The Relationship Between Dietary Protein Intake, Body Composition, and Physical Activity in Breast Cancer Survivors

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THE RELATIONSHIP BETWEEN DIETARY PROTEIN INTAKE, BODY COMPOSITION, AND PHYSICAL ACTIVITY IN BREAST CANCER SURVIVORS

By

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TABLE OF CONTENTS

List of Tables ................................................................................................................................. iv
Abstract ........................................................................................................................................... v
1. INTRODUCTION .......................................................................................................................1
2. REVIEW OF LITERATURE ....................................................................................................11
3. RESEARCH DESIGN AND METHODS .................................................................................27
4. RESULTS AND DISCUSSION ................................................................................................33
5. CONCLUSIONS AND FUTURE STUDIES ............................................................................51
APPENDICES ...................................................................................................................................53
A. PHYSICIAN CONSENT DOCUMENT ..................................................................................53
B. IRB APPROVAL LETTER ......................................................................................................54
C. TELEPHONE INTERVIEW.....................................................................................................56
D. INFORMED CONSENT DOCUMENT ...................................................................................58
E. DEMOGRAPHIC QUESTIONNAIRE.....................................................................................60
F. MEDICAL HISTORY ...............................................................................................................63
G. DIRECTIONS FOR 3- DAY FOOD RECORD ........................................................................71
H. EXAMPLE OF HOW TO KEEP YOUR FOOD RECORD ....................................................74
I. PEDOMETER LOG ..................................................................................................................76

References ......................................................................................................................................78
Biographical Sketch .......................................................................................................................86
LIST OF TABLES

1. Participant Characteristics .........................................................................................................34

2. Comparison of Participant’s Characteristics of Participants who Consumed Less than 1.14 g/kg of bw/day and Greater than 1.14 g/kg of bw/day of Protein.................................................................35

3. Body Composition Measures .....................................................................................................36

4. Physical Activity and Strength Measures ..................................................................................37

5. Comparison of Body Composition of Participants who Consumed Less than 1.14 g/kg of bw/day and Greater than 1.14 g/kg of bw/day of Protein........................................................................................................38

6. Comparison of Physical Activity and Strength of Participants who Consumed Less than 1.14 g/kg of bw/day and Greater than 1.14 g/kg of bw/day of Protein...........................................................................................39

7. Nutrient Intake of Participants ...................................................................................................40

8. Comparison of Nutrient Intake of Participants who Consumed Less than 1.14 g/kg of bw/day and Greater than 1.14 g/kg of bw/day of Protein........................................................................................................40

9. Protein, Strength, and Body Composition Correlations.............................................................41
ABSTRACT

While the overall survival rate for breast cancer has improved, breast cancer survivors (BCS) are still left with the negative side effects from cancer treatments that affect body composition. Cancer treatment side effects can cause a decrease in lean mass (LM), increase in fat mass (FM), and decrease in bone mineral density (BMD). PURPOSE: To evaluate the relationship between dietary protein intake habits and body composition (LM, FM, BMD) in BCS.

METHODS: Thirty-two (59 ± 8 years) BCS participated. Body composition was measured by dual-energy X-ray absorptiometry (DXA). Upper and lower body strength was measured via one repetition maximums (1RM) on chest press (CP) and leg extension (LE) machines, and handgrip (HG) strength was assessed using a HG dynamometer. Physical activity was assessed by pedometers. Dietary habits were recorded in a 3-day food log. Pearson product moment correlations and one-way analysis of variance was used to analyze and compare the data. All significance was accepted at p<0.05. RESULTS: The average BMI and steps/day classified the women as overweight (27.6 ± 5.6 kg/m²) and “low active” (6,286 ± 2,734 steps/day). The BCS consumed on average 1758 ± 517 kcal/day, with 16.4 ± 4% protein (1.00 ± 0.32 g/kg/day), 45.9 ± 7% carbohydrates, and 38.1 ± 5% fat. Average calcium and vitamin D intake (from food and supplements) were 2041.7 ± 710 mg/day and 1930.6 ± 1166 IU/day respectively. Significant correlations were found between protein and % body fat (r=-0.502) and LM:FM ratio (r=0.487). There were no significant relationships with other measurements of body composition, strength or steps/day. CONCLUSION: Our findings indicate that greater protein intake may attenuate increases in FM and improve the LM:FM ratio in BCS. Further research and larger samples are needed to elucidate potential benefits of protein on body composition in postmenopausal BCS.
CHAPTER 1

INTRODUCTION

The second leading cause of death for women in the United States is cancer; among that breast cancer is the most common cancer, regardless of race or ethnicity (World Health Organization, International Classification of Diseases). In 2010 there were 206,966 new cases of breast cancer in the United States, and 40,996 annual deaths from the disease (United States Cancer Statistics Data, 2010). The Center for Disease Control and Prevention has reported a 2.0% decline in deaths from breast cancer among all women between 2001 and 2010 (Edwards et al., 2014). While this is a positive trend for women diagnosed with the disease, breast cancer survivors (BCS) are still left with negative repercussions to their body composition from both the cancer and the treatment. For the purpose of this review, the common definition of breast cancer survivorship as defined by the American Society of Clinical Oncology (ASCO) will be defined as someone who has no disease after the completion of treatment, also known as being cancer free or in remission (Miller, 2013). In order to attenuate the cancer progression there are a variety of treatments prescribed, and each treatment plan differs among breast cancer patients. Treatments such as chemotherapy, radiation, surgery, and hormone suppressant therapy have been shown to slow the progression of cancer growth and in some cases destroy cancer entirely (Breastcancer.org, 2012). However, with these successful treatments come a list of side effects that can last longer than the cancer in women and affect daily living and quality of life (QOL). These side effects include; fatigue (Jacobsen et al., 1999), depression (Bardwell & Fiorentino, 2012), loss in muscle mass (LM) (Satariano & Ragland, 1996), an increase in fat mass (FM) (Camoriano et al., 1990) and ultimately lower QOL (Montazeri et al., 2008). Losses of muscle
tissue increase the development of sarcopenia (Prado, Antoun, Sawyer, & Baracos, 2011).
Sarcopenia is the decline of muscle mass and/or function, and is usually age related in
development but can develop due to different diseases (Cruz-Jentoft & Landi, 2014). These side
effects can inhibit women from getting regular exercise and performing daily functional
activities, which in turn can affect body composition and QOL, but the benefits of treatment
outweigh the negative side effects, which lead many women diagnosed with breast cancer to
undergo treatment and cope with the side effects thereafter.

Body composition has become an emerging factor for prognosis of breast cancer and has
been linked to the likelihood of reoccurrence in BCS (Abe et al., 1976; Anderson, 2010). A
comprehensive literature review was conducted analyzing the relationship between survival or
recurrence of breast cancer and obesity at diagnosis or weight gain after diagnosis (Chlebowski,
2002). The review highlighted that women with breast cancer who were overweight or gained
weight after diagnosis were found to be at greater risk for breast cancer recurrence and death
compared with women who weighed less (Chlebowski, 2002). Obesity was also associated with
estrogen hormone profiles likely to stimulate breast cancer progression (Chlebowski, 2002).
Along with the weight gain, cancer progression can also result in a loss of muscle mass
particularly skeletal muscle, which can lead to sarcopenia (Villaseñor et al., 2012) and the
concurrent increase in adipose tissue, characterized as sarcopenic obesity. Along with the loss of
muscle mass being associated with cancer progression, different treatments methods can
accelerate this loss of muscle mass (Prado et al., 2011).

Sarcopenia can be detrimental to a person’s QOL, which is one aspect that is very
important to patients when choosing their cancer treatment plan. Sarcopenia can result in poor
muscle strength, thereby leading to the inability to complete daily functional tasks, disability, and mortality (Evans, 1995; Villaseñor et al., 2012). A prospective study was conducted using 471 women diagnosed with breast cancer stages I-IIIA, which evaluated the prevalence of sarcopenia among the cohort and examined whether sarcopenia, which was defined as two standard deviations below the young healthy adult female mean of appendicular lean mass divided by height squared (<5.45 kg/m²), was associated with overall and breast-cancer-specific mortality (Villaseñor et al., 2012). After 9.2 years it was found that of the surveyed women, 75 of them were classified as sarcopenic, and among the 92 deaths within the group, 46 of the deaths were attributed to sarcopenia. It was concluded that sarcopenia was associated with an increased risk of overall mortality in women with breast cancer (Villaseñor et al., 2012). While not all BCS are considered sarcopenic, many of them have declines in muscle mass. Many women who are diagnosed with breast cancer are postmenopausal or due to cancer treatment become menopausal. During menopause there is a decline of the sex hormone estrogen, which can be related to an increase in adipose mass, decrease in muscle mass and strength (Messier et al., 2011). This relationship between estrogen and muscle mass loss is another factor for development of sarcopenia in BCS, as well as an increase in adipose tissue which can put BCS at a higher risk for reoccurrence.

It has been suggested that people with poor dietary protein intake are at a higher risk of developing losses in muscle mass and strength (Walrand, Guillet, Salles, Cano, & Boirie, 2011). Prado et al. (2012) examined the dietary habits of 51 advanced cancer patients. Dietary habits were assessed using 3-day dietary logs, and foods from the logs were grouped by macronutrients and examined. The authors found that of the 51 patients 49% of them consumed less protein than recommendations suggested. Similar results were seen in diet changes after diagnosis of breast
cancer patients. Dietary habits and changes after diagnosis was evaluated in 116 breast cancer patients. The participants were asked to complete food frequency logs, dietary recalls, and dietary change questionnaires to evaluate changes in dietary intake pre and post breast cancer diagnosis over a 2 year span. Of the 116 participants, 67 of them reported to have changed their dietary habits after being diagnosed with breast cancer. There was a significant decrease in total energy, protein, total fat, fatty acids and vitamin E intake after diagnosis (Shaharudin, Sulaiman, Shahril, Emran, & Akmal, 2013). While it was seen that participants lowered intake of high fat food, and increased fruits and vegetables, the decrease in protein could harm their activity levels and their ability to maintain muscle mass (Breen & Phillips, 2013; Prado et al., 2008; Shaharudin et al., 2013). Protein intake has been seen to improve muscle mass, regardless of physical activity status (Børsheim et al., 2008). For example, 12 glucose intolerant participants (female n=7, male n=5; 67.0 ± 5.6 years old) were given 11 grams of essential amino acid + arginine supplements twice a day, between meals for 16 weeks. Diet and physical activity were not otherwise modified throughout the study. Muscle mass was measured using a whole-body dual-energy X-ray absorptiometry (DXA) scan every 4th week, maximal leg strength and functional tests were performed at baseline, 8,12, and 16 weeks into the program. During the study muscle mass increased (p=0.038). At week 12, the average increase in muscle mass was 1.14 ± 0.36 kg (p < 0.05 vs baseline), however at week 16 muscle mass only increased 0.60 ± 0.38 kg and was not considered significant when compared to baseline. There was a significant improvement in lower body strength, and positive trends in usual gait speed, timed 5-step test, and timed floor-transfer test to improve (Børsheim et al., 2008). These results suggest that an increase in dietary protein alone without any other interventions may improve muscle mass, muscle strength, and physical function among elderly individuals (Børsheim et al., 2008). Due to the observed
decrease in protein intake and the effects it has on developing sarcopenia, BCS should try and consume a diet rich in essential amino acids in order to avoid losses in muscle mass and decreases in strength (Børsheim et al., 2008; Greenlund, 2003; Prado et al., 2012; Shaharudin et al., 2013).

In order to maintain or improve muscle mass, protein needs to be consumed (Paddon-Jones, 2014). As healthy adults age there is a decrease in post-absorptive muscle protein synthetic rate in response to an amino acid feeding (Guillet et al., 2004). Furthermore, it has been suggested that elderly adults or special populations such as BCS need to increase their daily protein intake from the recommended daily allowance (RDA) recommendation of 0.8 grams per kilogram of body weight per day (g/kg of bw/day) (Campbell, Crim, Dallal, Young, & Evans, 1994). Campbell and colleagues (1994) did a metabolic study on 12 men and women, breaking them into two groups, a low protein diet consisting of 0.8 g/kg of bw/day and a high protein diet of 1.6 g/kg of bw/day. They found that the low protein diet group did not reach nitrogen equilibrium and the net nitrogen balance for this group was negative. The high protein group reached nitrogen equilibrium, but they found protein excretion in the urine, suggesting that the 1.6 g/kg of bw/day may not be fully utilized in the body, from the results they suggest consuming 1.4-1.6 g/kg of bw/day in order to offset the rate of muscle mass decline (Campbell et al., 1994). Inadequate protein consumption can compromise the body’s ability to recover from stress and diseases such as the development of breast cancer and treatment. Therefore, it is important to increase the consumption of adequate amounts of protein rich foods to prevent changes in body composition and offset the development of sarcopenia (Gaillard, Alix, Boirie, Berrut, & Ritz, 2008). To date, there are few studies we are aware of that have been published to
investigate the relationship between dietary protein intake, body composition, and physical activity in BCS.

