantly, and showed undesirable nutritional status. A correlation was found in the ratio of poor diet quality and higher values for BMI, waist-hip ratio and waist-height. This suggests while chemotherapy affects not only patients, diet quality and intake of micro and macronutrients, also have negative impact on their nutritional status and an increase in anthropometric values in chemotherapy.

2.8.4. Effects of Chemotherapy on Hb and Alb of Breast Cancer Patients

Before and during chemotherapy, cancer patients experience anaemia especially from the effects from chemotherapy. It is important to carry out pretreatment test of liver function and full blood count tests and for albumin and haemoglobin levels in order to ascertain the nutritional status and prognosis of treatment outcome. Chemotherapy normally targets and destroy cancers cells, does not extend to normal sensitive cells including surrounding cells, blood and its production tissues and cells (Chauhan *et al*., 2016). Lee *et al*. (2017) showed that, after initiation of treatment, Hb started to decline from 12.8 g/dl in the first 3 months and continue till 6 months to reach 12.0 g/dL. However, a 10 g/dL was the lowest haemoglobin level with the normal range in clients as 12.0-14.0 g/dL. According to Boehm *et al*. (2007), the mean Hb before chemotherapy was 12.63 g/dL with range of 9.18- 15.95 g/dL, whilst during treatment, the mean was 12.21 g/dL (SD 1.12) and after chemotherapy it rose up to 12.79 g/dL (SD 1.46). Meanwhile, Leonard *et al*. (2005) found that chemotherapy influenced anaemia of < 12.0 g/dL in 43-47% of patients, whilst those with severe anaemia, graded as grade 3 to 4 with Hb ≤ 7.9 g/dL affected 11% patients, and grade 1 to 2 anaemia patients of Hb level<10.9–8 g/dL was 67-97%. The effect of chemotherapy does not only have an impact on Hb level; albumin level could equally be reduced to below normal level of

3.5 g/l to 5.5 g/L or 35.0-55.0 g/dL which is associated with poor survival and increased mortality at any stage of BC (Chauhan *et al*., 2016).

CHAPTER THREE

3.0. MATERIALS AND METHODS

3.1. STUDY SITE

Tamale Teaching Hospital is the only Teaching Hospital in the northern part of country and situated in the eastern part of Tamale Metropolis. It serves as the referral centre for the three northern regions. It has a bed capacity of 71.5 and complement of 443, which represent percentage (71.5%) of total beds occupied at a time and number of beds available respectively.

3.2. STUDY DESIGN

The study was prospective cohort design. Data was collected from breast cancer (BC) patients under chemotherapy attending the Tamale Teaching Hospital from March to July 2018. A designed questionnaire was used to gather information from patients from their folders on key sociodemographic characteristics, anthropometric parameters, side effects from chemotherapy, 24 hour diet intake and dietary diversity, and some nutritional and biochemical profile of patients. Targeted participants were identified, as patients who came with breast problems to the breast clinic for consultation, and those who were finally diagnosed, confirmed and put on chemotherapy were selected for the study.

3.3. STUDY POPULATION

The study individuals were adult breast cancer clients reporting to the Breast Cancer Clinic at the hospital, for medical attention and were receiving chemotherapy as treatment for breast cancer.

3.4. SAMPLE SIZE DETERMINATION

The number of participants in the study was determined on the basis of incidence of breast cancer in TTH over a year, which was averagely 7 cases in a month, out of 89 of breast cancer patients seen in a year at the breast clinic (records from the TTH breast clinic). With using the Cochran's proportional formula, $n = t^2 \times p\ (1- p) / d^2$

(Cochran, 1977) and considering 7 per 100,000 (which translate into a proportion of 0.000007, that is, 0.007%) of breast cancer in Tamale Teaching hospital in Ghana with confidence interval (CI) level of 95% and 0.05 precision (margin of error), estimated sample size was; $n = 10.68 \approx 11$ as shown below, $n = (1.96)^2 \times p\ (1-p) / (0.05)^2$

$= 3.8416 \times 0.007\ (1 – 0.007) / (0.05)^2$

$= 3.8416 \times 0.006951 / 0.0025$

$= 0.02670 / 0.0025$

$= 10.68, \approx 11$

Where n is the sample size, with t representing the value for normal distribution in the assumption of 95% confidence level (1.96), p is the proportional incidence rate (0.000007) of breast cancer and d is margin of error of estimation.

To account for a dropout rate of 50%, the sample size was increased to 17.

3.5. PARTICIPANT SELECTION

Participants were purposively selected based on non-probability method at the breast clinic. On the clinic day for participants reporting or visiting for attention, all those who were under investigation for diagnosis for one condition or the other, and finally if

confirmed as BC were approached. Only those who were put on chemotherapy were approached and had the study explained to them. Those who consented to participate were selected and included as study participants.

3.6. DATA COLLECTION METHODS

A semi-structured questionnaire was used as the main data collection tool consisting of open and closed ended questions (appendix I). The questionnaire was used to collect information on sociodemographic characteristics such as occupation, educational level, age, and sex. It also gathered data on anthropometric parameters including weight, height, waist circumference, hip-circumference total body and visceral fats and total muscle mass. Others were chemotherapy adverse effects including signs and symptoms, and 24 hourly diet recall. The first 24 hour diet recall was taken on the day of initiation of chemotherapy, the second one at second cycle chemotherapy and third at the third cycle of chemotherapy. A 24 hour diet recall included the major three or main meals for the day, other meals or foods and drinks from the house or outside taken between the major meals.

Heights of participants were measured using a stadiometer with bare feet and without head jear or scaff, bare head and took into account of more hair on the head. Waist circumference (WC) in centimeters was determined using tape measure with the flat site on the bare body between the iliac crest and the lower rib, and measured beneath the navel. The hip-circumference (Hip-C) was measured with a tape measure by the investigator and the trained personnel standing at the side of the client and passing the flat side with light wear on body, from the prominent of the head of femur. With the help of an assistant at the other side, the tape measure was passed on the prominent part of the buttocks and the other prominent head of the femur at the other side, then passed in front to be measured on the prominent head of the femur at the initial or first side.

The measuring tape was ensured it was not too tight or too loose in order to have an appropriate measurement for both WC and Hip-C.

With only light wear on them, weights of participants were measured using bioelectrical impudence machine (BIM), OMRON body composition monitor model

BF511 (OMRON HEALTHCARE Co., Ltd, Japan, 53, Kunotsubo, Terado-cho, Muko, Kyoto) at each period of patients attendance for chemotherapy. To determine weight change, which was part of the main outcome of the study, a difference was computed between the third cycle weight and the initial. The machine was also used to determine body BMI, body fat %, visceral fat %, skeletal muscle mass % and metabolic rate after the height, age and gender were entered into the machine. This determination was carried out using the manual procedure guide by the manufacturer's instructions. Patients were guided to stand on the footplate of the device bare footed without heavy or weight articles on them with a gently grasp of the two handgrips straight at right angles. Then, the BMI, body fat %, visceral fat % and skeletal muscle mass % values were then read after the machine had appeared to settle with the weight of the individual appeared on the screen.

3.7. QUALITY CONTROL

A drafted questionnaire was prepared and pretested on 3 three known breast cancer patients reporting for attendance and 2 assisted nurses at the breast clinic. All concerns on the questions in the questionnaire that needed clarification were addressed and incorporated into the final questionnaire.

The two assistants assisted in collecting all the data from the participants at the breast clinic using a comprehensive data collection plan to ensure efficiency. Following a day's data collection, a review was made to identify encounted obstacles for redress, and discuss the next schedule. Explanation and interpretation were given to participants

where necessary and answers elicited and documented on the day of collecting data. Where some clients could not provide answers appropriately due to inability to read or understand, they were explained to with interpretation, before responses were made to questions.

3.8. DEFINITION OF STUDY VARIABLES

a) Age was categorized on the bases of premenopause and postmenopause

b) < 40 years, 40-50 years and ≥ 50 years to look for age group most affected

c) Nutritional status was defined:

i) Anthropometric parameters of weight, height, waist circumference, hip circumference, body mass index (BMI), body fat, visceral fat and muscle mass ii) Biochemical profile was define as haemoglobin and albumin

d) Weight change was the difference between initial weight and change in weight after second cycle or at third cycle chemotherapy

e) Twenty four (24) hour dietary habits was the average of various different foods of three days main meals including snacks in three days in a week consumed

f) Dietary diversity is all kinds of foods in food groups included in 24 hour dietary habits.

3.9. DATA HANDLING, ANALYSIS AND PRESENTATION

The Microsoft office Excel 2010 was used to clean up data collected, and then entered into SPSS IBM version 20 for statistical analysis. Pearson's correlation, Spearman's correlation, bivariate correlation and linear regression were used to establish any association between initial nutritional status and weight change and post-therapy indicators.

3.9. ETHICAL CLEARANCE

With an introductory letter from Kwame Nkrumah University of Science and Technology to the Tamale Teaching Hospital (TTH), ethical clearance and authorization were sought for from TTH ethical clearance committee. On obtaining the ethical clearance and authorization, participants consent were sought and those who voluntarily accepted to participate were included for the study.

CHAPTER FOUR

4.0. RESULTS

4.1. Summary of Results

The study was a prospective survey to determine nutritional status and weight change of breast cancer patients undergoing chemotherapy. This chapter presents the results of the analysis of the data collected from participants which include sociodemographic characteristics, anthropometric and biochemical parameters, dietary intake and diversity, and the relationship between initial nutritional status and weight change over a period of treatment.

4.2. Sociodemographic Characteristics of Participants

All the 17 participants recruited were females, with the lowest age of 21years and the oldest, 69 years and had a mean age of 43 ± 13.2 years. Majority of the women 13 (76.5%) were in the premenopausal group. There were 8 (47.1%) respondents with age less than 40 years and those almost or in the menopausal age, ≥ 50 years were 5 (29.4%) participants. More than half of the respondents 11 (64.7%) had no formal education, and those who had some form of education, only 3 (17.6%) had up to the tertiary level. Occupation wise, more respondents were housewives 5(29.4%), with farmers being 2 (11.2%) and civil or public servants 2 (11.2%) as the least (Table
4.1).