**Purpose**

The purpose of the present investigation was to examine the relationship of protein intake, body composition measures (fat mass, lean mass), and physical activity in BCS.

**Research Questions**

The present study was designed to answer the following questions:

1. Is there a relationship between current dietary protein intake and body composition measures of lean body mass and fat body mass in 32 post-menopausal BCS?
2. Is there a relationship between dietary protein intake and physical activity?
3. Is there a relationship between physical activity and body composition measures of lean body mass and fat body mass in 32 post-menopausal BCS?

**Research Hypothesis**

The hypotheses of the present study include:

1. Postmenopausal BCS who consume a healthy diet with protein rich foods will have a greater amount of lean body mass.
2. Postmenopausal BCS who consume a healthy diet with protein rich foods will have a lower amount of fat mass.
3. Postmenopausal BCS who consume a healthy diet with protein rich foods will have greater physical activity levels.
Assumptions

Assumptions for the present study included the following:

1. All participants accurately reported their age, breast cancer medical history (diagnosis and treatment), menopausal status, current exercise status, and current dietary intake.
2. All participants accurately reported their dietary intake pre and post diagnosis of cancer.
3. All laboratory equipment yielded accurate measurements.

Delimitations

The delimitations of the present study included the following:

1. Only stage 0-III female BCS were allowed to participate in the present study. Therefore, male breast cancer patients, female survivors of stage IV breast cancer, or females with active cancer, were not eligible to participate in the present study.
2. Individuals with uncontrolled hypertension, diabetes, or heart disease were not eligible to participate in the study.
3. Female BCS must have been 3-month post-surgery and 2-month post-cancer therapy.

Limitations

The limitations of the present study included the following:

1. Only female BCS were included in the present study, and therefore results obtained may not be generalized to male breast cancer patients or patients suffering from other forms of cancer.
2. Participants were recruited on a volunteer basis, and thus may be more motivated than the general breast cancer population. Therefore, the results obtained may not be generalized to the entire breast cancer population.

3. Participants were recruited from the Tallahassee, Florida and surrounding regions. Therefore, the results obtained may not be generalized to female breast cancer survivors in other geographical regions.

4. Participants were asked for dietary recall and current dietary intake, therefore there may have been problems with memory recall.

Definitions of Terms

- **Adjuvant Chemotherapy**—Chemotherapy that is used to destroy suspected undetectable residual tumor after surgery or radiation treatment has eradicated all detectable tumor; effective in the treatment of breast cancer (medical-dictionary.thefreedictionary.com)

- **Body Composition** - The relative proportions of protein, fat, water, and mineral components in the body (medical-dictionary.thefreedictionary.com).

- **Breast Cancer** - Cancer that forms in tissues of the breast, commonly in the ducts (thin tubules that deliver milk to the nipple) and the lobules (milk glands) of the breast. In Stages 0 and 1, the cancer is called carcinoma in situ (in the original place) and therefore contained to place of origin, whereas in Stage 2 the cancer has begun to grow and spread but is still contained in the breast area. Stage 3 is an advanced stage in which the cancer has spread and invaded surrounding tissues (lymph nodes). In Stage 4 the cancer has spread beyond the breast region to other areas of the body (brain, bones, liver) (http://www.nationalbreastcancer.org).
• **Cancer** – a term for diseases caused by the uncontrolled growth of abnormal cells. (www.cancer.gov/dictionary).

• **Dual energy x-ray absorptiometry (DXA)** - A method of measuring bone density by passing x-rays of two different energy levels through the bone (www.cancer.gov/dictionary).

• **Hormone Therapy** - lowering the amount of the estrogen hormone in the body and blocking the action of estrogen on breast cancer cells (Breastcancer.org, 2012).

• **Invasive Cancer**- An invasive cancer is one that has already grown beyond the layer of cells where it started. Most breast cancers are invasive cancers. (http://www.cancer.org/cancer/breastcancer)

• **Lumpectomy**- Part of the surgical treatment of breast cancer, involving the removal of only to tumor and small areas of the surrounding tissue. (http://www.breastcancer.org/treatment/surgery)

• **Mastectomy**- Another more extreme part of the surgical treatment of breast cancer involving the removal of all of the breast tissue, from one or both sides of the body. The muscles under the breast are not removed. (http://www.breastcancer.org/treatment/surgery)

• **mTOR** - Mammalian target of rapamycin (mTOR), is a protein that regulates vital cell growth processes. mTOR receives external signals from growth factors, hormones, and proteins, and then signals for the cell to grow and divide, seek nutrition, or use its nutrition. (http://breastcancer.about.com/)

• **Radiation Therapy** – A form of cancer treatment that uses high-energy radiation from x-rays, gamma rays, protons and neutrons to kill cancer cells (www.cancer.gov/dictionary).
- **Sarcopenia** - The age related loss of skeletal muscle mass and strength, by approximately 0.5 – 1% loss per year after the age of 25 years. Sarcopenia is defined as having an appendicular skeletal muscle mass (arm + leg muscle mass) adjusted by height of <7.26 kg/m² in men and < 5.45 kg/m² in women (Villaseñor et al., 2012).

- **Sarcopenic obesity** – the simultaneous occurrence of low muscle mass (sarcopenia) and high adiposity (obesity; Benton, Whyte, & Dyal, 2011).

- **Quality of life** – an individual’s sense of well-being and the ability to perform various activities for the overall enjoyment of life (www.cancer.gov/dictionary).
CHAPTER 2

REVIEW OF LITERATURE

As of January 31, 2014 there were 2.8 million BCS in the United States (American Cancer Society, 2014a). 1 in 8 women will develop breast cancer within her lifetime (DeSantis, Ma, Bryan, & Jemal, 2014), making breast cancer the most common type of cancer in women living in the United States, excluding skin cancer. In 2013 there were 232,340 new cases of invasive breast cancer, and 64,640 deaths from breast cancer reported (DeSantis et al., 2014). Women who are considered overweight or obese are at higher risk of developing breast cancer or having recurrences (Huang et al., 1997). Women who exercise regularly have a 30%-40% reduction in risk of developing breast cancer (Anderson, 2010). These statistics demonstrate the importance of a healthy diet and being physically active for women’s health.

The diagnosis of breast cancer can have negative effects on a woman’s mental and physical health. Treatment for breast cancer can even have more effects on mental and physical health, which can last long after treatment has ended, leaving survivors with many lifestyle changes to deal with the side effects they suffer (Jacobsen et al., 1999; Johns, Stephens, & Preston, 2012; Koehler, 2009; Loprinzi & Cardinal, 2012; Thomas & Davies, 2007). The following review is intended to investigate the literature examining breast cancer survivors’ daily dietary habits after chemotherapy, radiation, surgery and/or hormone suppressant therapies. This review will concentrate on dietary protein intake, body composition; specifically muscle, and fat mass, and the relationship between regular protein intake within a survivor’s diet in relation to body composition and physical activity. In addition, the aim of this review is to report the need for increased dietary protein and exercise in BCS who are suffering from negative side effects of
diagnosis and treatment, and to discuss how these lifestyle adjustments may increase muscle mass, decrease fat mass, and improve physical activity, which all BCS can experience declines in. The primary objective for this research project is to investigate dietary protein intake habits and the effects on body composition and physical activity in BCS.

The diagnosis of breast cancer can be a traumatic event in women’s lives, and many treatment options come with potential side effects that can last after women have been declared cancer free. In a healthy adult, cells within the body multiply and die as an ongoing cycle (Board, 2012). Cancer occurs when the growth of the cells become uncontrolled, multiplying too quickly and failing to die, thereby disrupting the cycle and leading to the development of abnormal cells (Board, 2012). Female breasts are made up of milk producing glands known as lobules, which accounts for the majority of the breast; ducts, which are tiny tubes that carry the milk from the lobules to the nipple; and stroma, fat tissue and connective tissue surrounding the ducts and lobules (American Cancer Society, 2014b). Most common breast cancers form in cells that make up the lining of the ducts, but cancerous cells can form anywhere within the breast tissue (Anderson, 2010).

Treatment options for breast cancer patients include; chemotherapy, which utilizes drugs to slow or stop growth of cancer cells, unfortunately the drugs cannot decipher the difference between cancerous and healthy cells resulting in damage to healthy cells as well as the cancerous ones (WebMD, 2005). Radiation therapy targets cancer cells by emitting radiation through a high energy beam causing damage to the cells and destroying them (Breastcancer.org, 2012). Radiation damages all cells that are in the pathway of the beam, causing damage to some healthy cells, yet the healthy cells are better at repairing themselves from damage whereas cancerous
cells are not (Breastcancer.org, 2012). Surgery usually is the first treatment option for women with breast cancer, surgery consists of either a lumpectomy, which is the removal of only the tumor and small areas of the surrounding tissue, or a mastectomy which is the removal of all breast tissue from one or both sides (Breastcancer.org, 2012). Lastly, there are hormonal therapies which involve lowering the amount of the estrogen hormone in the body and blocking the action of estrogen on breast cancer cells (Breastcancer.org, 2012). Cancer treatments can include one or more therapies depending on the location and stage of the cancer (Breastcancer.org, 2012).

While all of these treatments have been shown to damage cancer cells and potentially rid the body of cancer, healthy cells can be damaged through the treatment process, resulting in side effects that can disrupt a woman’s daily living (Breastcancer.org, 2012; “Side effects of treatment,” 2002; WebMD, 2005). Some of these side effects include, loss in muscle mass (Satariano & Ragland, 1996), increase in fat mass (Camoriano et al., 1990) and reduced levels of physical activity (Hair, Hayes, Tse, Bell, & Olshan, 2014) due to fatigue. Additionally there have been links to different dietary habits and breast cancer risks, causing many women who have been diagnosed with breast cancer to change their dietary habits in hopes to have a healthier diet and reduce their risk of reoccurrence. It has been seen that with a change in diet there is also a significant decrease in protein intake (Velentzis et al., 2011). This reduction in protein consumption can affect body composition by causing losses of muscle mass and ultimately increases in fat mass.

Muscle loss is an extremely negative side effect of breast cancer treatment (Prado et al., 2011). The depletion of muscle mass and strength is known as sarcopenia and dynapenia,
respectively (Clark & Manini, 2008; Johns, Stephens, & Fearon, 2013), which is believed to be caused by atrophy and loss of skeletal muscle fibers (Walrand et al., 2011). Sarcopenia is defined as two standard deviations below the young healthy adult female mean of appendicular lean mass divided by height squared (<5.45 kg/m\(^2\)) (Villaseñor et al., 2012). Loss of muscle mass and strength is often associated with the aging process but can be accelerated with cancer treatment, specifically with the toxicity of chemotherapy (Prado et al., 2008). With a reduction in muscle mass comes a lack of muscular strength and frailty (Prado et al., 2008). Additionally low muscle mass is associated with breast-cancer-specific mortality (Villaseñor et al., 2012). Hormone production and sensitivity affect the anabolic and catabolic state for optimal muscle protein synthesis (MPS). Growth hormone (GH), insulin-like growth factor (IGF-1), corticosteroids, androgens, estrogens, and insulin, are especially important for muscle protein metabolism, and all decrease with age, but can also decrease with cancer treatments (Walrand et al., 2011). Hormone therapy is commonly prescribed to treat breast cancer by suppressing estrogen which is known to increase the risk of breast cancer (Tchatchou et al., 2009). Decreases in estrogen have been associated with losses in muscle mass and strength (Nedergaard, Henriksen, Karsdal, & Christiansen, 2013).