In terms of grades of participants' breast cancer, almost half of them were grade 2, 8 (47. 1%) with grade 1 making the least, 1(5.9%). Grade 3 had equal respondents of 4(23.5%) as grade 4 and others who were graded as 'higher grade' or 'invasive ductile carcinoma'. Majority of respondents 11(64.7%) were diagnosed within a month before initiation of chemotherapy. Whiles only 1(5.9%) started treatment 5 or more months

after diagnosis, 2(11.8%) and 3(17.6%) respondents had theirs diagnosed within 2 and 3 months respectively before they began their treatment. Most respondents 11(64.7%) noticed the signs and symptoms of the disease a year before reporting to the hospital; one participant three years before and three of them 4 years before reporting. There was no comorbidity reported or observed during respondents' attendance to the clinic.

Table 4.1: Distribution of Sociodemographic Characteristics of Respondent (n = 17)

Variable		N	%
Gender			
	Male	0	0.0
	Female	17	100
Age risk category			
	< 40	8	47.1
	40 - 49	4	23.5
	≥ 50	5	29.4
Menopausal age			
	Premenopausal (< 51)	13	76.5
	Postmenopausal (≥ 51)	4	23.5
Occupation			
	Farmer	2	11.2
	Businessman/Trader	4	23.5
	Housewife	5	29.4
	Civil/Public Servants	2	11.2
	Others	4	23.5
Educational level			
	No formal education	11	64.7
	Non-formal education	1	5.9
	Primary/JHS	1	5.9
	SHS	1	5.9
	Tertiary	3	17.6
Disease grade (G)			
	G/I	1	5.9
	G/II	8	47.1
	G/III	4	23.5
	IV and others	4	23.5

Where N is number of participants, % is percentage and Roman numerical are labeled as the stage of breast cancer, and others labeled as higher grade (G) or invasive ductile carcinoma

4.3. Anthropometric Characteristics of Participants

The various anthropometric parameters, weight (Wt), height (Ht), body mass index (BMI), waist circumference (WC), waist-hip circumference (HC), total body (BF), visceral fat (VF) and skeletal muscle mass (SMM) were measured.

The various anthropometric parameter variables were presented as means, standard deviations (SD), minimum and maximum values after second cycle of chemotherapy in Table 4.2 after SPSS analysis. With regard to weight, a mean of 69.3 ± 21.20 was obtained with the minimum being 46.2 kg and the maximum being 142.4 kg after the second cycle of treatment. In the case of BMI, the mean value 25.6 ± 6.3 kg was the same as the weight before treatment, although the minimum (17.0 kg) and maximum (46.0) changed. The mean waist circumference initially was 89.6 ± 13.91cm but, went up to 90.0 ± 14.3 cm after second cycle of treatment. The initial mean of waist to hip circumference and the after second cycle means was recorded as 0.89 cm. An initial maximum body fat was seen as 51.5% with a mean of 35.3% after chemotherapy. Furthermore, the visceral fat also had 6.4% ± 2.5 as the mean value after second chemotherapy with minimum and maximum of 3.0% and 14.0%, respectively.

Table 4.2: Distribution minimum, maximum mean and standard deviation (SD) of participants anthropometric parameters and biochemical profile before and after chemotherapy

Variable	Minimum	Maximum	Mean	SD
Weight (kg)	46.6	142.8	68.5	21.20
Weight1(kg)	48.8	143.4	69.1	21.14
Weight2(kg)	46.2	142.4	69.3	20.95
Height (m)	1.48	1.76	1.64	0.07
BMI (kg/m^2)	17.1	46.1	25.6	6.3
BMI1(kg/m^2)	17.8	46/3	25.7	6.3
BMI2(kg/m^2)	17.0	46.0	25.6	6.3
Waist circumference (cm)	74.0	136.0	89.6	13.91
Waist circumference1(cm)	72.5	137.0	90.1	13.99
Waist circumference2(cm)	70.0	137.0	90.0	14.3
Waist/hip ratio	0.80	0.97	0.89	0.04
Waist/Hip ratio1	0.78	0.97	0.90	0.05
Waist/Hip ratio 2	0.78	0.97	0.90	0.05
Body fat (%)	18.0	51.3	33.4	8.6
Body fat 1 (%)	21.1	53.8	35.0	7.9
Body fat 2 (%)	21.1	51.5	35.3	7.3
Visceral fat (%)	2.0	14.0	6.2	2.7
Visceral fat 1 (%)	3.0	15	6.3	2.7
Visceral fat 2 (%)	3.0	14.0	6.4	2.5
Muscle mass (%)	22.2	38.6	28.6	4.2
Muscle mass 1 (%)	20.9	35.2	27.4	3.9
Muscle mass 2 (%)	22.0	32.1	27.4	2.9

BMI is body mass index, 1 and 2 represents first and second cycle respectively and other variable without a numbers are before starting therapy

From analysis, the results showed a minimum weight of 46.6 kg and a maximum of 142.8 kg with minimum and maximum heights of 148 cm and 1.76 cm, respectively. The waist circumference showed minimum and maximum values of 74 cm and 136 cm respectively. The least in the initial body mass indices (BMIs) was 17.1 kg/m^2 and the maximum was 46.1 kg/m^2 with the muscle mass indicating a maximum of 32.1% and a minimum of 22.0%. Analysis on visceral fat levels indicated 16 (94.1%) of participants to be in the normal visceral range of fat of 1 to 9%, with only 1(5.9%) respondent showed a high fat level of 14%.

When ANOVA was used to analyse data, the increased mean difference between weight after first and second treatments of chemotherapy indicated a significance of $P = 0.005$. It also showed the mean increased difference between waist circumference before and after first treatment of chemotherapy was significant, $P = 0.001$. Table 4.3 illustrates those increased and decreased means differences before, within and after treatment that were significant.

Table 4.3: Association of nutritional status means differences before and after treatment of chemotherapy

Variable	Mean	*P*
Weight1 (kg)	69.1	0.005
Weight2 (kg)	69.3	
Waist circumference (cm)	89.6	0.001
Waist circumference1 (cm)	90.1	
Waist circumference (cm)	89.6	0.011
Waist circumference2 (cm)	90.0	
Waist circumference1 (cm)	90.1	0.004
Waist circumference2 (cm)	90.0	
Waist/Hip ratio 1	0.8982	0.024
Waist/Hip ratio 2	0.8994	
Visceral fat (%)	6.2	0.000
Visceral fat 1 (%)	6.3	
Visceral fat (%)	6.2	0.000
Visceral fat 2 (%)	6.4	
Visceral fat 1 (%)	6.3	0.000
Visceral fat 2 (%)	6.4	
Haemoglobin (g/dl) level 1	11.7	0.020
Hamoglobin (g/dl) level 2	11.5	

Variable without a numbers are those before starting therapy, and 1 and 2 represents first and second cycle respectively

When the results of the respondents' anthropometric parameters were categorized into underweight, normal, overweight, obese or obesity, high and very high, the distribution presented the various values in Table 4.3. Before the commencement of chemotherapy,

most 9(52.9%) of the respondents had normal body mass (BMI) with 2(11.8%) having obesity, and only one was under weight. After the second cycle of chemotherapy there was no change in number of underweight and obese participants before therapy was initiated, 1 (5.9%) and 2 (11.8%) respectively. There was a change in the number of respondents with normal from a less than one 9 (52.9%) to 10 (58.8%), and the number of overweight from 5 (29.4%) to 4 (23.5%). The number of participants 14 (82.4%) waist-hip ratio before and after second cycle still remained the same, which was as visceral fat with sixteen (94.1%) respondents but, a change of normal skeletal muscle mass from 9 to 13 participants. Sixteen 16 (94.1) had visceral fat within the normal range while 6 (35.3%) normal body fat with 5 (29.4%) and 4 (23.5%) respondents having high and very high body fats, respectively. Only one (1) respondent had very high skeletal muscle mass, 9(52.9%) had skeletal muscle mass within acceptable normal muscle mass with 4 (23.5%) having high skeletal muscle mass.

Table 4.4: Distribution of anthropometric parameters among participants before the start and after second chemotherapy

Variable	NBC	NAC	DBAC
Body mass index (BMI) kg/m^2) Underweight (<18.5)	1	1	0
Normal (18.5 – 24.9)	9	10	1
Overweight (25- 29.9)	5	4	-1

	Obese (≥30)	2	2	0
Waist circumference WC (cm)	Normal (< 80.0)	3	3	0
	Overweight (80.0-87.9)	5	6	1
	Obesity (≥ 88.0)	9	8	-1
Waist-Hip Ratio Metabolic risk visceral fat				
	Normal (≤ 0.85)	4	3	-1
	High (> 0.85)	13	14	1
Waist-Height Ratio Metabolic risk visceral fat				
	Normal < 0.5	3		
	High ≥ 0.5	14		
Visceral fat (VF) (%)				
	Normal (1-9)	16	16	0
	High (10-14)	1	1	0
	Very High (15-30)	0	0	0

Age range (years)	18-39	40-59	60-80			
Body Fat (BF) (%)						
	Low (<)	21.0	23.0	24.0	2	1	-1
	Normal (21-32.9)	21.0-32.9	23.0-33.9	24.0-35.9	5	6	1
	High (33-38.9)	33.0-38.9	34.0-39.9	36.0-41.9	7	5	2
	Very high (≥)	39.0	40.0	42.0	4	5	1

Skeletal muscle mass (SMM) (%)

	Low	< 24.3		
	Normal	24.3-30.3		
	High	30.4-35.3		
	Very high	≥ 35.4		
< 24.1	< 23.9	2	2	0
24.1-30.1	23.9-29.9	9	13	4
30.2-35.1	30.2-35.1	5	2	-3
>35.2	≥ 35.0	1	0	-1

NBC is number of participants before start of chemotherapy, NAC is number of participants after second cycle chemotherapy and DBAC is the difference between before and after second cycle chemotherapy number of participants. Meanwhile, waist circumference indicated majority 9(52.9%) had obesity and only few 3(17.6%) were within the normal range. The same applied to waist-hip ratio where 13(76.5%) showed high ratio > 0.85, and waist-height ≥ 0.5, 14 (82.4%).

A biomedical impudence machine (BIM) was used to determine the average basal metabolic rate of participants for three consecutive periods, from the start and after the

second chemotherapy. The average means, standard deviations (SD), minimum and maximums were determined by BIM as summarized in Table 4.4. At the beginning of therapy mean (SD) was 1421 ± 255 j/day. After second cycle of treatment, it became 1418 ± 251 j/day with the initial mean of 1419 ± 253 j/day. There was no significant metabolic energy difference between before, within or after treatment.

Table 4.5: Distribution of metabolic rate (MR) parameters before and during chemotherapy

Variable	Minimum	Maximum	Mean	SD
MR (j/day) Before first cycle	1087	2315	1421	266
MR (j/day) Before second cycle	1124	2284	1419	253
MR (j/day) Before third cycle	1172	2296	1418	251

4.4. Biochemical Profile of Respondents

Presented in Table 4.5 are biochemical parameters, haemoglobin (Hb) and albumin (Alb). Patients parameters obtained from laboratory results from their folders were analysed by the use of SPSS to give the biochemical statistical values. Considering the haemoglobin (Hb) levels before the start of chemotherapy, the minimum and maximum Hbs were 10.0 g/dl and 15.3g/dl, respectively, with a mean 12.1 ± 1.4 g/dl. After initiation of the treatment at the first cycle, mean Hb value obtained was 11.8 ± 1.3 g/dl with a minimum value of 9.4 g/dl and a maximum of 14.3 g/dl. The third cycle therapy Hb result had a mean value of 11.5 ± 1.0 g/dl and a minimum value of 10.1 g/dl and maximum of 13.9 g/dl.

With regards to albumin, before treatment began, the mean (SD) was found to be 44.1 ± 5.7 g/l with the minimum being 32.0 g/l and the maximum being 53.8 g/l. Before the 2nd cycle therapy had done, result of albumin values yielded a mean of 42.8 ±5.2 g/l with a minimum of 33.2 g/l and maximum of 53.6 g/l. At the 3rd cycle, a mean value of 43.1 ± 8.0 g/l was obtained with a minimum and maximum of 29.6 g/l and 68.3 g/l, respectively.

Table 4.6: Distribution of Haemoglobin and Albumin Levels of Respondents

Variable	Minimum	Maximum	Mean	Standard Deviation
Hb (g/dl) level at 1st cycle	10.0	15.3	12.1	1.4
Hb (g/dl) level after 1st cycle	9.4	14.3	11.7	1.3
Hb (g/dl) level after 2nd cycle	10.1	13.9	11.5	1.0
Alb (g/l) level at 1st therapy	32.0	53.8	44.1	5.7
Alb (g/l) level after 1st cycle	33.2	53.6	42.8	5.2
Alb (g/l) level after 2nd cycle	29.6	68.3	43.1	8.0

Where 1st is first, 2nd is second, Hb is hemoglobin and Alb is albumin

4.5. Signs and Symptoms from Chemotherapy Effect

Drugs that were administered to clients were kytril, Adriamycin, Cyclophosphamide, 5-flouruoracil and dexamethasone through intravenous and then, tablets of dexamethasone and metoclopramide for oral. There were some signs and symptoms exhibited and observed during this chemotherapy. Data collected and analyzed on signs and symptoms exhibited by respondents from medication are illustrated in Table 4.6.

Those signs and symptoms shown before the chemotherapy administration were loss of appetite and weight which were experienced by 8 (47.1%) respondents. These were followed by fatigue and constipation with 5 (29.5%) and 2 (11.8%) respondents, respectively. They had no experiences from the rest of the signs except, 1 (5.9%) respondent who had diarrhoea. It was noticed after the first but, before the 2nd cycle chemotherapy that, majority of respondents 13 (76.5%) had witnessed brittle or loss of hair and fatigue 12(70.6%). Quite a number of 6 (35.3%) respondents experienced diarrhea and early satiety with 3 (17.3%) that had lost appetite and also had constipation, with 2 (11.8%) having nausea and xerostomia.

The impact of the second cycle therapy increased respondents brittle and hair loss to 15 (88.2%) but, fatigue was decreased to 7 (41.2%). Respondents who had constipation rose to 4 (23.5%) but, still the same number 3 (17.3%) who loss appetite before the

cycle. Those respondents who experienced nausea and xerostomia were increased to 5 (29.4%) and 6 (35.3%) respectively but, diarrhoea was decreased to 1 (5.9%). Other symptoms the participants complained about were itching at the site and pain.

Table 4.7: Distribution of Signs and Symptoms from Chemotherapy Effect

Variable	Initial cycle		Second cycle		Third cycle	
	N	%	N	%	N	%
Loss of appetite	8	47.1	3	17.3	3	17.3
Nausea	0	0.0	2	11.8	5	29.4
Diarrhoea	1	5.9	6	35.3	1	5.9
Xerostomia	0	0.0	2	11.8	6	35.3
Early satiety	5	29.4	6	35.3	2	11.8
Fatigue	4	23.5	12	70.6	7	41.2
Constipation	2	11.8	3	17.3	4	23.5
Brittle/Loss of hair	0	0.0	13	76.5	15	88.2
Perceived Weight gain	0	0.0				
Perceived Weight loss	8	47.1				

4.6. Dietary Habits and Supplement Use of Respondents

Tables 4.7 and 4.8 are showing data on participants dietary habits and supplement taken on twenty (24) hour diet bases. The result was presented in three parts, with part one dealing with usual general 24 hour habitual food intake of participants, part two concentrated on 24 hour dietary habits at three consecutive chemotherapies and part three was on means on the 24 hour dietary habits arrived from after first two chemotherapy periods. No participant used supplement during data collection period.

4.6.1. General Twenty Four (24) hour Dietary Habits of Respondents before Chemotherapy

Assessment of respondents' habitual general intake with regard to dietary diversity from food groups was based on Food and Agricultural Organization (FAO) dietary guidelines

(2010). The assessment was used to determine respondents' frequency of intake of foods from various food groups (Figure 4.1). All 100% respondents indicated that they consumed grains with 16(94.1%) of them enjoy food from roots, tubers or plantain as their main meal. Sixteen 16 (94.1%) also indicated that, they consumed nuts and seeds while 14 (82.4%) of them indicated that they consumed beans or peas and their products for food. Nine (52.9%) respondents indicated they consumed milk and their products as against 8 (47.1%) who did not. Eight 8(47.1%) respondents indicated that they consumed organ meat as against 9 (52.9%). The results showed 16 (94.1%) respondents who used meat and poultry for their meals with 15 (88.2%) using fish and sea food to prepare food. Seven (41.2%) indicated that they added eggs to their meals.

Every respondent consumed dark green leafy vegetables, with 12 (70.6%) taking other vegetables. Less than half of respondents 47.1% used vitamin A-rich vegetable rich roots and tubers compared to 9 (52.9%) who did not. Though, majority 12 (70.6) used to take other fruits, those who took vitamin A-rich fruits were lesser and made up 64.7%. In the case of red palm oil usage, 12 (70.6%) respondents indicated Yes.

None of the respondents indicated consumption of insects and other small proteins.

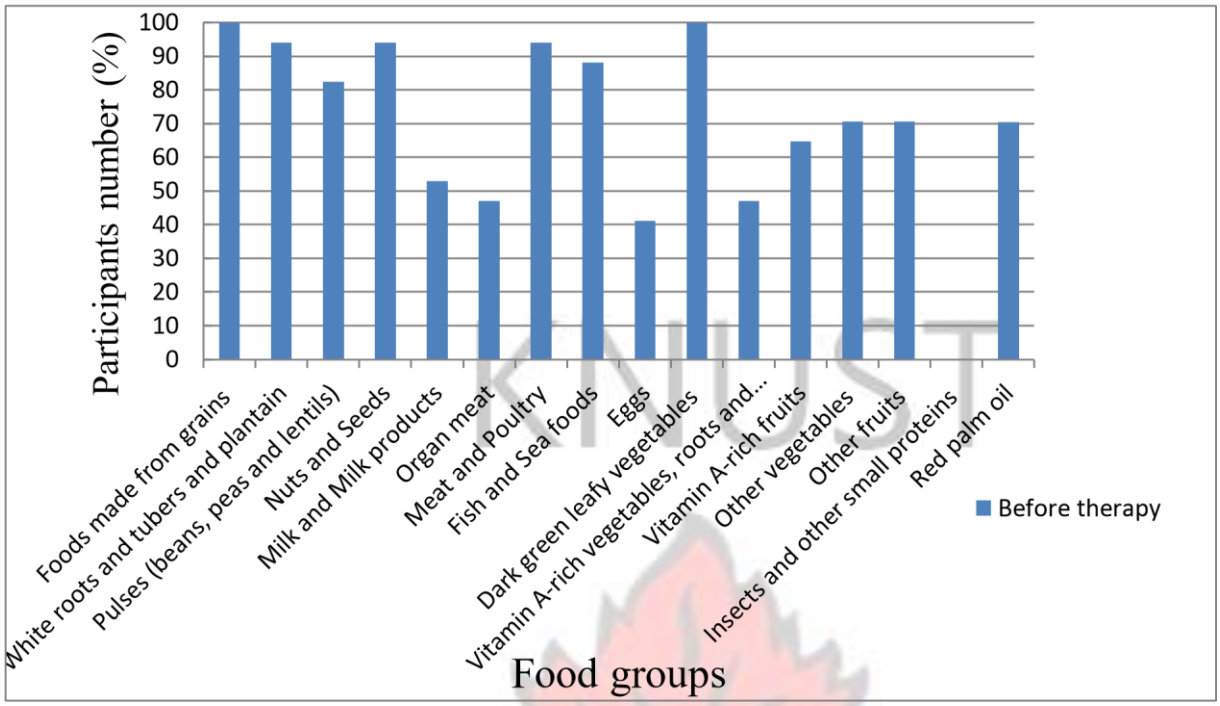

Figure 4.1: Distribution of general dietary habits and food diversity in food groups by participants before therapy

4.6.2. Twenty Four (24) hour Dietary Habits of Respondents under Chemotherapy

Figure 4.2 illustrates the scores of foods consumed from food groups classified into women dietary diverse score (WDDS) by FAO (2010) to determine proportional levels of intake of each food group. The figure also shows a twenty four (24) hour consumption of foods at each cycle of chemotherapy. Foods from the grains, roots, tubers and plantain were classified as starchy staples; meat, poultry, fish and sea foods were grouped into meat and fish; Vitamin A-rich vegetables, roots, tubers and Vitamin A-rich fruits grouped into vitamin A-rich fruits and vegetables; and other fruits and other vegetables were lamped as other fruits and vegetables.