In healthy adults there is a balance between MPS and muscle protein degradation (MPD), where MPS is greater than MPD. MPS increases in response to essential amino acids during feeding due to signaling of the mammalian target of rapamycin complex 1 (mTORc1) pathway (Phillips, Hill, & Atherton, 2012). When there is abnormal growth within the body, such as a tumor, inflammation occurs and proinflammatory cytokines are signaled (Johns et al., 2012). Proinflammatory cytokines limit MPS and promote MPD resulting in a disruption of the healthy MPS and MPD balance, causing a loss in muscle mass (Johns et al., 2012; Walrand et al., 2011).
Villaseñor et al. examined women with a history of breast cancer from The Health, Eating, Activity, and Lifestyle (HEAL) cohort on their physical activity, eating habits, body composition and other prognosis factors. From the 1,183 women who made up the cohort, 471 women were diagnosed with invasive breast cancer (stages I-IIIA) and were selected to complete self-reported questionnaires and in person evaluations including anthropometric measures of body weight, height, and hip and waist circumferences. A whole-body dual-energy X-ray absorptiometry (DXA) scan was used for fat and lean tissue measurements. All measurements were taken at baseline and at a follow up; the median length of the follow up was 9.2 years. Among the 471 participants 16% were sarcopenic and 38% were classified as obese based on total body fat percentages. There was an 85.3% overall 5 year survival rate among the sarcopenic women. Within the overall cohort (N=1,183) there was 15.9% prevalence of sarcopenia, which as stated by the authors was significant given the relatively young age distribution of the cohort (Villaseñor et al., 2012). Additionally it was found that sarcopenia was an independent predictor of poor survival (Villaseñor et al., 2012). Furthermore it was stated that women who were classified as sarcopenic were almost 3 times more likely to die from any cause unrelated to the cancer diagnosis and almost 2 times more likely to die from breast cancer (Villaseñor et al., 2012). Not all BCS will develop sarcopenia but many of them will have a decline in lean body mass. In a study examining body composition in women who underwent adjuvant chemotherapy it was found that over the course of treatment there was a significant decline in fat free mass by -2.2 ± 4% (P=0.03), and continued to decrease by -3.8 ± 6% (P= 0.01) 6 months after the last treatment (Freedman et al., 2004). While not all BCS are considered sarcopenic the natural effects of aging and menopause are not in their favor when it comes to losing muscle mass, and the effects of low muscle mass on survival shows a need for BCS to make lifestyle changes that
promote muscle mass increases such as participating in regular exercise and eating a diet that promotes muscle gains.

Another negative side effect that can come from the treatment of breast cancer is an increase in fat mass (Sheean, Hoskins, & Stolley, 2012). Obesity is associated with a higher mortality rate in breast cancer patients compared to non-obese patients (Abe et al., 1976), and can be a predictor for mortality and reoccurrence after being declared cancer free (Hepp et al., 2011). In an analysis of the impact of obesity on disease free survival in 1,361 early stage breast cancer patients who underwent treatment in the ADEBAR multicenter trial, the patients were grouped in either; underweight (BMI <18.5 kg/m$^2$), normal weight (BMI 18.5-25 kg/m$^2$), overweight (BMI 25 kg/m$^2$<BMI>30 kg/m$^2$) or obese (BMI >30 kg/m$^2$) groups. It was concluded in a multivariate analysis after a 60-month follow up that obesity was an independent prognostic factor of death (hazard ratio of 1,007 per 1kg/m$^2$ increase) (Hepp et al., 2011).

In another study information on the benefits of weight gain prevention and dietary counseling from a dietician was given to 272 chemotherapy-treated women at baseline and their weight was assessed at 6 and 12 months post cancer treatment (Trédan et al., 2010). At the 1 year time point after diagnosis, 60% of women had gained weight with a mean gain of 3.9 ± 3.0 kg despite dietary counseling (Trédan et al., 2010). Similar results were seen from the Health, Eating, Activity, and Lifestyle (HEAL) study made up of 514 women with stage 0-III breast cancer, who had surgery, hormone therapy, chemotherapy, or a combination of therapies (Irwin et al., 2005). From baseline up to 3 years, 68% of women gained body weight and 74% gained percent body fat with a total (N=514) mean increase of 1.7 ± 4.7 kg of body weight and a mean increase of 2.1 ± 3.9% body fat (Irwin et al., 2005). Furthermore, Nissen et. al (2011) assessed
body weight and fat mass trends before chemotherapy, during and 1 year following start of treatment. They found that baseline BMI was associated with change in fat mass in torso ($P = .006$) and arms ($P = .008$). Specifically, women of normal weight (BMI < 25 kg/m$^2$) had an increase in these areas and overall were more likely to increase total body weight after one year from baseline than overweight (25kg/m$^2$ ≤ BMI < 30 kg/m$^2$) or obese (BMI ≥30 kg/m$^2$) women (Nissen, Shapiro, & Swenson, 2011). Women in the overweight and obese categories had lower gains in weight but still increased fat mass and decreased muscle mass, suggesting a trend in sarcopenic obesity (Nissen et al., 2011). Similarly, in 36 women who had received adjuvant chemotherapy there was a significant mean gain of 2.1 kg one year following diagnosis, along with significant increases in body fat percentage (2.2 ± 0.6%; $P = 0.04$) and fat mass (2.3 ± 0.7 kg; $P =0.04$) (Demark-Wahnefried et al., 2001). Additionally, there was an observed decrease in lean body mass (-0.4 ± 0.3 kg) and leg lean mass (-0.2 ± 0.1 kg) (Demark-Wahnefried et al., 2001). From the research that has been presented it is evident that interventions need to focus on attenuating the increases in fat mass and preventing decreases in lean muscle mass during and after treatment in women with breast cancer. The majority of women who have been diagnosed with breast cancer report a change in diet after diagnosis (Shaharudin et al., 2013; Trédan et al., 2010; Velentzis, Woodside, Cantwell, Leatham, & Keshtgar, 2010). Velentzis et. al (2010) reviewed the dietary habits pre and 1 year post diagnosis in 1,560 women who had been diagnosed with breast cancer. They found significant decreases in intake of red meat, processed meat, refined grains, full fat dairy foods, desserts, alcohol, and high energy drinks. Additionally, there were significant increases in the intake of fruits, vegetables, poultry, fish, whole grains, and milk. They also saw a significant decrease in total calories consumed per day as well as a significant decrease in fats, protein, and carbohydrates, and an increase in fiber (Velentzis et al.,
Protein consumption decreased significantly in multiple studies analyzing dietary habits after a breast cancer diagnosis and can be attributed to a reduction in red meat intake and not consuming enough protein from alternate sources (Shaharudin et al., 2013; Velentzis et al., 2010). While the reduction in red meat and diets high in fat are beneficial to BCS, the noted reduction in protein intake after diagnosis can be harmful to a BCS body composition. Protein is an essential component for a healthy diet, and ingestion of protein stimulates MPS helping to maintain muscle mass (Katsanos, Kobayashi, Sheffield-Moore, Aarsland, & Wolfe, 2006). Protein is needed to fuel the muscles for building and maintaining muscle mass throughout a woman’s lifespan (Evans, 1995). High protein diets have been shown to be beneficial for body fat regulation (Prado et al., 2008). Dietary habits among adults residing in the United States usually consist of a large bulk of protein in dinner meals and less protein in breakfast. Research has found that to gain the full benefits of consuming protein for muscle growth and repair, every meal must have an evenly distributed amount of protein, rather than consuming larger amounts in one meal than the others (Evans, 1995). There is an ongoing debate on what the right amount of protein is needed that should be consumed in a daily diet. The amount of protein needed to maintain one’s health can differ depending on the person’s health status and age. Age and gender can affect a person’s energy levels and dietary needs as Pitkänen and colleagues (2003) demonstrated when they studied age and gender differences in serum amino acid concentrations in 72 men and women ranging from 23-92 years of age. The participants were asked to record their physical activity and food intake using 5-day logs, and were instructed to keep all living and dietary habits the same throughout the study period. Blood samples were taken after an overnight fast and the blood serum was extracted and analyzed for amino acid content by use of chromatography. The results from the serum analysis showed a significant decrease in the
following categories; total nutrient intake of energy, protein, alcohol, water, sodium, and fiber, which were all correlated with age. Total amino acids, essential amino acids, non-essential amino acids, and branch-chain amino acids were also decreased however; there was an increase in both citrulline and cysteine with age. The male participants were seen to have significantly higher concentration levels of essential amino acids, branch-chain amino acids, than the female participants (Pitkänen et al., 2003). With a decrease in energy intake and amino acid levels the body cannot fuel the MPS process as efficiently as it was able to at a younger age, especially in women as their amino acid concentration levels dropped significantly (Pitkänen et al., 2003), demonstrating a need for higher dietary protein intake.

The recommended daily allowance (RDA) guidelines suggest that a female 19-70+ years old should be consuming 46 grams of protein a day (National Research Council, 2005), and the United States Department of Agriculture (USDA) suggests having 10-35% of calories in the diet come from protein sources (Agriculture, 2010). The age range is very broad and as research has shown with an older female a higher protein intake is required to sustain energy and muscle mass. After diagnosis, many women decrease their red meat consumption and increase poultry consumption in their diets, but due to the decrease in red meat there is a reduction in protein consumption (Velentzis et al., 2011). In a study looking at the relationship between diet and bone mineral density in postmenopausal BCS, a 24-hour food log was given to 24 postmenopausal BCS. Results showed that on average 17 ± 7% of the BCS’s caloric intake was from protein and they were consuming an average of 1.06 ± 0.54 g/kg of protein (Page et al, 2011). While the BCS protein intake was within the USDA’s suggested caloric range 17% is on the lower end of the recommendation and BCS can benefit from a higher intake. When examining dietary habits of 1,982 BCS, Holmes et al. (1999) reported a strong association between protein intake and...
survival. BCS who consumed less than 60.9 grams of protein had a stronger relative risk for death (RR = 1), and the association decreased greatly in BCS who consumed 67.8 grams or more of protein (RR = 0.55). There was an inverse association with increasing intake of protein, and a 35% lower risk for the highest quintile of protein intake, observing an increase in survival among BCS who ate more protein (Holmes et al., 1999). Similarly, Farvid et. al (2014) found that postmenopausal women who had a higher intake of poultry were associated with a lower risk of breast cancer.

Due to the increase in MPD from inflammation, increased protein intake is important to stimulate MPS (Johns et al., 2013). When looking at the fractional rate of MPS in patients with advance cancers researchers divided patients into two groups, an experimental group (n = 13) who consumed a meal containing 40g of protein, based on casein and whey protein and enriched with 10% free leucine, and a control group that consumed a meal with 24g of casein protein and no other additives (Deutz et al., 2011). MPS fractional rate was seen to increase in the experimental group after consumption of the meal from 0.073 ± 0.023 to 0.097 ± 0.033%/h (p = 0.0269) while the control group’s MPS fractional rate did not increase; 0.073 ± 0.022 %/h pre-consumption and 0.065 ± 0.028 %/h post-consumption (Deutz et al., 2011).

Data on physical activity and dietary habits of 2,987 breast cancer patients from The Nurse’s Health Study cohort was analyzed, and found that BCS who consumed higher amounts of protein were more physically active and had lower BMIs (Holmes et al., 2014). Additionally, physical assessment was surveyed on average 38 months after diagnosis, BCS who ate higher amounts of protein and were more physically active were less likely to gain weight between time of diagnosis to time of physical assessment (Holmes et al., 2014). Furthermore, BCS who
participated in 3 or more MET-hours per week and consumed 74.3 grams per day or higher of protein had a 97% 5-year survival rate (Holmes et al., 2014). By increasing protein intake there can be an increase in MPS, which can possibly ward off the effects of muscle mass loss. Increasing physical activity will also increase muscle mass further and decrease fat mass reducing the risk for reoccurrence and mortality (Abe et al., 1976; Anderson, 2010; Balagopal, Schimke, Ades, Adey, & Nair, 2001; Benton et al., 2011; Broderick et al., 2014; Demark-Wahnefried et al., 2001; Deutz et al., 2011; Guillet et al., 2004; Hepp et al., 2011; Holmes et al., 1999; Irwin et al., 2005; Josse, Atkinson, Tarnopolsky, & Phillips, 2011; Kerksick et al., 2009; McTiernan et al., 2003; Rohan et al., 2013; Thomas & Davies, 2007; Villaseñor et al., 2012).