With the exception at the second cycle where 15 (58.8%) participants took the starchy staples, which consist of carbohydrate sources, almost all 16 (94.1%) participants took them at the first and third cycles.

Eleven (64.7%) Respondents at the first and third cycle consumed legumes, nuts and seeds as more of fat and oil sources, and 10 (58.8%) respondents at the second cycle. Meat and fish had majority 16 (94.1%) respondents at the first and second cycle consumed them as protein sources, with all the 17 taken them at the third cycle. Only one (1) (5.9%) participant across the three cycles took organ meat. For milk and its products, less than half 6 (35.3%), 4 (23.5%) and 5 (29.4%) Respondents consumed them at the initial, second and third cycles, respectively. While 12 (70.6%) and 11 (64.7%) respondents took dark green vegetables at the first, third and second cycles, few and less than half 4 (23.5%), 1 (5.9%) correspondingly consumed other vitamin A-rich fruits and vegetables at first, second and third cycles. Nine (52.9%) participants took other fruits and vegetables at the first cycle, with lesser 7 (41.2%) and 6 (35.3%) taken them at the second and third cycles.

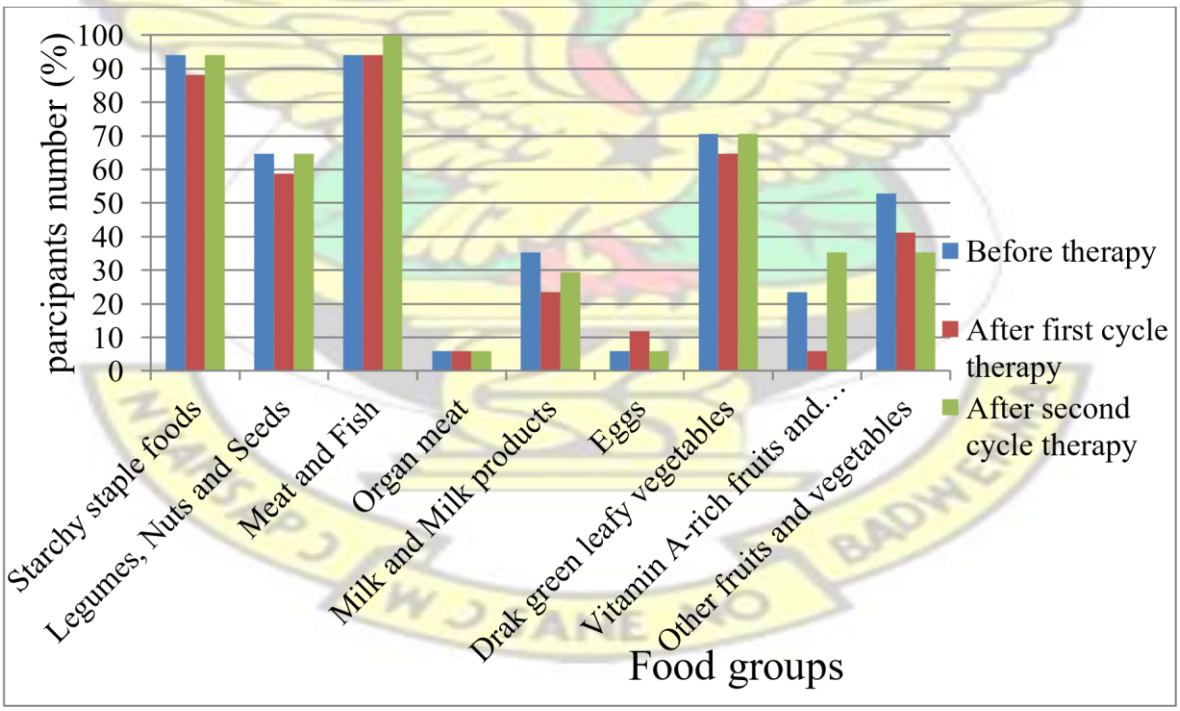

Figure 4.2: Distribution of Dietary Habits and Food Diversity in Food Groups by Participants (n=17)

As shown in Figure 4.2, respondent's proportional consumption score of diverse foods in the food groups indicated there were changes across between average score before therapy and after first and second cycle therapy. However, the average 16 (97.1%) and 2 (8.9%) proportion of respondents after first and second therapy of consumption of dark green vegetables and eggs were proportionally higher than 16 (94.1%) and 1 (5.9%) before treatment began. One person's each took organ meat and eggs, the same one mean of Respondents who consumed organ meat after second therapy but, higher mean proportion of 2 (8.9%) by addition of one consumed eggs.

4.7. Nutritional Status and Impact of Chemotherapy Over A Second Cycle Period

4.7.1. Weight Change of Respondents after Second Cycle of Chemotherapy

Weights change were recorded in Table 4.7 with presentation as weights before, during, after second cycle chemotherapy, and weight change between after second cycle and before chemotherapy.

Table 4.8: Distribution of initial, 2nd cycle, 3rd cycle and weight change after 2nd cycle therapy

Initial Weight (Wt)	Weight (Wt) at Second cycle	Weight (Wt) at Third cycle	Weight (Wt) change after 2nd cycle
61.3	63.5	63.8	2.5
52.2	55.2	54.4	2.2
48.0	50.8	51.9	3.9
72.2	72.2	73.1	0.9
65.4	65.0	66.0	0.6
83.0	85.5	84.0	1.0
60.6	58.1	61.6	1.0
72.3	71.8	71.3	-1.0
71.3	72.0	74.0	2.7
65.1	68.6	67.1	2.0
66.4	68.2	69.3	2.9
58.7	55.9	55.3	-3.4
64.1	64.3	63.3	-1.1
142.8	143.4	142.4	-0.4

63.8	63.7	63.8	0.0
70.0	71.8	71.2	1.2
46.6	46.2	48.4	1.8

At the beginning of the measurement of respondents, the highest weight recorded was 142.6 kg, and the least was 46.6 kg. When weight change data was analysed after second cycle of chemotherapy, the mean was 0.99 ± 1.8 kg. The analysis showed the lowest weight changed value to be -3.4 with a maximum value of 3.9 shown in Table 4.8.

Table 4.9: Distribution of Initial Weight and Weight Change after Second cycle Chemotherapy

Variable	Minimum	Maximum	Mean	SD
Initial weight (kg)	46.6	142.6	68.5	21.2
Changed in weight after second cycle (kg)	-3.4	3.9	0.99	1.8

4.7.2. Relationship between Initial Anthropometric indices and Weight Change

To determine any relationship between the initial nutritional status and weight change, Chi-Square, bivariate correlation and linear regression tests were used to test for any relationship.

With the use of Chi-square test, there was no relationship between initial nutritional statuses and weight change after second cycle (Table 4.9).

Table 4.10: Distribution of Chi-square test result between initial statuses and weight change after second cycle chemotherapy

Variable	Cut-Off Points	NBC	NAC	*P*
Body mass index (BMI)	< 18.5	1	1	0.250
	18.5 – 24.9	9	10	
	25 – 29.9	5	4	

	≥ 30	2	2	
West circumference (WC)	< 80	3	3	0.281
	80 – 87.9	5	6	
	≥ 88	9	8	
WC- Hip ratio	< 0.85	2	3	0.665
	≥ 0.85	15	14	
Body fat (BF)%	Low	2	1	0.250
	Normal	6	6	
	High	5	5	
	Very high	4	5	
Visceral fat (VF)%	Normal	16	16	
	High	1	1	
	Very	0	0	
Skeletal muscle mass (SMM) %	Low	2	2	0.619
	Normal	9	13	
	High	5	2	
	Very high	1	0	
Haemoglobin (Hg) level based on anaemia	< 11	3	4	0.597
	≥ 11	14	13	
Albumin (Alb) level based on low and normal	< 3.5 g/l or 35 g/dl	1	2	0.319
	≥ 35 g/dl – 55 g/d	16	14	

NBC is number of participants before chemotherapy and NAC number of participants after chemotherapy

On the hand, the analysis indicated that, almost all the initial anthropometric parameters were significantly correlated with weight change after second chemotherapy except, waist to hip ratio and skeletal muscle mass. Haemoglobin and albumin were not also correlated as observed in Table 4.10.

Table 4.11: Distribution of correlation between participants initial nutritional status and change in weights after second chemotherapy

Variable	Weights (Kg) after second chemotherapy

	R	*P*
Height (m)	0.529	0.029
Body mass index (BMI) (Kg/m^2)	0.947	0.000
West circumference (WC) (cm)	0.971	0.000
WC- Hip ratio	0.333	0.191
Body fat (BF) (%)	0.711	0.001
Visceral fat (VF) (%)	0.886	0.000
Initial basal metabolic rate (%)	-0.449	0.071
Skeletal muscle mass (SMM) (%)	-0.436	0.080
Haemoglobin (Hg) (g/dl) level	-0.032	0.902
Albumin (Alb) (g/l) level	-0.158	0.546

Furthermore, all the three tests showed correlation by Pearson's correlations with appreciable strong ratio of -0.554, and significant association of 0.021, between height and weight changed with a significance, *P* = 0.024 for linear regression as presented in Table 4.11.

Table 4.12: Distribution of Relation between initial nutritional statuses and weight change of participants after second cycle of chemotherapy Variable Weigh

	Height (kg)	BMI t (m)	WC (Kg/m^2)	WC-HCr	BF (cm)	VF	SMM (%)	Hb (%)	Alb (%)	(g/dl)	(g/l)
Bivariate Correlation											
Ratio (R)	-0.267	-0.554	-0.246	-0.131	0.061	0.007	0.014	-0.107	-0.132	-0.025	
Pearson's Correlation (*P*)	0.299	0.021	0.340	0.616	0.817	0.980	0.959	0.683	0.614	0.925	
Linear Regression											
Ratio (R)	-0.264	-0.544	-0.246	-0.134	-0.046	0.014	0.004	-0.112	-0.140	0.010	
P	0.305	0.024	0.340	0.609	0.862	0.956	0.987	0.669	0.591	0.969	

BMI is body mass index, WC is waist circumference, WC-HCr is waist to hip circumference ratio, BF is body fat, VF is visceral fat, SMM is skeletal muscle mass, Hb is haemoglobin,, Alb is albumin and *P* is association or significance

CHAPTER FIVE

5.0. DISCUSSION

All participants who attended the breast clinic at Tamale Teaching hospital were females with 8 (47.1%) having age below 40 years and the least of 21 years while the oldest was 69 years. The results are in agreement Ghartey *et al*. (2016) and Jedy-Agb *et al.,* (2016), who reported that age below 40 years are affected and may be becoming more affected with breast cancer. Reproductive lifespan with its associated high estrogen limit breast cancer occurrence in premenopausal than postmenopausal, who have low levels, as it turns to reduce the risk and protect against the cancer. The results are, however, in variance to the studies by White *et al.* (2014) and John *et al*. (2016), who study showed breast cancer occurred in individuals 50 years and above. A mean of 43 years in this study confirms a study in sub-Saharan Africa by White *et al*. (2016), that, the average age developing breast cancer may be 40 years or above

Housewives (29.4%) and those who were into business or traders (23.5%) were those mostly affected in this study, forming about 53% of total respondents with the latter said to be in socioeconomically better position for seeking attention to their condition. Out of the 17 respondents, majority 64.7% of them had no formal education and were the most affected followed by tertiary education 3 (17.6%), similar to study by Mahammed and Daoud, (2013), who revealed high illiterate respondents who had breast cancer (40.9%) and 11.2% who had tertiary education.

Affected clients who visited the clinic with the breast cancer at grade (G) 3 or stage III, and IV together made a total of 47.1% and same as those who sorted attention at the clinic and were diagnosed to have grade 2 or stage II. Lee et al. (2016) study observed at diagnosis, 43.5% of patients with stage II, 31.0%, and 22.3% at stage III.

It was observed in this study that, majority (64.7%) of the respondents reported for medical attention within a year after noticing the signs and symptoms within a year although 17.6% reported 4 years or later for medical attention after noticing the signs and symptoms. A study in Ghana has shown that, women with breast cancer reported for medical attention as late as 8 to 10 months after diseases onset, which is seen among the young age and advanced stage grades III and IV of the disease (Thomas *et al*., 2017). Anthropometric parameters are important in determining nutritional status in the health state of an individual so, thus its significance in breast cancer which is associated with comorbidity diseases, and poor prognosis outcome from recurrence and treatment toxicity intolerance. The basal metabolic rate mean 1421 ± 266, minimum of 1087 j/day) and Maximum of 2315 j/day decreased after second cycle of therapy to mean of 1418 ± 251 1376, minimum and maximum of 1172 j/day and 2296 j/day, respectively, indicating conservation of energy for tissues utilization or activities such as repair and building up of other tissues for maintenance, if not, also influenced increase in body weight or size. This study however, showed the difference in means were not statistically significant.

From the analyzed results the heights of the respondents had a mean, 1.64 ± 0.07 m with the least height of 1.48 m and the tallest, 1.76 m. Although, both minimum and the maximum weights had decreased from 142.8 kg and 46.6 kg to 142.4 kg and 46.2 kg, respectively, a positive weight increased was presented from mean weight before chemotherapy as 68.5 kg and 69.3kg after second cycle chemotherapy which were associated benefit and improvement in patient outcome as evidence by Atalay and Küçük (2015) in weight gain following adjuvant chemotherapy benefit and improvement in patient outcome. The difference in means weights recorded were associated with significances of 0.005, between weights before chemotherapy and after

second cycle treatment. Meanwhile, in Key *et al*. (2004) and Deluche *et al*. (2018) where this weight gain is associated with the ratio of weight and height resulting in overweight and obesity may lead to poor prognosis and contributes to co morbidities such as diabetes, hypertension and osteoarthritis.

There was no change in body mass index (BMI) of underweight respondents of one (5.9%) before and during therapy but, underweight predispose to low treatment efficacy mortality as in Bering *et al*. (2015). Over the second cycle period of treatment there was an increased in normal body mass index (BMI) to 58.8%, serving as conducive state for successful therapy outcome. A total of 6 (35.3%) respondents from overweight 4 (29.4%) and obese 2 (11.8%) after second cycle chemotherapy were at risk for metabolic syndrome diseases, breast cancer (BC) recurrence or poor prognosis therapy outcome, which is said to be in line with Custódio *et al.* (2016), Key *et al*. (2004) and Deluche *et al.* (2018), where 56% of breast cancer patients from nutritional assessment were overweight from three different treatments, with studies shown overweight and obese are at risk for breast cancer, serving as the bases for prognosis for recurrence and mortality compared with normal body mass index. After the second cycle chemotherapy 17.6% respondents waist circumference were within the normal range, ≤ 80 cm. However, respondents with overweight (29.4%) and obese (52.9%) waist circumference (> 80 cm) together still remained the same as overweight of 35.3% and obese of 47.1% before therapy and after second cycle treatment respectively. Even though, categorized respondents numbers were almost the same, the differences in their means before and after chemotherapy were significant. These significances were shown before and after treatment as $P = 0.001$, $P = 0.011$ and 0.004. With evidence as high waist circumference (> 80 cm) 80.8% in the study of Bering *et al*. (2015), the total 82.3% respondents in this study were predisposed to poor treatment prognosis,

metabolic syndrome, cardiovascular diseases (CVDs) and recurrent BC. Further determination of waist to hip ratio indicated a high number of 14 (82.5%)) respondents were found to be at risk for comorbidities or recurrence of BC after treatment, with some other investigations found waist and waist-to-hip ratio (≥ 0.85 cm), which show the distribution of abdominal cavity and lean muscle mass ratio, predicts risk for cardiovascular diseases and metabolic syndrome more clearly (Ramírez-Vélez *et al*., 2017: Flint *et al*., 2010; BC Cancer Agency, 2012; Raposo *et al*., 2018) than BMI.

A total of 11 (64.7 %) respondents from high body fat (BF) of 7 (41.1%) respondents and very high BF of 4 (23.5%) respondents before chemotherapy indicated a decreased to 10 (58.8%) respondents after second cycle therapy administered. The effects of the therapy decreased to 10 (58.8%) showed a decreased by two respondent from before therapy of 7 (41.1%) respondents, which after second cycle chemotherapy yielded 5(29.4%) respondents each from high and very high BF to established risk for comorbidities and BC recurrence. Risk, which was categorized based on age and body fat (BF) accumulation had shown that, the10 (58.8%) respondents were at risk for metabolic diseases and CVDs and BC risk for recurrence or for comorbidities or CVDs. Studies in Li *et al.* (2017) and Kitchlew *et al*. (2017) also revealed from investigations on body fat (BF) mass corresponding to obesity of 30kg/m^2 in young Caucasians who were 35% of women were at risk for diseases or metabolic syndrome while BC patients are at risk for or age at risk for comorbidities, recurrence and mortality.

Almost all the 94.1%) respondent visceral fat had shown desired levels within the normal range (1 to 9%) before and during chemotherapy, and was indication for good treatment prognosis and outcome. Differences in means before and after treatment were statistically significant between the cycles of chemotherapy, P = 0.00. Even though, only one (5.9%) respondents visceral fat was high and therefore, was only the one at

risk for metabolic syndrome and CVDs from visceral fat, it was similar to studies by Flint *et al*. (2010), BC Cancer Agency (2012), and Raposo *et al*. (2018) who found age at risk of visceral fat, though greater than 10 %, were at risk for commodities and BC recurrence.

Accordingly, skeletal muscle mass which was also categorized on age bases, had impact from chemotherapy. With respect to skeletal muscle mass (SMM), there was an increased in normal to 13 (76.5%) respondents after second cycle treatment from 9 (52.9%) respondents before chemotherapy with associated decreased by 3 (17.6%) and 1 (5.9%) respondents from those having high and very high SMM before treatment began. Desirable high proportional level of 15 (88.2%) respondents with normal (76.5%) and high (17.6%) SMM together after the second cycle chemotherapy was indicating client's chance of success in full treatment regimen as compared to few sarcopenia (11.8%) respondents who still remained the same as the initial of 2 (11.8%) respondents, would be prone to chemotherapy toxicity or intolerance after the third cycle therapy. The decreased in SMM by the total of 4 (23.5%) respondents is shown in Lønbro *et al*. (2017), where decreased in muscle mass happens frequently due to cancer impact itself and or its chemo or hormone therapy effects, which is related to tumour progress, treatment intolerance and response with poor survival. To prevent or manage sarcopenia, one should not depend on nutrition counseling or advice alone, but the support of physical aerobic activities will help improve muscle mass and performance. Study by Neefjes *et al*. (2017) have it that, diet is not the only major factor in the determining healthiness; muscle mass and work performance but, the culminated aerobic and resistance exercise intervention helps in

pathophysiological mechanism have positive effects in sarcopenia.