In 2006, the American Cancer Society (ACS) published physical activity recommendations for cancer survivors suggesting cancer survivors need to engage in at least 150 minutes of moderate intensity or 75 minutes of vigorous exercise or a combination of both each week (Kushi et al., 2006). The ACS also recommends limiting sedentary behaviors such as sitting or lying down for long periods of time, and engaging in physical activity above usual activities (Kushi et al., 2006). Getting enough physical activity can be an important prognosis factor. When examining physical activity in 2,892 BCS, it was found that women in the low physical functioning category had a 40% higher risk of breast cancer mortality (Marinac, Patterson, Villasenor, Flatt, & Pierce, 2014). Additionally, women who participated in 3 or more metabolic equivalent (MET) hours per week had a decreased risk for breast cancer mortality (Holmes, Chen, Feskanich, Kroenke, & Colditz, 2014). In a study examining the physical activity levels pre- and post- breast cancer diagnosis in a cohort of 1,735 women, aged 20-74 years, diagnosed with invasive breast cancer between 2008 and 2011, it was found that only 35% of BCS met current physical activity guidelines post-diagnosis. A decrease in physical activity
following diagnosis was reported by 59% of patients, with the average study participant reducing her activity by 230 minutes a week (Hair, Hayes, Tse, Bell, & Olshan, 2014). One explanation for a reduction in physical activity is cancer related fatigue. Fatigue is a very common treatment side effect, which can inhibit women from getting regular exercise and performing daily functional activities, in turn affecting body composition. Cancer related fatigue is highly prevalent in breast cancer patients (Groll, Luctkar-Flude, Tranmer, & Woodend, 2009). In a study done by Jacobson et al. (1999), questionnaires regarding fatigue levels and QOL were given to two groups of women, breast cancer patients who had been receiving adjuvant chemotherapy and peer nominated, age matched women who had no history of breast cancer. The breast cancer patients were given questionnaires before and twice during their treatment. The women with no history of breast cancer were given the same questionnaire before the breast cancer groups’ treatment, and then twice more. It was concluded that the women receiving adjuvant chemotherapy experienced significantly worse fatigue than their age matched comparison women with no history of breast cancer. Differences were evident in severity, and frequency of fatigue as well as perceived interference of QOL. Furthermore, a similar study was done looking at both lung and breast cancer patients who had received radiation treatment and evaluated their overall QOL with fatigue as a domain/subscale. It was concluded that fatigue was the most prominent domain/subscale of QOL, and had the most significant changes and negative effects, being the only subscale that independently contributed to QOL (Dagnelie et al., 2007). Even though the treatment type between the two studies were different the results were similar, no matter what type of treatment, these results showed that fatigue is one of the main factors for a decline in physical activity, and finding motivation for physical activity when one is fatigued can be a challenge. 812 women diagnosed with breast cancer from the HEAL study cohort were
interviewed on their physical activity, frequency, and duration, from 1 year prior to diagnosis and 4 to 12 months after diagnosis (Irwin et al., 2003). Women decreased their total physical activity significantly by an estimated 2.0 hours per week after diagnosis (P<0.05) (Irwin et al., 2003). When broken down into type of physical activity, recreational/sports activities dropped by 50% in women who were treated with radiation and chemotherapy compared to a 24% decrease in women who underwent surgery only or a 23% significant decrease in women who had been treated with radiation only (P < 0.05) (Irwin et al., 2003). Obese women (BMI ≥ 30 kg/m²) had a 41.4% decrease in post diagnosis recreational/sport activities resulting in a greater decrease when compared to the leanest women who had a 24.1% decrease and overweight women (25 kg/m² ≤ BMI < 30 kg/m²) (Irwin et al., 2003). When broken down into intensity of physical activity light activities (< 3METs), moderate activities (3-6 METs), and vigorous activities (> 6 METs) all decreased by 13.9%, 44.9%, and 136.2%, respectively (Irwin et al., 2003). The decrease in physical activity can be an explanation for weight gain commonly seen after 1 year of diagnosis (Irwin et al., 2003). When comparing physical activity and weight changes in women who have received adjuvant chemotherapy to age and education matched cancer free women it was found that at diagnosis the mean BMI for 24 women was 30.2 ± 8.1 kg/m² and increased significantly by the 1 year mark, (P=0.015) to a mean increase of 2.6 ± 6.4 kg/m² from time of diagnosis to 1 year after treatment completion (Broderick et al., 2014). By the 1 year time mark women who had received a cancer diagnosis had mean BMI of 31.2 ± 8.1 kg/m², which was significantly different when compared to the cancer free comparison group who had a mean BMI of 25.1 ± 1.9 kg/m² (p = 0.02) (Broderick et al., 2014). At 1 year, the cancer group only had 3 women considered at a healthy weight compared to 9 women in the cancer free group (Broderick et al., 2014). Physical activity which was measured by questionnaires showed high levels of sedentary
behaviors in the cancer group with a mean of 6.8 ± 1.9 hours of sedentary behaviors per day at the 6-week time mark, 7.3 ± 2.3 hours per day at the 6-month time mark and 7.6 ± 2.3 hours per day 1 year after chemotherapy completion with a trend towards significance in the decrease of physical activity over the 1 year span (Broderick et al., 2014). The cancer free comparison group spent significantly more time doing light physical activity than the cancer group (p=0.003) with differences at the 6-week and 1 year time marks (Broderick et al., 2014). Additionally, it was found that fatigue, being a side effect of treatment, was still reported 1 year after completion of chemotherapy and 1/3 of the group reported still being affected by it severely, which was considered a mechanism for a decrease in physical activity (Broderick et al., 2014). Fatigue therefore is one of the main reasons for the increase in sedentary behaviors and decrease in physical activity seen in BCS that may help explain the increases in body weight and fat mass and decreases in muscle mass commonly seen after the completion of treatment (Broderick et al., 2014; Groll, Luctkar-Flude, Tranmer, & Woodend, 2009; Irwin et al., 2003, 2005; Jacobsen et al., 1999).

For BCS, the primary goal for post-treatment lifestyle changes should be to increase muscle mass and decrease fat mass through dietary changes and exercise. Scientific evidence shows that physical activity may reduce the risk of breast cancer (McTiernan et al., 2003) and to help gain back muscle strength that has been lost (Lenz, 2010). Physical activity is important for survivors who want to avoid reoccurrence and trying to improve muscle strength that may have been lost. Survivors who are trying to become more physically active and increase their muscle mass should be consuming meals that are rich in essential amino acids throughout the day (Katsanos et al., 2006; Lenz, 2010; Symons, Sheffield-Moore, Wolfe, & Paddon-Jones, 2009).
The most important goal for women, who have recently been diagnosed with breast cancer, is to receive the most beneficial treatment no matter the side effects to combat the cancer cells and eventually be declared cancer free. While the cancer may no longer be in the body, the side effects from treatment will stay until women make lifestyle changes. Many BCS will seek out information on different methods in hopes to improve their body composition and prevent reoccurrence. No pharmaceutical drug has been shown to reverse side effects better than diet modification and increases in physical activity and exercise. Due to the scientific evidence that physical activity may reduce the risk of breast cancer (McTiernan et al., 2003) as well as help gain back muscle strength that has been lost (Lenz, 2010) this focus area is very important for survivors who want to avoid reoccurrence and are trying to gain back independence through an improvement in daily function, and improve muscle strength that may have been lost due to treatment. Along with physical activity comes the need for maintaining a healthy weight and balancing caloric intake with physical activity to avoid excess weight gain and/or reduce weight until BCS are no longer classified as overweight or obese (Kushi et al., 2006). BCS should begin to keep track of their dietary habits and the types of foods they are consuming and their caloric intake in a day. Especially how many grams of protein they are consuming in a day, as well as, the quality of protein. BCS who consume higher amounts of protein have been linked to having lower BMIs and being more physically active (Holmes et al., 2014). BCS who are trying to become more physically active and increase their muscle mass should be consuming meals that are rich in protein (Katsanos et al., 2006; Lenz, 2010; Symons et al., 2009). The United States Department of Agriculture (USDA) states a healthy diet consists of fruits, vegetables, whole grains, fat-free or low-fat dairy products and the inclusion of lean meats, poultry, fish, nuts and beans. Diets should contain little saturated, and trans-fats, cholesterol, sodium, and added sugars.
(Agriculture, 2010). For the benefit of cancer reduction it is suggested to consume at least 5 servings of a variety of fruits and vegetables (Kushi et al., 2006), along with an increase in poultry and reduction in red meat intake (Holmes et al., 2014; Velentzis et al., 2011). The USDA recommends 6 to 11 servings of grains per day with whole grains accounting for half the servings, additionally whole grains can help with weight management, 2 to 3 servings of meat preferably lean meat, 2 to 3 servings per days of fats and oils, making up 30% or less of the total daily food intake (Agriculture, 2010). Along with benefits of cancer reduction and increases in MPS an overall healthy diet as suggested above can reduce the risk for development of secondary and chronic diseases such as stroke, cardiovascular disease, and type 2 diabetes (Kushi et al., 2006; Agriculture, 2010). With the combination of both physical activity and healthy dietary habits body composition in women will improve (Camoriano, Loprinzi, Ingle, Therneau, Krook, 1990; Chlebowski, 2002; Loprinzi & Cardinal, 2012; Meyerhardt et al., 2012).
CHAPTER 3

RESEARCH DESIGN AND METHODS

Study Overview

This study was a cross-sectional study designed to examine the relationship of daily dietary protein intake, body composition (lean mass and fat mass), and physical activity in BCS. We included women BCS who received chemotherapy, radiation and/or hormone suppressant therapy alone or in conjunction with any other form of traditional cancer treatment and who have completed all their treatments with the exception of hormone suppressant therapy. The rationale for accepting BCS still taking hormone suppressant therapies was because after initial treatments are completed, hormone suppressant therapies are prescribed for an additional period of 3 to 5 years. Excluding women still taking hormone suppressant therapies would have significantly decreased the number of women eligible for the study.

Inclusion Criteria

32 post-menopausal (induced or natural) women BCS (stages 0-III), ages 40-75 years, having completed chemotherapy and/or radiation (at least 2 months post treatment), were recruited from Tallahassee, FL and surrounding areas. Women currently taking or who had completed hormone suppressant therapies were eligible to participate in this study. There were no restrictions to race or socioeconomic status. All women had a physician’s consent signed (Appendix A) before participating in the study to verify cancer remission. This study was approved by the University Institutional Review Board (Appendix B).


Exclusion Criteria

Women diagnosed with stage IV breast cancer or those who are currently diagnosed with active cancer; those receiving endocrine (e.g., prednisone, other glucocorticoids) or neuroactive (e.g., dilantin, phenobarbital) drugs or any other prescription drugs known to influence fat or muscle metabolism; those with a history of hypo or hyperthyroidism or any other disease known to alter metabolism; those with uncontrolled hypertension ($\geq 160/100$ mmHg), uncontrolled diabetes (blood glucose $> 250$ mg/dl), heart disease, kidney disease, allergies to milk protein; those treated with pharmacologic doses of vitamin D or anabolic steroids were not able to participate in the study. In addition, all participants were at least 3 months post-surgery and 2 months post treatment in order to participate. Male breast cancer survivors were not eligible for this study.

Data Collection

Laboratory Visit 1

Once participants had been screened and given an orientation to the study over the telephone (Appendix C) and met the initial requirements of the study, they were invited to the Clinical Exercise Physiology Laboratory at The Florida State University for a further orientation to the study. During the orientation visit, the study coordinator reviewed the time commitment and explained the study protocol. Participants were given the opportunity to ask questions. If the participant was interested in participating in the study, she then completed an informed consent (Appendix D) and was given a physician’s consent form (Appendix A) to get completed by her physician for approval to participate in study. Questionnaires on demographics (Appendix E) and medical history (Appendix F) were also completed at that time. Once eligibility was confirmed,
physician’s consent received, and participant had consented to participate, the participant was then scheduled for her first testing visit.

During the first testing visit participants came to the laboratory and completed height and weight measurements on a physician’s scale. Waist and hip circumference was taken at least 2 times at the narrowest part of the waist and largest protrusion around the buttocks, respectively. Body composition measurements (iDXA™, Lunar, GE) of total body, android and gynoid regions, and appendicular measures of fat-free mass and fat mass were assessed. Handgrip strength was measured using a handgrip dynamometer (Lafayette Instruments, Lafayette, IN). Grip strength was tested 3 times alternating hands after each try, the highest measurement of the three tries from the left and right side were added together. Both upper and lower body strength were assessed using the chest press and leg extension exercises (MedX™, Ocala, FL), respectively. After a warm-up, participants were progressed towards the maximum weight that they could lift one time (1RM) through a full range of motion. All measurements were recorded, with the goal of achieving a 1RM within 3 to 5 maximal attempts. 3-day dietary food records (2 weekdays and 1 weekend day) (Appendix G and Appendix H) were distributed. Participants were given information on serving sizes and asked to record everything they consumed and how many servings they consumed for 2 week days and 1 weekend day. Participants were also given a Digi-walker Yamax SW 200 pedometer (San Antonio, TX) to wear on their waistband every day for 7 consecutive days along with a one week pedometer log (Appendix I). Both 3-day dietary food records and pedometer log were collected during the second visit.
Laboratory Visit 2

On the second visit, participants returned their 3-day food records and pedometer log. Participants also had their 1RM strength measures repeated. The highest value that was obtained during the 1RM from either the first or second visit was the criterion measure of strength. 3-day food record data were entered into choosemyplate.gov food tracker, where meals were broken down into macronutrients grams per day, and total calories consumed based off of the food entries from each participant.

Participant Recruitment

BCS (stages 0-III) with diverse racial and ethnic backgrounds, including African Americans, Asians, and Hispanics who live in Tallahassee metropolitan and rural areas within reasonable commuting distances were recruited via newspaper advertisements, public service announcements, feature stories related to health on local television and radio, science articles in local newspapers, and flyers posted on campus, in health clinics and fitness centers, and in employment development centers. We also recruited through Cooperative Extension nutrition and health specialists, local breast cancer support groups, local churches and hospitals, groups on campus, and community groups.

Anticipated Risks and Solutions

All participants needed medical clearance from their oncologist or primary care physicians verifying that they did not fall within the exclusionary criteria for the study. At any time during the study, participants who did not meet the inclusion criteria were not able to continue with the study. Potential physical risks to participants in this study were minimized by
using skilled technicians in testing procedures. All personnel involved in the study were CPR and First Aid Certified. If participants expressed significant fatigue or do not feel comfortable with testing procedures, the test was not completed at that time. If at any time a participant experienced chest pain or had any signs or symptoms of dizziness or had any abnormal blood pressure or heart rate response to testing, emergency personnel would be contacted. In case of emergency, emergency personnel was available within five minutes on the university campus.

Possible adverse events could include a low exposure to radiation (< 5 mrem per DXA scan) associated with a DXA scan. Doses received from DXA scans examinations are small in comparison to other common radiation sources and are believed to represent no significant health risk. By comparison, natural background radiation is about 300 mrem per year, an x-ray of the spine is 70 mrem, a mammogram is 45 mrem, and a typical cross-country plane flight is approximately 6 mrem of radiation.

If an adverse event occurred, forms were used to report the details. Serious adverse events were reported to the PI who would then inform the IRB. Unanticipated non-serious adverse events were reported within 30 days and serious adverse events were reported within 48 hours.

All data were coded numerically and results were kept confidential throughout the course of the study. The master sheet of codes and questionnaires obtained was retained by the PI and kept in a locked cabinet in a locked room in the Department of Nutrition, Food and Exercise Sciences after completion of the research project. Results of this study will be published and/or presented at meetings but no names, initials, or other identifying characteristics will be reported.
Medical records will be maintained in strictest confidence according to current legal requirements and will not be revealed unless required by law.

**Statistical Analyses**

Descriptive statistics were calculated for all variables and included means and standard deviations. The primary aim of this study was to investigate the relationships of protein intake, body composition, and physical activity in post-menopausal BCS. Pearson product moment correlations were used to evaluate the relationships of protein intake, body composition and physical activity. One-way analysis of variance (ANOVA) was used to determine differences of BCS who consumed greater than 1.14 g/kg of body weight/day and less than 1.14 g/kg of body weight/day on measurements of body composition and physical activity. All significance was accepted at $p \leq 0.05$. All analyses were performed using the SPSS (v.21; Armonk, NY) statistical package.
CHAPTER 4

RESULTS AND DISCUSSION

Data were collected on 32 postmenopausal BCS participants, ages 40-74 years (mean ± SD = 59 ± 8 years). These participants were part of an ongoing study that was examining the effects of resistance training and protein supplementation on body composition. Baseline data of the participants were used for the present study. All of the 32 participants completed 3-day food logs, body composition measures with DXA (iDXA™, Lunar, GE), 7-day pedometer logs, and strength measures.

Participant’s characteristics are presented in Table 1. The women ranged in height from 148.9 to 174.3 cm with a mean height of 162.3 ± 6.0 cm, and average body weight was 72.5 ± 15.0 kg. Most of the participants were considered overweight with a mean BMI of 27.6 ± 5.8 kg/m². Participant’s months since breast cancer diagnosis ranged from 5-261 months with a mean of 77 ± 59 months. The participant’s stage of cancer ranged from 0-3 with the majority of the participants having stage 1 cancer. The participants were broken into 2 groups; participants who consumed greater than 1.14 g/kg of bw/day of protein and participants who consumed less than 1.14 g/kg of bw/day of protein and one-way analysis of variance was performed to compare the groups.

Table 2 presents the analysis of variance results comparing the characteristics between participants who ate greater than 1.14 g/kg of bw/day of protein and participants who ate less than 1.14 g/kg of bw/day. The participants had similar average ages; 59 ± 6 and 60 ± 9 years and height; 163.6 ± 3.9 and 161.8 ± 7.0, respectively. However there was a significant difference
between the group’s weight and BMI. The participants who ate greater than 1.14 g/kg of bw/day of protein weighed an average of 64.7 ± 7.3 kg compared to the participants who ate less than 1.14 g/kg of bw/day weighing 76.0 ± 16.3 kg, additionally the groups average BMIs were 24.3 ± 3.1 kg/m² and 29.1 ± 6.2 kg/m². The participants who ate greater than 1.14 g/kg of bw/day weighed less and had a lower BMI than the participants who ate less than 1.14 g/kg of bw/day. The participants who ate less than 1.14 g/kg of bw/day of protein were further out from diagnosis with an average of 84 ± 63 months since diagnosis compared to the participants who ate greater than 1.14 g/kg of bw/day of protein having an average of 61 ± 49 months since diagnosis, however, this difference was not significantly different. Both groups on average were diagnosed with stage 1 breast cancer.

Table 1: Participants’ Characteristics (N=32)

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>59 ± 8</td>
<td>40-74</td>
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<tr>
<td>Height (cm)</td>
<td>162.3 ± 6.0</td>
<td>148.9-174.3</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>72.5 ± 15.0</td>
<td>50.3-111.9</td>
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<tr>
<td>BMI (kg/m²)</td>
<td>27.6 ± 5.8</td>
<td>20.9-44.1</td>
</tr>
<tr>
<td>Months Since Diagnosis</td>
<td>77 ± 59</td>
<td>5-261</td>
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<tr>
<td>Stage of Cancer</td>
<td>1 ± 1</td>
<td>0-3</td>
</tr>
</tbody>
</table>

BMI= Body Mass Index
Body composition results are presented in Table 3. The 32 participants had an average lean mass of 40.4 ± 6.3 kg, with a wide range of 25.4-52.4 kg. Similarly the participants had a wide range of fat mass from 16.8-56.6 kg with an average fat mass of 29.4 ± 9.4 kg. The average lean to fat mass ratio was 1.46 ± 0.35, with a range of 0.89-2.34 and an average total body fat percentage of 41.4 ± 5.5% with a range of 30.0-52.8%. The participants had an average waist circumference of 85.7 ± 13.8 cm, and 12 participants had a waist circumference higher than 88 cm, increasing their risk for cardiovascular disease and reoccurrence of breast cancer. The participants had an average hip circumference of 107.9 ± 10.8 cm, total bone mineral density of 1.111 ± 0.141 g/cm² and appendicular skeletal muscle mass index of 6.8 ± 1.3 kg/m². Two participants fell below the 5.45 kg/m² appendicular skeletal muscle mass index cut point and were considered sarcopenic.

Table 2: Comparison of Participant’s Characteristics of Participants who Consumed Less than 1.14 g/kg of bw/day and Greater than 1.14 g/kg of bw/day of Protein (N=32)

<table>
<thead>
<tr>
<th></th>
<th>&lt;1.14 g/kg/day (n=22)</th>
<th>&gt;1.14 g/kg/day (n=10)</th>
<th>p value</th>
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<tr>
<td>Age (years)</td>
<td>60 ± 9</td>
<td>59 ± 6</td>
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<tr>
<td>Height (cm)</td>
<td>161.8 ± 7.0</td>
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<td>Weight (kg)</td>
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<td>64.7 ± 7.3*</td>
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<td>BMI (kg/m²)</td>
<td>29.1 ± 6.2</td>
<td>24.3 ± 3.1*</td>
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<tr>
<td>Months Since Diagnosis</td>
<td>84 ± 63</td>
<td>61 ± 49</td>
<td>0.323</td>
</tr>
<tr>
<td>Stage of Cancer</td>
<td>1 ± 1</td>
<td>1 ± 1</td>
<td>0.374</td>
</tr>
</tbody>
</table>

Values are means ± standard deviations

BMI = Body Mass Index
Physical activity and strength measures of all 32 participants are shown in Table 4.

Pedometer logs were used to collect the average steps participants took each day for seven consecutive days. Participants walked an average of 6,286 ± 3,243 steps/day which classified them as low active (Tudor-Locke, Bassett, 2004). Walking less than 5,000 steps/day is classified as living a sedentary lifestyle and walking more than 12,500 steps/day would be classified as highly active, the participants had a wide range of steps/day ranging from 2,278-13,421 steps/day, with classifications ranging from sedentary to highly active. Participants’ average handgrip, 1RM chest press, and 1RM leg extension were 50.5 ± 8.8 kg, 85.4 ± 22.8 kg, and 97.0 ± 25.4 kg, respectively.

Table 3: Body Composition Measures (N=32)

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean Mass (kg)</td>
<td>40.4 ± 6.3</td>
<td>25.4-52.4</td>
</tr>
<tr>
<td>Fat Mass (kg)</td>
<td>29.4 ± 9.4</td>
<td>16.9-56.6</td>
</tr>
<tr>
<td>Lean to Fat Mass Ratio</td>
<td>1.46 ± 0.35</td>
<td>0.89-2.34</td>
</tr>
<tr>
<td>Total Body Fat (%)</td>
<td>41.4 ± 5.5</td>
<td>30.0-52.8</td>
</tr>
<tr>
<td>Total BMD (g/cm²)</td>
<td>1.111 ± 0.141</td>
<td>0.916-1.573</td>
</tr>
<tr>
<td>Waist Circumference (cm)</td>
<td>85.7 ± 13.8</td>
<td>65.4-118.9</td>
</tr>
<tr>
<td>Hip Circumference (cm)</td>
<td>107.9 ± 10.8</td>
<td>91.5-129.3</td>
</tr>
<tr>
<td>ASMI (kg/m²)</td>
<td>6.8 ± 1.3</td>
<td>4.7-10.7</td>
</tr>
</tbody>
</table>

BMD = Bone Mineral Density

ASMI=Appendicular Skeletal Muscle Mass Index (skeletal muscle mass of the limbs/(height)²)
Table 4: Physical Activity and Strength Measures (N=32)

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps/Day</td>
<td>6,286 ± 3,243</td>
<td>2,278-13,421</td>
</tr>
<tr>
<td>Handgrip (kg)</td>
<td>50.5 ± 8.8</td>
<td>31.8-70.8</td>
</tr>
<tr>
<td>Chest Press 1RM (kg)</td>
<td>85.4 ± 22.8</td>
<td>36.4-128.3</td>
</tr>
<tr>
<td>Leg Extension 1RM (kg)</td>
<td>97.0 ± 25.4</td>
<td>41.9-150.0</td>
</tr>
</tbody>
</table>

1RM = One Repetition Maximum

Analysis of variance was used to analyze and compare body composition, physical activity, and strength measure differences between participants who consumed less than 1.14 g/kg of bw/day of protein and participants who consumed more than 1.14 g/kg of bw/day of protein (Table 5,6). Of the 32 participants 22 of them consumed less than 1.14 g/kg of bw/day, and 10 of them consumed greater than 1.14 g/kg of bw/day of protein. Participants who consumed more than 1.14 g/kg of bw/day of protein had lower fat mass and lower total body fat percentage than the participants who consumed less than 1.14 g/kg of bw/day. Additionally the participants who consumed greater than 1.14 g/kg of bw/day had a significantly higher lean to fat mass ratio. When comparing the two group’s strength and physical activity measures it was seen that the participants who ate greater than 1.14 g/kg of bw/day had slightly higher steps/day and lower strength measures but no significant differences were found between the groups.

Table 7 presents the nutrient intake of participants from the 3-day food log. The 32 participants consumed an average of 1,758 ± 517 calories a day with a large range of 214-2,707 calories a day. The participant’s average consumption of protein was 71 ± 22 g a day, and 1.00 ± 0.32 g/kg of bw/day when calculated relative to body weight. The participants consumed a daily
average of 201 ± 66 g of carbohydrates, 827 ± 322 mg of calcium, and 5 ± 5 µg of vitamin D. Additionally on average the participant’s diets collectively consisted of 46 ± 7% carbohydrates, 38 ± 5% fat, and 16 ± 4% protein.

Table 5: Comparison of Body Composition of Participants who Consumed Less than 1.14 g/kg of bw/day and Greater than 1.14 g/kg of bw/day of Protein (N=32)

<table>
<thead>
<tr>
<th></th>
<th>&lt;1.14 g/kg/day (n=22)</th>
<th>&gt;1.14 g/kg/day (n=10)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lean Mass (kg)</strong></td>
<td>41.2 ± 7.2</td>
<td>38.6 ± 3.1</td>
<td>0.270</td>
</tr>
<tr>
<td><strong>Fat Mass (kg)</strong></td>
<td>32.1 ± 9.8</td>
<td>23.6 ± 5.4*</td>
<td>0.016</td>
</tr>
<tr>
<td><strong>Lean to Fat Mass Ratio</strong></td>
<td>1.35 ± 0.29</td>
<td>1.70 ± 0.36*</td>
<td>0.006</td>
</tr>
<tr>
<td><strong>Total Body Fat (%)</strong></td>
<td>43.1 ± 5.0</td>
<td>37.6 ± 4.8*</td>
<td>0.006</td>
</tr>
<tr>
<td><strong>Total Body BMD (g/cm²)</strong></td>
<td>1.121 ± 0.160</td>
<td>1.088 ± 0.090</td>
<td>0.547</td>
</tr>
<tr>
<td><strong>Waist Circumference (cm)</strong></td>
<td>88.7 ± 15.1</td>
<td>79.1 ± 7.2</td>
<td>0.066</td>
</tr>
<tr>
<td><strong>ASMI (kg/m²)</strong></td>
<td>7.1 ± 1.4</td>
<td>6.2 ± 0.7</td>
<td>0.081</td>
</tr>
</tbody>
</table>

Values are Means ± Standard Deviations
BMD= Bone Mineral Density
*p<0.05, Significantly different from the group consuming <1.14 g/kg/day of protein

The nutritional intake results of participants who ate greater than 1.14 g/kg of bw/day compared to the participants who ate less than 1.14 g/kg of bw/day are reported in Table 8. There was no significant difference in calorie intake of those who ate greater than 1.14 g/kg of bw/day of protein compared to the participants who ate less than 1.14 g/kg of bw/day. There was also no difference in the amount of carbohydrates eaten between the two groups. The participants who
ate greater than 1.14 g/kg of bw/day of protein consumed significantly more protein in absolute grams, 88 ± 19 g/day when compared to 64 ± 19 g/ day. Fat consumption was approaching significance with a p-value of 0.064 between the participants who consumed less than 1.14 g/kg of bw/day of protein and the participants who ate more than 1.14 g/kg of bw/day of protein. There were no significant differences between the groups in calcium and vitamin D consumption.