Cancer can lead to malnutrition, infiltration and destruction of haemopoietic tissue which causes anaemia, and chemotherapy and radiation-induced myelo-suppression and cytokine-mediated anemia (Edgren *et al*., 2010; Lee *et al*., 2017). This impact of chemotherapy on haemoglobin (Hb) and albumin risk for anaemia and hypoalbumenia (Alb) affect prognosis, treatment and could influence mortality.

Mean of Hb of respondents found in this study before chemotherapy was 12.1 ± 1.4, almost the same as Lee et al. (2016), 12.8 ± 1.4 which became < 12.0g/dl at three months of treatment with the current study indicating a decreased to a level of 11.5 ± 1.1 g/dl after second cycle of chemotherapy. These values were within normal and acceptable levels (12 – 16 g/dl) for females at the study site of Tamale Teaching hospital required for better prognosis and treatment outcome. Mean value decreased between first and second cycles with a significance of $P = 0.024$. With regard to maximum Hb levels before and after chemotherapy were all although, within the normal range and were indicating potentials for good treatment outcome, the impact of chemotherapy reduced the initial value of 15.3 g/dl to 13.9 g/dl. However, the minimum Hb before and after chemotherapy of 10.0g/dl and 9.4 g/dl showed to be moderately anaemic, with the impact of chemotherapy on Hb influenced moderately anaemic in 3 (17.6%) respondents but, Lee *et al*. (2016) found a range of 2 to 78% at the diagnostic stage who were at risk for poor outcome from prognosis, treatment and probably, temporal discontinuation of the right treatment regimen.

Results from albumin had found mean value to be 44.1 ± 5.7 with the highest value of 53.6 g/l which were positive signs for treatment success. With the maximum albumin level increased to 68.3 g/l, the impact from treatment after the second cycle had rather reduced mean value to 42.1 ± 9.0 g/l which was still showing good prognosis outcome from treatment since mean was within the normal range (35 – 53 g/l), per the study

centre of Tamale Teaching Hospital. However, a minimum of 32.0 g/l before chemotherapy and 29.0 g/l after second cycle, according to Al-Joudi, (2005) and Gupta and Lis, (2010) were hypoalbunaemia, suggesting malnutrition and therefore, poor prognosis and outcome with risk of nutritional complication and determining mortality factor in anticancer therapy. While Fujii *et al.* (2014) had observed slight or no serum hypoalbonaemia in breast cancer patients, it was observed this investigation after second cycle treatment that, chemotherapy had impacted on Alb to less than 35 g/l level, by an increased 1 to 2 (11.8%) respondents. From other studies, Fatima *et al*. (2013) showed an association of 20% between cases and control subjects, In otherwise, high serum albumin which was found in non-cancer patients resisted estrogen responsive breast cancer cells proliferation, and with low level of < 3.7g/L was high marker of poor prognosis for mortality of even non-operable cancers (Buyukcelik *et al*., 2012).

Impact of the chemotherapy drugs have shown to have influence and improve metabolism by reduction in metabolic rate, and also contributed to improve in appetite by increased more than half in the number by 5(29.4%) respondents from 8 (47.1%) respondents loosing appetite before therapy started. Just as World Food Programme (WFP) (2012) research had indicated almost every individual of family in Northern Ghana consume carbohydrate from starchy staple foods for energy such as maize, rice and yam, the consumption of various foods from the food groups and food diversity generally had shown that averagely, 16 (94.1%) respondents and almost all the respondents frequently or over three 24 hour diet recall, used or consumed such starchy staples foods to provide mostly carbohydrate as energy. These starchy staple foods contain very limited numbers and amounts of required protein, minerals and vitamins important for maintaining, building and protecting functions and physical activities of body.

An appreciable proportion of more than 50%, 11 (64.7%) respondents generally and frequently before therapy, and averagely after the first and second cycle treatment over the three 24 hour diet recall period consumed legumes, nuts and seeds to meet their energy requirement from fats and oils sources, in addition to carbohydrate they may provide. Even though, no quantities are used in the study, since majority used the starchy and nuts and seeds as energy source for their staple foods almost all the time, are likely to consume excess energy which may predispose them to overweight or obesity. With more of the respondents frequently taking the energy foods, evidence and observational studies by Beeken *et al*. (2016) have however stated available lifestyle changes on limited intake of high caloric foods with the ratio of low-fat to high fibre diet could prevent and protect against the development and progression of breast and endometrial cancers, as these foods provide limited sources of proteins, and more but, also limited minerals and vitamins than grain or starchy staple foods which are required as antioxidants.

An equivalent high proportion of 16 (94.1%) respondents as those who took grain starchy or staple foods consumed meat and fish, where these are the source of protein to meet their protein requirement though, they are at the same time, provide same energy levels as carbohydrate in grain or starchy or legumes, with more but, inadequate mineral and vitamins required by the body. With regard to evidence and observational studies available on lifestyle changes on limited intake of red meat and processed meats with the ratio of low-fat to high fibre diet could prevent and protect against the development and progression of breast and endometrial cancers (Beeken *et al*., 2016). In this study, it is shown after the second cycle of therapy that, all the 17 respondents consumed meat and fish with average of 97.1% after first and second cycle therapy indicating, proportionally, almost all respondents consumed meat and fish posting them to risk for

recurrence and poor prognosis. Furthermore, some used to take meat organs and eggs with records of respondents proportionally lower than 50%, (47.1 %) and 7 (41.2%) including the average after first cycle and second cycle therapy in general frequency and 24 hour dietary recall intake. Notwithstanding the risk, the consumption of high level of fish which contain polyunsaturated omega 3fatty acids act as antioxidants, might protect respondent and reduces the risk for breast cancer and cancer in general (Pal *et al*., 2012; LeMay-Nedjelski, 2018; Chapkin, 2008) but, the ratio or levels of meat and fish intake were not determined.

Fruits and vegetables contain vitamin A, C, E and selenium that act as antioxidant and neutralize and activate enzymes in the carcinogen detoxification, and their high intake in cancer patients are potential free radical scavengers, with Potter, (1997 and Kapil *et al*. (2013) stating vast amount of epidemiological evidence researches proposing that a relatively high fruit and vegetable consumption is associated with protection of patients and reduced risk of breast cancer. Cruciferous vegetables such as cabbage especially contain micronutrients and other components that have cancer protective properties including breast cancer inhibitory properties (Pal *et al*., 2012). Furthermore, intake of selenium, folic acid, vitamin $B_{12,}$ vitamin D, chlorophyll, and antioxidants such as α-carotene, β-carotene, lycopene, lutein, cryptoxanthin protect and prevent cancer, with ascorbic highly beneficial intravenously and limited orally (Levi *et al*., 2001; Pal *et al*., 2012) in addition to prevention or correcting anaemia. Generally, more than half proportion of 12 (70.6%) and 11 (64.7%) respondents respectively frequently before chemotherapy as those of 12 (70.6%) and 11 (64.7%) respondents over the twenty four (24) hour individual dietary recall, claimed to have consume dark green vegetables shows some appreciable of 5 (29.4%) respondents breast cancer patients used not to take some fruits and vegetables adequately. High proportions of respondents taken this

dark green alone would not provide enough of various vitamins and minerals since they do not contain required levels of the important elements needed by BC patients. Vitamin A-rich roots and tubers which contain vitamin A as antioxidants were eaten by less than half proportions 47.1% of respondents before chemotherapy began. Research on Ghanaians women by Hall *et al*. (2009) and WFP (2012) revealed low as 38% and 22 % respectively, consumed fruits and vegetables, with this current study also indicating less than half proportions than half 4 (23.5%), 1 (5.9%), 7 (41.2%) and 6 (35.3%) respondents correspondingly consumed other vitamin A-rich fruits and vegetables, and other fruits and vegetables at first, second and third cycles, and then second and third cycles. Those few who took these fruits and vegetables is an indication of higher proportions of more than half of the respondents were not daily taking enough recommended levels (at least, 400 mg) to protect themselves with antioxidants, fibre, vitamins and minerals but, rather expose them to oxidative stresses. Other investigations (Potter, 1997 and Kapil *et al*., 2013) stated that, vast amount of epidemiological evidence researches proposed that a relatively high fruit and vegetable consumption is associated with protection of patients and reduced risk of breast cancer. In Zhang *et al*. (2011) and Link *et al*. (2013) on the other hand to this low consumption, indicated enough intake of plantbased dietary pattern with sufficient whole grains, fruits, vegetables, fish including high in cooked greens, legumes or Mediterranean diets were associated with BC risk reduction as proposed by Potter, (2005) and Kapil *et al*., (2013) with vast amount of evidence epidemiological researches that a relatively high fruit and vegetable consumption is associated with a reduced risk of breast cancer. Furthermore, intake of selenium, folic acid, vitamin $B_{12,}$ vitamin D, chlorophyll, and antioxidants such as αcarotene, β-carotene, lycopene, lutein, cryptoxanthin protect and prevent

cancer, with ascorbic highly beneficial intravenously and limited orally (Levi *et al*., 2001; Pal *et al*., 2012) in addition to prevention or correcting anaemia.