Table 9 presents the Pearson Products Moment correlations of selected body composition measures with protein, physical activity, and strength. There was a significant negative correlation between protein and total body fat (r= -0.502) and a significant positive correlation between protein and lean to fat mass ratio (r=0.487). Additionally there was a significant negative correlation between steps per day and waist circumference (r=-0.434), as well as a positive significant correlation between lean mass and handgrip strength (r=0.413). Chest press 1RM was also found to be positively significant with BMI (r=0.607), fat mass (r=0.509), lean mass (r=0.806) and waist circumference (r=0.613). Additionally there was a positive significance correlation between waist circumference and total body fat percentage (r=0.632). No other significant correlations were found.

Table 6: Comparison of Physical Activity and Strength of Participants who Consumed Less than 1.14 g/kg of bw/day and Greater than 1.14 g/kg of bw/day of Protein (N=32)

<table>
<thead>
<tr>
<th></th>
<th>&lt;1.14 g/kg/day (n=22)</th>
<th>&gt;1.14 g/kg/day (n=10)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps per Day</td>
<td>6,099 ± 2,523</td>
<td>6,679 ± 3,242</td>
<td>0.589</td>
</tr>
</tbody>
</table>
Table 6-continued

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Handgrip (kg)</strong></td>
<td>50.7 ± 9.1</td>
<td>49.9 ± 8.4</td>
<td>0.805</td>
<td></td>
</tr>
<tr>
<td><strong>Chest Press 1RM (kg)</strong></td>
<td>89.3 ± 24.8</td>
<td>76.9 ± 15.7</td>
<td>0.158</td>
<td></td>
</tr>
<tr>
<td><strong>Leg Ext. 1RM (kg)</strong></td>
<td>101.2 ± 24.5</td>
<td>86.7 ± 26.1</td>
<td>0.150</td>
<td></td>
</tr>
</tbody>
</table>

Values are Means ± Standard Deviations
1RM= One Repetition Maximum

Table 7: Nutrient Intake of Participants (N=32)

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calories (Kcal)</strong></td>
<td>1,758 ± 517</td>
<td>214-2,707</td>
</tr>
<tr>
<td><strong>Carbohydrates (g)</strong></td>
<td>201 ± 66</td>
<td>30-328</td>
</tr>
<tr>
<td><strong>Protein (g)</strong></td>
<td>71 ± 22</td>
<td>4-137</td>
</tr>
<tr>
<td><strong>Protein (g/kg of bw/day)</strong></td>
<td>1.00 ± 0.32</td>
<td>0.08-1.82</td>
</tr>
<tr>
<td><strong>Carbohydrates (%)</strong></td>
<td>46 ± 7</td>
<td>35-57</td>
</tr>
<tr>
<td><strong>Fat (%)</strong></td>
<td>38 ± 5</td>
<td>27-47</td>
</tr>
<tr>
<td><strong>Protein (%)</strong></td>
<td>16 ± 4</td>
<td>7-27</td>
</tr>
<tr>
<td><strong>Total Calcium (mg)</strong></td>
<td>827 ± 322</td>
<td>111-1,987</td>
</tr>
<tr>
<td><strong>Total Vitamin D (µg)</strong></td>
<td>5 ± 5</td>
<td>0-21</td>
</tr>
</tbody>
</table>

Table 8: Comparison of Nutrient Intake of Participants who Consumed Less than 1.14 g/kg of bw/day and Greater than 1.14 g/kg of bw/day of Protein (N=32)

<table>
<thead>
<tr>
<th></th>
<th>&lt;1.14 g/kg/day</th>
<th>&gt;1.14 g/kg/day</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calories (Kcal)</strong></td>
<td>1,690 ± 547</td>
<td>1,905 ± 433</td>
<td>0.283</td>
</tr>
</tbody>
</table>
### Table 8-continued

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean ± SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates (g)</td>
<td>190 ± 63</td>
<td>0.196</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>64 ± 19</td>
<td>0.002</td>
</tr>
<tr>
<td>Carbohydrates (%)</td>
<td>46 ± 7</td>
<td>0.819</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>39 ± 4</td>
<td>0.064</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>15 ± 4</td>
<td>0.020</td>
</tr>
<tr>
<td>Total Calcium (mg)</td>
<td>784 ± 353</td>
<td>0.269</td>
</tr>
<tr>
<td>Total Vitamin D (µg)</td>
<td>5 ± 5</td>
<td>0.478</td>
</tr>
</tbody>
</table>

Values are Means ± Standard Deviations

*p<0.05, Significantly different from the group consuming <1.14 g/kg/day of protein

### Table 9: Protein, Strength, and Body Composition Correlations

<table>
<thead>
<tr>
<th>Component</th>
<th>BMI (kg/m²)</th>
<th>Total Body Fat (%)</th>
<th>Lean Mass (kg)</th>
<th>Fat Mass (kg)</th>
<th>LM:FM Ratio</th>
<th>Waist Circ. (cm)</th>
<th>Total BMD</th>
<th>ASMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (g/kg/day)</td>
<td>-0.244</td>
<td>-0.502**</td>
<td>0.048</td>
<td>-0.316</td>
<td>0.487**</td>
<td>-0.239</td>
<td>-0.160</td>
<td>-0.087</td>
</tr>
<tr>
<td>Steps/Day</td>
<td>-0.326</td>
<td>-0.270</td>
<td>-0.227</td>
<td>-0.256</td>
<td>0.301</td>
<td>-0.434*</td>
<td>-0.139</td>
<td>-0.291</td>
</tr>
<tr>
<td>Handgrip (kg)</td>
<td>0.047</td>
<td>-0.244</td>
<td>0.413*</td>
<td>0.018</td>
<td>0.208</td>
<td>0.124</td>
<td>0.097</td>
<td>0.221</td>
</tr>
<tr>
<td>Chest Press 1RM (kg)</td>
<td>0.607**</td>
<td>0.120</td>
<td>0.806**</td>
<td>0.509**</td>
<td>-0.143</td>
<td>0.613**</td>
<td>0.570**</td>
<td>0.752**</td>
</tr>
<tr>
<td>Leg Ext. 1RM (kg)</td>
<td>0.319</td>
<td>-0.132</td>
<td>0.659**</td>
<td>0.255</td>
<td>0.120</td>
<td>0.326</td>
<td>0.497**</td>
<td>0.516**</td>
</tr>
</tbody>
</table>

* Correlation is significant at the p ≤ 0.05 level

** Correlation is significant at the p ≤ 0.01 level

1RM= One Repetition Maximum

BMI= Body Mass Index
Discussion

This study explored the relationship between dietary protein intake, body composition, and physical activity in postmenopausal BCS. In the 32 BCS who were on average overweight and low active, it was found that higher protein consumption in the diet was related to lower percent body fat and higher ratio of lean to fat mass. When evaluating the differences in protein intake for BCS who reported eating greater than 1.14 g/kg of bw/day in their diet, these women had significantly lower body weight, BMI, fat mass and percent body fat as well as a greater lean to fat mass ratio than the women who reported less protein in their diet. No relationships were found with protein intake and physical activity measured by steps/day or strength measures of chest and leg 1RM and handgrip. However, there were significant correlations between lean body mass and strength measures of the chest press, leg extensions and handgrip. Women who had higher levels of steps/day had lower waist circumferences.

The hypotheses for our study were 1) BCS who consume a healthy diet with protein rich foods will have a greater amount of lean body mass; 2) BCS who consume a healthy diet with protein rich foods will have a lower amount of fat mass; and 3) BCS who consume a healthy diet with protein rich foods will have greater physical activity levels. Based on the results of this study the first hypothesis was rejected since no relationship was found between reported protein intake and lean mass. However, the second hypothesis was accepted since there was a significant negative correlation between reported protein intake and body fat percentage and significant differences of lower body weight, body fat percentage, and fat mass, in the BCS reporting that they consumed at least 1.14 g/kg of bw/day and those who do not. Additionally the lean to fat mass ratio was also significantly higher in the BCS who reported they consumed greater than 1.14 g/kg of bw/day. The third hypothesis was rejected since there were no
relationships between protein intake and physical activity measured by steps/day and strength. BCS who walked more each day had lower waist circumferences and women who were stronger had greater amounts of lean mass.

Weight gain and obesity are commonly seen in BCS due to the negative side effects of cancer treatment (Camoriano et al., 1990). Unfortunately it has been reported that being overweight or obese can increase a BCS chances of cancer reoccurrence (Abe et al., 1976). Obesity has been associated with estrogen hormone profiles likely to stimulate breast cancer progression (Chlebowski, 2002), making it imperative for BCS to have dietary and physical activity habits that promote increases and/or maintenance of lean mass and decreases of fat mass in order to decrease risk of reoccurrence, cancer progression, and breast cancer related mortality. In this study the participants on average were considered overweight, with 12 of the 32 participants being classified as overweight and 9 out of the 32 being obese. Two similar studies examining physical activity in relation to breast cancer diagnosis had similar participant weight classifications to the present study. In the first study using breast cancer patients as participants it was found that at time of cancer diagnosis the average BMI for 24 breast cancer patients was $30.2 \pm 8.1 \text{ kg/m}^2$ and BMI increased after a year of treatment (Broderick et al., 2014), and in the second study using 2,987 breast cancer patients it was found that the average BMI was $25.1 \text{ kg/m}^2$ classify the participants as overweight (Holmes et al., 2014). Along with the risk of reoccurrence, being overweight can also increase the risk for breast cancer mortality (Chlebowski, 2002). Participants in the present study had similar lean mass and fat mass averages when compared to other studies using BCS (Ahmed, Thomas, Yee, & Schmitz, 2006; Page, 2011). Ahmed et al (2006) looked at the same body composition measures as the present study in 23 BCS and found baseline lean mass and fat mass averages were $38.1 \pm 5.2 \text{ kg}$ and $31.6$
± 11.5 kg respectively, slightly lower than the present study’s average of 40.4 ± 6.3 kg for lean mass and higher than the average fat mass of 29.4 ± 9.4 kg. In an exercise intervention study using impact activity and resistance exercise, the average lean mass measurement of 23 BCS at baseline was 45.3 ± 5.0 kg, which is somewhat higher than the participants’ average in the present study, yet the intervention study had a much lower fat mass average of 25.8 ± 9.6 kg, this could be because the participants consumed less calories a day than the participants in the present study. (Winters-Stone et al., 2012).

Studies have shown that increasing protein intake can prevent weight gain after cancer diagnosis, increase survival rates (Holmes et al., 2014), and decrease risk for reoccurrence (Holmes et al., 1999). Others have found that BCS who consumed higher amounts of protein, were more physically active and were considered normal weight by BMI (Holmes et al., 2014). Although in the current study we found that the participants who consumed higher amounts of protein were of lower body weight, they were not more physically active, disagreeing with the finding of the study by Holmes et al.

On average the participants in the present study were consuming 1,758 calories a day, which is close to the RDA recommendation of 1,800 calories a day for women. Page et al. (2011) examined body composition in 24 BCS. The BMI reported in their study was not different than the present study, but the BCS consumed an average of about 200 more calories a day than the participants in the present study. However, others who examined changes in dietary habits after breast cancer diagnosis found that their participants decreased their caloric intake after diagnosis and were consuming less calories than the RDA, similar to the present study’s caloric intake (Shaharudin et al., 2013). The BCS have been shown to decrease their caloric intake as an effort
to lose weight through calorie restriction or to prevent a common trend of weight gain after
diagnosis (Abe et al., 1976; Shaharudin et al., 2013). By losing weight or preventing weight gain
BCS are trying to decrease their risk for reoccurrence (Chlebowski, 2002).

The participants in the current study on average were within the recommended
parameters for carbohydrates and protein percentage of the diet. The RDA recommends 45-65%
of the diet to be carbohydrates and the participants were consuming 46 ± 7% carbohydrates.
However the participants within the study were above the recommended 20-35% value for fat
consumption with an average of 38 ± 5%. This higher percentage of fat intake could be one of
the reasons the participants were overweight. The RDA recommends a diet to consist of 10-35%
protein and the participants were consuming 16 ± 4%, however being on the lower side of the
recommendation. Protein is needed to fuel the muscles for building and maintaining muscle mass
throughout a woman’s lifespan (Evans, 1995; Phillips et al., 2012). In healthy adults MPS
increases in response to ingestion of essential amino acids due to signaling of the mammalian
target of rapamycin complex 1(mTORc1) pathway (Phillips et al., 2012). By ingesting higher
amounts of protein MPS will be stimulated through the mTORc1 pathway signaling response
therefore muscle mass can better be maintained (Katsanos et al., 2006). By not consuming
enough protein, MPS will not be stimulated and the balance between MPS and MPD will shift in
a negative direction (Pitkänen et al., 2003). Even though the participants in this study were
within the RDA they may need higher amounts of protein to make up for the loss in muscle mass
and increases in fat mass from the effects of their cancer treatment. Shaharudin et al. reported
similar results in a study examining dietary changes two years after cancer diagnosis in breast
cancer patients. Their participants were considered overweight with an average BMI of 26.4 ±
5.3 kg/m², like the participants in the present study they consumed 14.8 ± 0.3% of protein
The participants in the present study who consumed higher amounts of protein had less total body fat and a higher lean mass to fat mass ratio. Additionally the participants who consumed greater than 1.14 g/kg of bw/day of protein had smaller waists, lower body weight, BMI, total body fat and fat mass. One reason for the better body composition in the participants who consumed higher amounts of protein could be due to greater food-derived thermogenesis. The metabolic cost to break down protein is greater than other macronutrients. The thermic response to protein ingestion has been reported to be 50-100% greater than that of carbohydrates (Johnston, Day, & Swan, 2002). By consuming more protein the BCS may be using more energy to break down and utilize the nutrient therefore increasing their resting metabolic rate (Johnston et al., 2002). Another reason for a more positive body composition in the participants who consumed higher amounts of protein is increased satiety. Protein is a stimulator of a gastrointestinal hormone called cholecystokinin, which has been known to induce satiety. By ingesting protein, cholecystokinin is stimulated signaling the feeling of fullness, thus the participants may not eat as much because they do not feel hungry (Johnston et al., 2002; Latner, Schwartz, 1999). The participants who consumed greater than 1.14 g/kg of bw/day of protein average BMI was considered in the normal weight classification. Holmes et al. found that women who consumed less than 60.9 grams of protein a day had a greater relative risk for death and the association decreased greatly when 67.8 grams or more of protein was consumed. In the present study our participants were consuming an average of 71 grams of protein a day, slightly higher than the previous study’s finding (Holmes et al., 1999). By consuming higher amounts of protein the participants are improving their body composition and decreasing their weight leading to perhaps a decrease in risk of breast cancer reoccurrence and breast cancer mortality (Holmes et al., 1999).
As seen in the literature many BCS change their dietary habits after diagnosis, one of those changes being decreasing protein intake (Shaharudin et al., 2013; Velentzis et al., 2010). The reduction in protein has been attributed to a reduction in meats high in fat, which is beneficial for BCS. However with the reduction of meats high in fat BCS were not consuming enough lean sources of protein to make up for the difference, ultimately harming their body composition (Shaharudin et al., 2013; Velentzis et al., 2010). In the present study the average dietary protein consumption was 1.00 ± 0.32 g/kg of bw/day, which meets the RDA of 0.8 g/kg of bw/day, however this recommendation may not be high enough for older adults and the BCS population. It has been recommended by Campbell and colleagues that older adults and special populations such as BCS should consume at least 1.14 g/kg of bw/day (Campbell et al., 1994; Holmes et al., 1999). It has also been shown that the BCS who consume more protein have better body composition measures of lean to fat mass, possibly due to the stimulation of MPS (Phillips et al., 2012; Holmes et al., 1999).

Protein is an essential part of a healthy diet and consuming adequate amounts of protein can promote increases in lean mass and decreases in fat mass (Josse et al., 2011). This study also found a negative statistically significant correlation between protein and total body fat mass (r= -0.502) supporting evidence that high protein diets have been shown to be beneficial for body fat regulation (Prado et al., 2008) and a positive relationship between protein and lean to fat mass ratio (r=0.487).

Participants from this study were considered “low active” averaging below 10,000 steps per day, and there were no statistically significant results between protein intake and physical activity. Similar to Holmes and colleagues findings, the majority of their participants engaged in
little to no activity after breast cancer diagnosis (Holmes et al., 2014). According to the American Institute for Cancer Research cancer survivors should get at least 30 minutes or more a day of physical activity and limit sedentary behaviors. In the present study the average number of steps per day classified the women as “low active” thereby not meeting the recommended guidelines for cancer survivors (Glade, 2008). Similar to Holmes and colleagues findings the majority of their participants engaged in little to no activity after breast cancer diagnosis. In the present study however, there was a significant correlation between steps per day and waist circumference measurements. The women who took more steps per day were more physically active and therefore had a smaller waist measurement than the women who took fewer steps per day and were less physically active. The results were similar to Pelclová, Gába, Tlučáková, & PoŚpiech, who looked at the association between physical activity guidelines and body composition variables in middle-aged and older women. They found that women who had higher steps per day had a significant negative correlation with hip and waist ratio (Pelclová, Gába, Tlučáková, & PoŚpiech, 2012).

There were also positive relationships found between lean mass and chest press 1RM (r=0.806), lean mass and leg extension 1RM (r=0.659) and lean mass and handgrip strength (r=0.413). Additionally total BMD was significantly correlated with 1RM chest press and 1RM leg extension (r=0.570, r=0.497, respectively). It has been shown that BCS who exercise, and increase their lean mass are able to maintain or increase BMD (Winters-Stone, 2012). While physical activity was not shown to be significant the participants who consumed greater than 1.14 g/kg of bw/day of protein were slightly more active and had significantly less fat mass than the participants who consumed less than 1.14 g/kg of bw/day. The “low active” physical activity level could be another reason why the participants were overweight. As explained earlier BCS
are left with many negative side effects from cancer treatment such as fatigue (Jacobsen et al., 1999), low muscle mass (Satariano & Ragland, 1996) and increased fat mass (Camoriano et al., 1990) resulting in low physical activity (Demark-Wahnefried et al., 2001).

The participant’s average intake of calcium was 827 ± 322 mg/day, and average dietary intake of vitamin D was 5 ± 5 µg/day which are both well below the RDA. Consuming a combination of both calcium and vitamin D within the diet can enhance absorption of nutrients, benefiting the body. Studies have shown that calcium intake has a significant positive relationship with lean mass (Demark-Wahnefried et al., 2008; Page, 2011). Denmark-Wahnefried et al. studied the effects of calcium intake and exercise in 82 breast cancer patients currently on adjuvant chemotherapy treatment, broken down into 3 groups; calcium rich diet, consuming 1200-1500 mg of calcium in the diet; calcium rich diet plus 30 minutes or more of aerobic and strength training exercise; and calcium rich diet plus exercise plus 5 or more servings of fruits and vegetables. They reported an overall preservation of lean mass in all groups and a 0.5 ± 2.4 kg increase in the calcium rich diet group, when compared to baseline (Demark-Wahnefried et al., 2008). Similarly Page et al. reported a positive significant correlation between dietary calcium and lean mass in 24 BCS. It has also been seen that higher amounts of calcium intake may decrease body weight as Zemel et al. reported participants who consumed a high calcium diet (1,256 ± 134 mg/day) lost 8.6 ± 1.1% of baseline weight, and lost 5.61 ± 0.98 kg of fat mass (Davies et al., 2000; Zemel, Thompson, Milstead, Morris, & Campbell, 2004). Even though the present study’s participant’s average consumption of calcium was not considered high, there was a wide range with some participants reporting high calcium consumption. Velentzis et al. had a much larger study population, but found that on average the participants were consuming about half as much calcium as the participants in the present study. Participants
in both studies were on average overweight or obese (Velentzis et al., 2011). An increase in calcium intake may possibly benefit BCS by helping to reduce their body weight and fat mass.

**Limitations**

There are a few limitations to the study design that need to be addressed. This study utilized a 3-day food log as a basis to obtain dietary information of the participants. This information may not have been reliable or reflective of the participant’s normal dietary habits. Estimation of portion sizes is something to take into account; participants may not have been estimating serving sizes properly without measuring them precisely. However, ever effort was made to teach the participants what portion sizes were and how to report their food consumption. Additionally when recording everything consumed in 3 days participants may have been more aware of their dietary habits and may have eaten less or more healthy without realizing it. Another limitation is the smaller sample size (N=32) and the regional demographics. These data may not be representative of the population as a whole and may be specific to this region in Northwest Florida.
CHAPTER 5

CONCLUSIONS AND FUTURE STUDIES

It has been recommended that a healthy diet should consist of foods rich in protein of at least 1.14 grams per kilogram of body weight per day or higher of protein (Campbell et al., 1994). About 31% of participants consumed this recommended dose of protein in the present study. Finding non-pharmaceutical ways to decrease fat mass and increase lean mass, as well as increase physical activity and decrease susceptibility of side effects in BCS is critically important for this population. Dietary changes may benefit BCS by potentially decreasing their risk for reoccurrence and decreasing mortality. These findings contribute to the understanding of breast cancer patients’ dietary changes and physical activity behaviors after cancer diagnosis and the benefits of consuming adequate protein in the diet.

These results indicate the amount of protein consumed is associated with lower body composition measures in fat mass, and is an important component when trying to prevent overweight or obesity in postmenopausal BCS. Higher amounts of protein consumed has been shown to decrease weight gain and increase survival (Holmes et al., 1999; Nichols et al., 2009). Adequate amounts of protein can also be beneficial to this population by improving body composition by increasing the lean to fat mass ratio. Protein consumption has also been linked to increased physical activity (Holmes et al., 2014). Increasing physical activity and strength measures can help increase and maintain lean mass and decrease fat mass in postmenopausal BCS. Diet is vital for the health and well-being of BCS. In this study, the majority of women were overweight or obese and had low levels of physical activity. The women who consumed 1.14 g/kg of bw/day or higher of protein had a BMI in the normal classification, weighed less,
had a lower fat mass and total body fat percentage, as well as a higher lean to fat mass ratio than those who consumed less than 1.14 g/kg of bw/day of protein. Focusing on body weight control, lowering fat mass, and increasing lean mass through physical activity and a healthy diet of higher amounts of protein will help maintain an optimal body composition and reduce the risk of reoccurrence and mortality of breast cancer.
APPENDIX A

PHYSICIAN CONSENT DOCUMENT

Florida State University
Dept. of Nutrition, Food & Exercise Sciences
Tallahassee, FL. 32306
(850) 644-4685

A patient of yours, ________________________, has expressed an interest in taking part in a research project sponsored by the Department of Nutrition, Food and Exercise Sciences at Florida State University. The purpose of this form is to make you, the physician, aware that the above individual wishes to participate in a study that will entail some physical exertion. Please see attached informed consent. We would like your input as to whether the patient may have an underlying condition that would be contraindicated for participation in this study.

1. Does this individual have any physical limitations/conditions which you feel warrants the complete exclusion of testing (yes/no)?

2. Does this individual have any physical limitations/conditions which you feel warrants limiting or modifying the testing session (yes/no)?
   If so, please explain:

3. Additional Comments:

If you have any questions or concerns pertaining to this form and/or your patient's participation in the research project please feel free to contact me at 644-4685. Thank you for your assistance.

Physician's Signature ________________________ Date __________

Please mail the completed form or fax: Lynn B. Panton, Ph.D
436 Sandels Building
Florida State University
Tallahassee, FL 32306
Fax: (850) 645-5000

FSU Human Subjects Committee approved on 10/14/2013 Void after 9/10/2014 HSC # 2013.11468
APPENDIX B

IRB APPROVAL LETTER

The Florida State University
Office of the Vice President For Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-8673, FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 1/12/2015

To: Erica Schleicher

Dept.: NUTRITION FOOD AND EXERCISE SCIENCES

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
The Relationship Between Protein Intake, Physical Activity, and Body Composition in Breast Cancer Survivors

The application that you submitted to this office in regard to the use of human subjects in the research proposal referenced above has been reviewed by the Human Subjects Committee at its meeting on 12/10/2014. Your project was approved by the Committee.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 12/9/2015 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the
Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chair of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is FWA00000168/IRB number IRB00000446.