Comparing the findings on the intake of various foods, across the food groups and with regard to food diversity, most of the 16 (94.1%) respondents used or consumed starchy staple foods, legumes, nuts and seeds, meat and vegetables with less proportionately than 50% consuming fruits and vegetables. This suggest a risk of inadequate intake of fibre, vitamins and minerals which are important in inhibition, prevent and protect the body oxidative free radicals which could cause recurrence, poor prognosis outcome in BC and cardiovascular diseases. Change of dietary lifestyle with the modification of plant-base diet for whole grains, fruits, vegetables, beans and lentils with desirable amount of phytochemicals of fibre, vitamins and other compounds limit the risk of cancer (BC Cancer Agency, 2012). Meanwhile, this comparison may only be reflecting this study, as de Vries *et al*., 2017 study on whole dietary habits in breast cancer in which it said, the extent to which diet intake is affected is not consistently explained due to different experiences exhibited by patients with different methods and times used to collect data on dietary intake before or during therapy.

At least, 8 (47.1%) clients were able to realize that they lost weight, with the same number also loosing appetite before the inception of therapy. After second cycle of therapy 5 (29.4%) respondents each lost appetite and experienced early satiety which could contribute to losing weight and poor treatment outcome. No participant experienced nausea, xerostomia, or brittle or loss hair, with the exception of 5 (29.4%) and 4 (23.5%) participants, who experienced early satiety and fatigue as the next higher levels signs and symptoms. As observed by Neefjes *et al*. (2017) and Koo *et al.* (2017) before treatment, there were complains of weight loss and fatigue. However, every participant experienced one sign or symptom as revealed by Pagotto and Silveira,

(2014) and de Vries *et al*. (2017) that, chemotherapy regimen showed patients had the experiences of nausea, vomiting, loss of appetite, loss or gain in weight, dry mouth or xerostomia, fatigue, sarcopenia, diarrhoea or constipation and, brittle and loss of hair of one or another, where majority 15 (94.1%) encountering brittle or loss of hair, followed by fatigue of 7 (41.2%) then, xerostomia and nausea with 6 (35.3%) and 5 (29.4%) respectively with least diarrheoa by 1 (5.9%) person after the second cycle chemotherapy in this study. .

At the initial before chemotherapy, 8 (47.1%) participants were able to recognize that they have lost weight though, some other could have probably lost weight where findings from Norshariza *et al*. (2017) investigation reported on loss of weight are some of the initial sign and symptom that can be witnessed in cancer patients. The rest could not tell whether they lost or had gain weight before. Although there was decreased from initial measured mean weight of 61.8 ± 21.20 to 61.3 ± 20.95 after second cycle treatment, there was an overall gain in weight. Investigations have indicated that weight gain is not only found in the initial development of the disease, that the occurrence varies between 50 to 96% in patient on chemotherapy with 20% or more gaining more than 10kg and the gain continues in the months and years after treatment (Costa *et al*., 2002; Kim *et al*., 2013; Custódio *et al*., 2016; van den Berg *et al*., 2017).

After the second cycle therapy with a minimum and maximum weight change of -3.4 kg and 3.9 kg a positive mean weight of 0.99 ± 1.8 kg was gained which conforms with Custódio *et al.* (2016) and van den Berg *et al.* (2017) study, which found within first year after diagnosis, the increased weight assumes the values from 1.0 kg to 6.0 kg. The gain in weight did over shadow three (17.6%) respondents after second cycle therapy, which has shown among patients put on chemotherapy and radiation in Rier *et al*. (2016) had experiences the effects of further weight loss or lean body mass (LBM).

Custódio *et al.* (2016) research on the assessment of the nutritional status in chemotherapy had observed that 56% (n=31) of patients were overweight of three different treatments

Tests that were conducted to establish any relationship between initial nutritional status and weight change showed no association when Chi-square was used. Associations were established between some anthropometric parameters initial nutritional status and weight change after second cycle just as Custódio *et al.* (2016) found correlation in higher values for BMI, waist-hip ratio and waist-height. Bivariate and linear regression tests also indicated correlation between heights and the difference in after second cycle chemotherapy and initial weights. In consonance to this study were Willet (2000); Green *et al*. (2011) and Zhang *et al*. (2015) investigations across countries and populations or groups, who found a strong association between increasing in height and tall adult heights, and the risk of breast, ovarian and other cancers. Also, according to Zhang *et al*. (2015), a 10cm increase in adult height in women was associated with risk for breast cancer

CHAPTER SIX

6.0. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The results obtained from the analyzed data have shown that, more of the nutritional status of participants had increase in mean differences after treatment. This effect affected weight (P = 0.005), waist circumference (P = 0.001), waist to hip ratio (P =

0.024), visceral fat (P = 0.000), with haemoglobin (P = 0.020) and albumin had theirs decreased. Most participants consumed more energy giving foods as compared to foods for protection or prevention such as vegetables and fruits. Majority of participants showed increase in body weight with an indication of all positive mean change of 0.99 and a maximum change of 3.9 kg. The change in weight after treatment had correlation with some anthropometric parameters such as height, body mass index, waist circumference and body fat.

6.2. Recommendations

There is the need for further investigation into nutritional risk factors during the therapy of breast cancer patients such as, professionals and patients knowledge on nutrition in the management of breast cancer and types of diets or foods intake.

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APPENDICES Appendix I KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY DEPARTMENT OF BIOCHEMISTRY AND BIOTECHNOLOGY MSC NUTRITION AND DIETETICS

QUESTIONNAIRE ON: NUTRITIONAL STATUS AND WEIGHT CHANGES OF BREAST CANCER PATIENTS RECEIVING CHEMOTHERAPY IN TAMALE TEACHING HOSPITAL

CONSENT

You are kindly invited to participate in this research aimed at assessing nutritional status and weight changes of breast cancer patients who are receiving chemotherapy in Tamale Teaching Hospital. The research is part fulfilment of the requirement for the award of degree of MSc in nutrition and dietetics in Kwame Nkrumah University of Science and Technology.

Information gathered will be confidential and known to you only the respondent, and therefore response will be guaranteed with anonymity. Your free and true answers to the questions are desired. Participation is not compulsory, which will also not be considered as part of the process in the services rendered or care for you.

Thank you for your consent and care.

SECTION A: SOCIODEMOGRAPHIC CHARACTERISTICS OF PATIENT

1. Patient ID: (A up to required number)…… Date of completion……

2. Occupation: 1. Farmer [ ] 2. Businessman/Trader [ ] 3. Housewife [ ] 4. Civil/Public servant [ ] 5. Others [ ]
3. Education level: 1. No formal education [ ] 2. Non-formal education [ ] 3. Primary/JHS [ ] 4. SHS [ ] 5. Tertiary [ ]
4. Age [ ]
5. Sex: 1. Female [ ] 2. Male [ ]
6. Period of first diagnosis…….
7. Period of first seeing symptoms or suspecting symptoms……..
8. Stage; 1. I [ ] 2. II [ ] 3. III [ ] 4. IV [ ]
9. Presence of any other morbidities Yes [ ] No [ ]

SECTION B: ANTHROPOMETRIC PARAMETERS

10. Weight (average of 2 weighs)…. …. …… 11. Height (average of 2 measures)…….
12. Waist circumference……..
13. Hip-circumference……
14. Total body fat…….
15. Visceral fat……
16. Total muscle mass……..

SECTION C: SIDE EFFECTS OF CHEMOTHERAPY

Loss of appetite Yes [ ] No [ ] Nausea Yes [ ] No [ ]
Diarrhea Yes [ ] No [ ] Xerostomia Yes [ ] No [ ]
Early satiety Yes [ ] No [ ] Fatigue Yes [ ] No [ ]
Weight gain Yes [ ] No [ ] Weight loss Yes [ ] No [ ]
Constipation Yes [ ] No [ ] Brittle/loss of hair Yes [ ] No [ ]
Others specify…….

SECTION D: DIET INTAKE (24 hourly dietary intake**)**

a. Description of meals and snack taken last day and night from home and outside

Breakfast	**Snack**	**Lunch**	**Snack**	**Dinner**	**Snack**

b. Dietary diversity of foods in food groups consumed

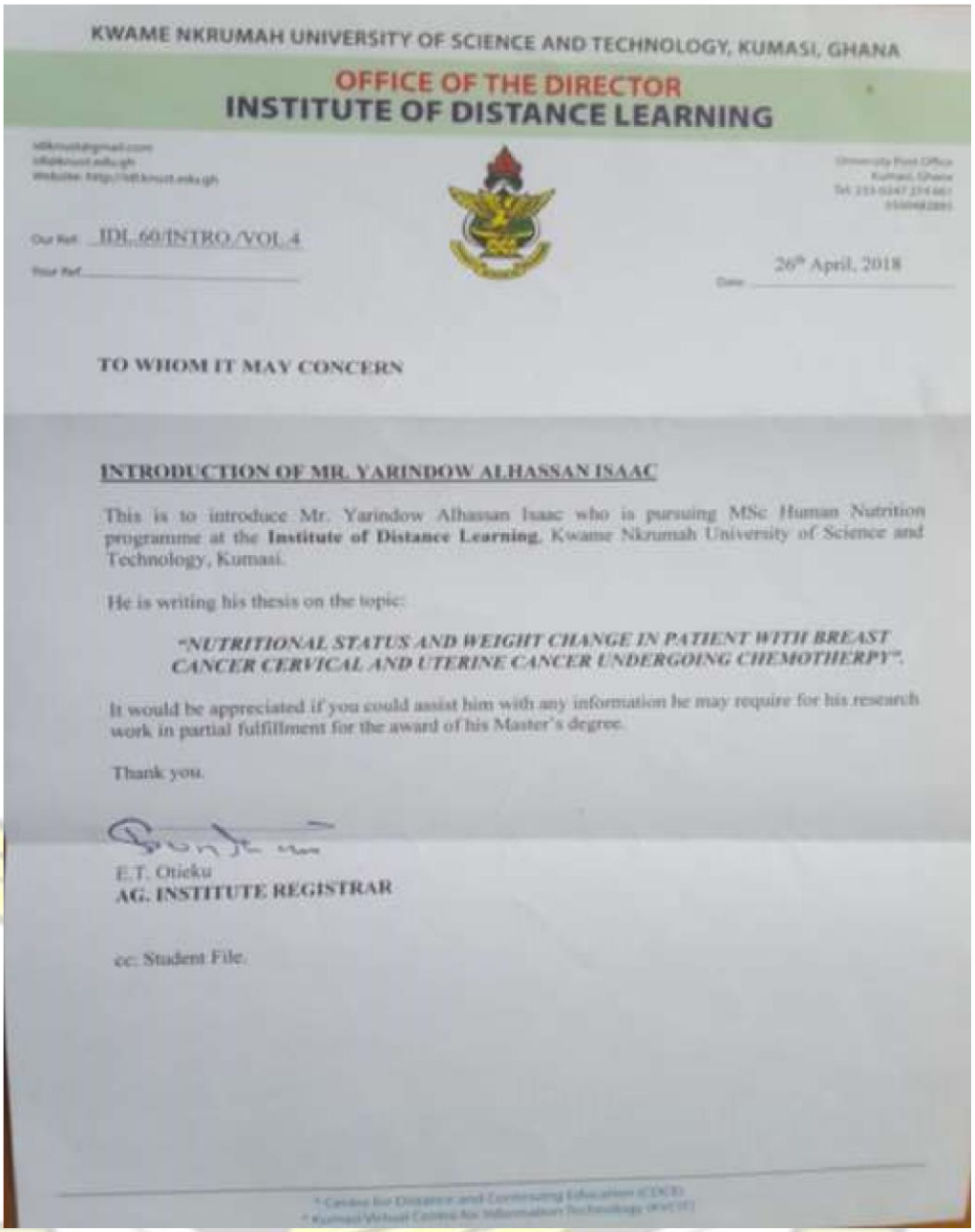
	Food categories	Description/examples	Consumed Yes = 1 No= 0
A	Foods made from grains	Porridge, bread, rice, pasta/noodles, banku, kenkey, TZ, or other foods made from grains (sorghum, millet, oats, wheat)	
B	White roots and tubers and plantains	White potatoes, white yams, cassava, cocoyam, fufu, konkonte or any other foods made from white-fleshed roots or tubers, or plantains	
C	Pulses (beans, peas and lentils)	Mature beans or peas, soy beans (fresh or dried seed), lentils or bean/pea products, including hummus, tofu and tempeh	

D	Nuts and seeds	Any tree nut, groundnut/peanut or certain seeds, or nut/seed "butters" or pastes	
E	Milk and milk products	Milk, cheese, yoghurt, burkina or other milk products but NOT including butter, ice cream, cream or sour cream	
F	Organ meat	Liver, kidney, heart, gizzard or other organ meats or blood-based foods, including from wild game	
G	Meat and poultry	Beef, pork, lamb, goat, rabbit, wild game meat, chicken, duck or other bird	
H	Fish and seafood	Fresh or dried fish, shellfish or seafood, canned fish, clams, oysters, shrimps, lobsters, crabs, octopus	
I	Eggs	Eggs from poultry or any other bird	
J	Dark green leafy vegetables	Any medium-to-dark green leafy vegetables, including wild/foraged leaves (dandelion, lettuce, okro green)	
K	Vitamin A-rich vegetables, roots and tubers	Pumpkin, carrots, squash or sweet potatoes that are yellow or orange inside, sweet red pepper, squash, orange flesh sweet potato,	
L	Vitamin A-rich fruits	Ripe mango, ripe papaya, apricot, cantaloupe melon, passion fruit, Red palm fruit,	
M	Other vegetables	Cabbage, cauliflower, celery, cucumber, eggplant, green pepper, lettuce light green, mushroom, okro light green, onion, tomato	
N	Other fruits	Apple, avocado, banana white flesh, cashew fruit, coconut flesh, grapefruits, grapes, guava, lemon, orange,	
		pineapple, star fruit, sour sop, Yellow mobin (Atoa), African star fruit (Alansa)	
O	Insects and other small protein foods	Insects, insect larvae/grubs, insect eggs, fish roe and land and sea snails	
P	Red palm oil	Red palm oil	

SECTION E: NUTRITIONAL PROFILE

17. Hb level ……
18. Albumin…….

Appendix II



KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI, GHANA

OFFICE OF THE DIRECTOR
INSTITUTE OF DISTANCE LEARNING

Our Ref: IDL/60/INTRO/VOL.4

Your Ref:

Date: 26th April, 2018

TO WHOM IT MAY CONCERN

INTRODUCTION OF MR. YARINDOW ALHASSAN ISAAC

This is to introduce Mr. Yarindow Alhassan Isaac who is pursuing MSc Human Nutrition programme at the **Institute of Distance Learning**, Kwame Nkrumah University of Science and Technology, Kumasi.

He is writing his thesis on the topic:

"NUTRITIONAL STATUS AND WEIGHT CHANGE IN PATIENT WITH BREAST CANCER CERVICAL AND UTERINE CANCER UNDERGOING CHEMOTHERPY".

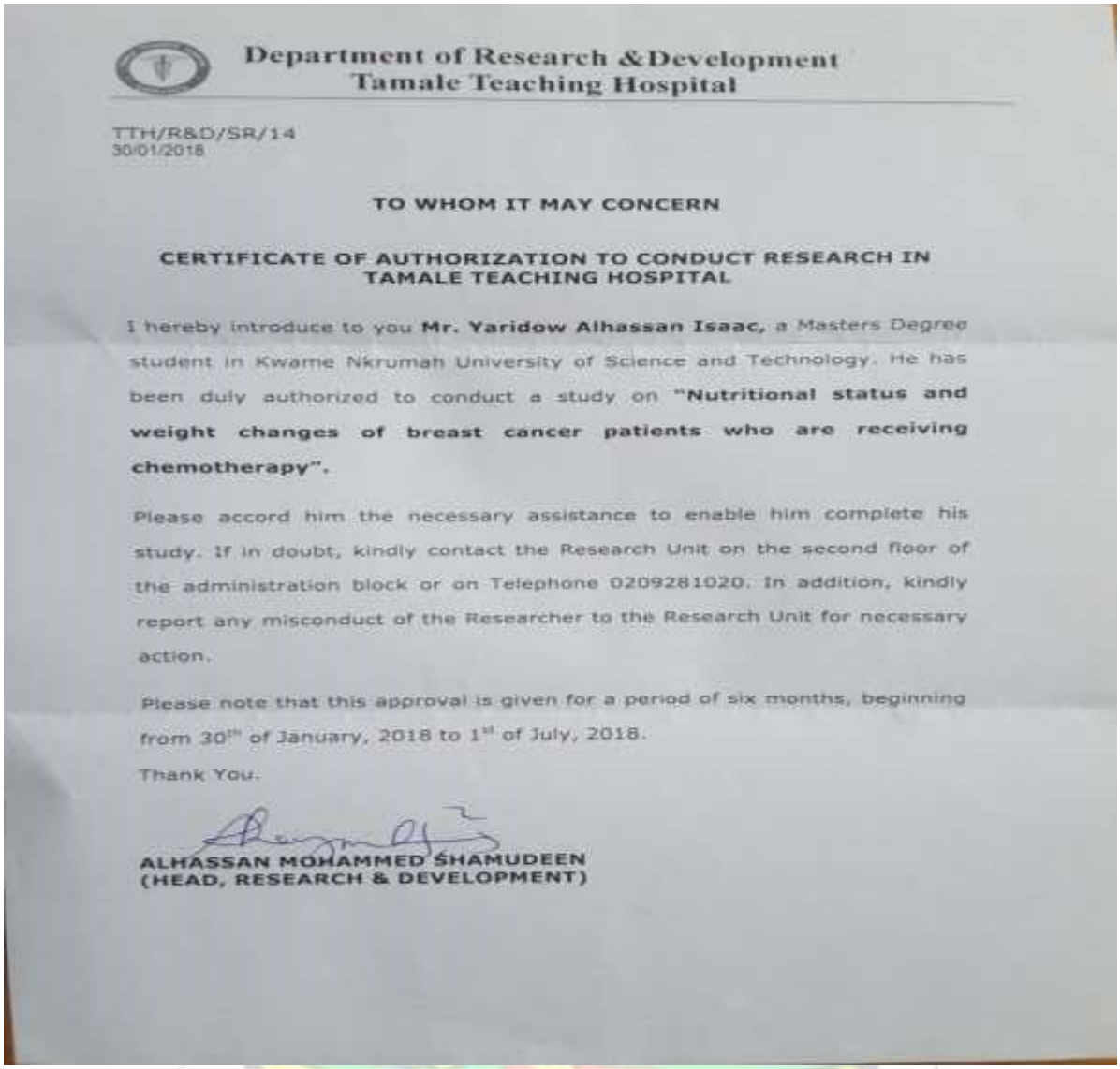
It would be appreciated if you could assist him with any information he may require for his research work in partial fulfillment for the award of his Master's degree.

Thank you.

E.T. Otieku
AG. INSTITUTE REGISTRAR

cc: Student File.

Appendix III



Department of Research &Development
Tamale Teaching Hospital

TTH/R&D/SR/14
30/01/2018

TO WHOM IT MAY CONCERN

CERTIFICATE OF AUTHORIZATION TO CONDUCT RESEARCH IN TAMALE TEACHING HOSPITAL

I hereby introduce to you **Mr. Yaridow Alhassan Isaac,** a Masters Degree student in Kwame Nkrumah University of Science and Technology. He has been duly authorized to conduct a study on **"Nutritional status and weight changes of breast cancer patients who are receiving chemotherapy".**

Please accord him the necessary assistance to enable him complete his study. If in doubt, kindly contact the Research Unit on the second floor of the administration block or on Telephone 0209281020. In addition, kindly report any misconduct of the Researcher to the Research Unit for necessary action.

Please note that this approval is given for a period of six months, beginning from 30th of January, 2018 to 1st of July, 2018.

Thank You.

ALHASSAN MOHAMMED SHAMUDEEN
(HEAD, RESEARCH & DEVELOPMENT)