Cc: Lynn Panton, Advisor
HSC No. 2014.13504
Hello, my name is (state your name) calling from The Florida State University regarding the breast cancer research project that you inquired about. We are currently looking for breast cancer survivors, ages 40-75 years, having completed chemotherapy treatment. We expect the study to last approximately 2 weeks. The 2 weeks will consist of 2 visits spaced out over 2 weeks. The testing will consist of the following assessments: muscular strength by one-repetition maximal tests, and hang grip test, dietary intake log, and physical activity assessed by pedometer log.

The women in the study will be asked to complete a daily dietary log for two weekdays and one weekend. Additionally women will be given a pedometer to wear for one week and be instructed to record the number of steps obtained daily. The testing will last an hour and be performed at The Florida State University.

Do you have any questions? If not, and you are interested, I would like to ask you some questions regarding your present state to determine your eligibility. If you have any of the following conditions or are taking any of the medicines listed below, you may not be eligible to participate in the study.

1. Were you diagnosed with stage IV breast cancer or are currently diagnosed with active cancer?
2. Do you have uncontrolled hypertension (>160/100 mmHg), uncontrolled diabetes
   (fasting blood glucose >126), uncontrolled heart disease, kidney disease, allergies to milk
   protein?

3. Are you on endocrine (e.g., prednisone, other glucocorticoids) or neuroactive (e.g.,
   dilantin, phenobarbital) drugs or any other prescription drugs known to influence fat or
   muscle metabolism?

Since you do not have any of the exclusion criteria, would you like to schedule with me a time
for you come in for a more in depth orientation to the study?

Thank you very much for your time and we are looking forward to working with you shortly.
APPENDIX D

INFORMED CONSENT DOCUMENT

INFORMED CONSENT DOCUMENT

I voluntarily consent to be a participant in the research project entitled “The Relationship Between Protein Intake, Physical Activity, and Body Composition in Breast Cancer Survivors” conducted by Lynn Panton, Ph.D., Michael J. Osmund, Ph.D., Cara Pappas, N.D., and Erica Schleicher, B.S. of the Department of Nutrition, Food & Exercise Sciences at The Florida State University.

The purpose of the proposed study is to examine the relationship among protein intake physical activity (strength and steps/day), and body composition measures (fat mass, lean mass, bone density), in postmenopausal breast cancer survivors. Thirty four post-menopausal breast cancer survivors, ages 40-75 years, will be recruited for this study.

My participation in this project will involve coming to the Clinical Exercise Physiology Laboratory at Florida State University for testing on two occasions after my initial orientation visit to hear about the study. The first visit will include answering questions on health status, and measuring dietary intake, physical activity, and body composition. The second visit will include turning in my diet recall and pedometer log as well as repeating my strength tests. During my orientation visit I will be given an informed consent document to sign and a medical history form to complete before I can participate in the study. I will be given a physician’s consent form to take to my oncologist or primary care physician to make sure he or she does not have any concerns for me to participate in the study. I will also be given a 3-day food diary to fill-out and bring back for my first visit. After the physician's form has been returned to the laboratory I will be scheduled for my first visit.

During my first visit. I will complete a questionnaire packet assessing quality of life and physical activity status and I will return my 3-day food diary. I will also have my body composition measured. Waist and hip circumference measures will be taken a minimum of 2 times at the smallest part of the torso and the largest part of the buttocks, respectively. My body composition will be measured via the use of a dual-energy X-ray absorptiometry (DXA) scanner and bioelectrical impedance. Very low doses of radiation are used, however this test is non-invasive. I will lie on a padded table for approximately 5 minutes while the scan is being completed. Testing will be completed according to the manufacturer’s instructions and specifications by a certified X-ray technician. Bioelectrical impedance is also non-invasive. Two electrodes will be placed on my hand and foot. A very low electrical current which I do not feel goes from the electrodes to measure body composition and water content of the body. Both upper and lower body strength will be assessed using the chest press and leg extension exercises, respectively. After a warm-up, I will be progressed towards the maximum weight that I can lift one time through a full range of motion, also called a one-repetition maximum (1RM). All measurements will be recorded within three to five attempts. I will then be given a pedometer, which will measure the number of steps that I take. I will wear the pedometer for one week on 1 occasion and will record the number of steps in log sheets that I will be given. I will return the log sheet to the laboratory when completed during my second visit. This visit will take approximately 2 hours.

On the second visit (occurring at least 72 hours following the first visit), I will have my height and weight assessed. I will return the 3-day food diary and pedometer log. I will also have my 1RM strength measures repeated. Height and weight will be assessed using a standardized scale.

FSU Human Subjects Committee approved on 1/12/15. Void 12/09/15. HSC # 2014.13504
My 1RMs will be verified by repeating the strength tests. The highest measurement for the upper and lower body from the 2 days of testing will be considered the 1RM. The second visit will take approximately 1 hours.

Body composition will be evaluated by iDXA. This involves some radiation of approximately 0.5 mREM per total body scan. This is much less than the radiation a person receives from a chest X-ray (20-50 mREM) and substantially less than a full dental X-ray (300 mREM) or an abdominal X-ray (250 mREM). The measurement is non-invasive.

There are minimal risks or discomforts with answering questionnaires. I may choose not to complete the questionnaires but will not be able to participate in the study.

The possible benefits of my participation in this research project include learning about my body composition, waist and hip circumferences, and physical activity levels.

The results of this research study may be published but my name or identity will not be revealed. Information obtained during the course of the study will remain confidential, to the extent allowed by law. My name will not appear on any of the results. No individual responses will be reported. Only group findings will be reported in publications. Confidentiality will be maintained by assigning each participant a code number and recording all data by code numbers. The only record with the participant’s name and code number will be kept in a locked file in a locked office.

In case of an injury, first aid will be provided to me by the laboratory personnel working on the research project. Any other necessary treatment or care will be provided at my expense.

Any questions I have concerning this research study or any aspect of my participation, before or after my consent, will be answered by the investigators or they will refer me to a knowledgeable source. I understand that I may contact Dr. Lynn Panton at Dr. Michael Ormsbee or Erica Schleicher at [provided information] for answers to questions about this research project or my rights. Group results will be sent to me upon my request.

In case of injury, or if I have questions about my rights as a subject/participant in this research, or if I feel I have been placed at risk, I can contact the chair of the Human Subjects committee, Institutional Review Board, through the Office of the Vice President for Research, at (850) 644-8633. The nature, demands, benefits and risks of the project have been explained to me. I knowingly assume any risks involved.

I have read the above informed consent document. I understand that I may withdraw my consent and discontinue participation at any time without penalty or loss of benefits to which I may otherwise be entitled. In signing this consent form, I am not waiving my legal claims, rights or remedies. A copy of this consent form will be given to me.

_________________________  ___________________________
(Participant)                      (Date)

FSU Human Subjects Committee approved on 1/12/15. Void 12/09/15. HSC # 2014.13504

59
APPENDIX E

DEMOGRAPHIC QUESTIONNAIRE

Florida State University
Dept. of Nutrition, Food & Exercise Sciences
Tallahassee, FL 32306
(850) 644-4685

DEMOGRAPHIC INFORMATION

ID#

Home address

Street

City State ZIP County

Home phone

Cell phone

Do you text message? Yes ____ No ____

Office phone
Email address ________________________

Family Physician ____________________________________________________________

Office phone ______________________________________________________________

Oncologist ________________________________________________________________

Office phone ______________________________________________________________

**Emergency Information**

Name: ________________________________________________

Relationship to you: ____________________________________________

Home phone __________________________ Office phone ______________________

Cell phone ____________________________

**Personal Information**

Age ______ Date of birth _____/_____/______

Month Day Year
Height ______ in. ______ cm

Weight ______ lb. ______ kg

Ethnic Category

____ Hispanic or Latino

____ Not Hispanic or Latino

Racial Categories

____ American Indian/Alaskan Native

____ Asian

____ Native Hawaiian or Other Pacific Islander

____ Black or African American

____ White

____ Other: ______________________
Answer the following questions, indicating the month and year of the event or diagnosis where appropriate.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Month/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Has a doctor ever told you that you have heart disease?</td>
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<tr>
<td>2. Have you ever had a heart attack?</td>
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<tr>
<td>3. Have you ever had chest pain?</td>
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<tr>
<td>4. Have you ever had cardiac catheterization?</td>
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</tr>
</tbody>
</table>
5. Have you ever had balloon angioplasty? __ __ ___/___

6. Have you had coronary artery bypass graft surgery? __ __

If yes, list date and number of grafts:

___/___ # grafts: ___ 1 ___ 2 ___ 3 ___ 4+
    Mo.   Yr.

7. Have you ever had a stroke? __ __ ___/___

8. Do you have hypertension (high blood pressure)? __ __ ___/___

If yes, how long have you had hypertension?

_____ less than 1 year
_____ 1-5 years
_____ 6-10 years
_____ more than 10 years

Yes    No    Month/Year
9. Do you have diabetes mellitus?  

10. Do you take insulin for diabetes?  

If yes, how long have you taken insulin?  

- less than 1 year  
- 1-5 years  
- 6-10 years  
- more than 10 years  

11. Do you take oral hypoglycemics for diabetes?  

12. Do you have a cardiac pacemaker?  

If yes, how long have you had a cardiac pacemaker?  

- less than 1 year  
- 1-5 years  
- 6-10 years  
- more than 10 years  

13. Have you had a carotid endarterectomy?  

65
14. Has your doctor ever told you that you have a heart valve problem? ___ ___ ___/___

15. Have you had heart valve replacement surgery? ___ ___ ___/___
   If yes, what heart valves were replaced? ___ mitral ___ aortic

16. Have you had cardiomyopathy? ___ ___ ___/___

17. Have you had a heart aneurysm? ___ ___ ___/___

18. Have you had heart failure? ___ ___ ___/___

19. Have you ever suffered cardiac arrest? ___ ___ ___/___

20. OTHER MEDICAL PROBLEMS: Indicate if you have had any of the following medical problems:
   Past   Now
   ___   ___   Alcoholism
   ___   ___   Allergies
   ___   ___   Anemia
   ___   ___   Arthritis
   ___   ___   Asthma
   ___   ___   Back injury or problem
Blood clots
Bronchitis
Cirrhosis
Claudication
Elbow or shoulder problems
Emotional disorder
Eye problems
Gall bladder disease
Glaucoma
Gout
Headaches
Hemorrhoids
Hernia
Hip, knee, or ankle problems
Intestinal disorders
Kidney disease
Liver disease
Lung disease
Mental illness
Neck injury or problem
Neuralgic disorder
OB/GYN problems
Obesity/overweight
Osteoporosis
Parkinson's disease
List medications you are taking below:

<table>
<thead>
<tr>
<th>Name of Drug</th>
<th>Dosage</th>
<th>Times/day</th>
<th>Duration of drug use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

Please list all vitamins, minerals and herbs and other nutritional supplements you are currently taking.
How long have you been taking them and how frequently?

Are you allergic, sensitive or intolerant of any foods or medications (e.g. lactose, soy, wheat)?
Yes_____ No____

If yes, please describe:

Food____________________________________________________________

Medication _______________________________________________________

Other ___________________________________________________________

Do you exercise regularly? Yes_____ No_____

What kinds of exercise? How often? How intense?

Do you: Smoke?______ Packs per day_______ # years smoked _____

Drink alcohol? _____ Drinks per day _______

Cancer History
Diagnosis (stage of cancer):

Date of diagnosis:

Types of treatment (surgery, radiation, chemotherapy, hormone therapy):

Beginning and ending dates of each treatment:

Are you currently on hormonal therapy (which type)?

Menopausal age (Natural or Treatment induced):

Additional information:
DIRECTIONS FOR 3-DAY FOOD RECORD

3-Day Food Record

1. Keep your 3-day food record on 2 week days and 1 weekend day. Try to have these be typical eating days.

2. Please record each food you eat immediately after you eat it.

3. Record only one food item per line.

3. Be as specific as possible when describing a food eaten: how it was cooked and the amount you ate. Don’t forget to include all beverages you drink. For example: Coffee with 1 tsp. Cream, 12 oz. Regular Coke, or 8 oz. Sweetened Tea.

4. Include brand names or labels from food items whenever possible.

5. Record amounts eaten in household measures. For example: one cup nonfat milk, 3 ounces grilled chicken, 2 tablespoons ranch dressing, 1 medium fruit, 2 slices cheese.

6. Include the method used to prepare the food item. For example: fresh, frozen, stewed, fried, baked, canned, broiled, raw, braised.

7. For canned foods, include the liquid in which it was canned. For example: Sliced peaches in heavy syrup or Fruit cocktail in light syrup.

8. If you eat at a restaurant, do your best to estimate portion size and list the restaurant you ate at. List any visible fat, oil, or sauces added to your food.
9. List amount and type of oil or butter you use in the preparation of your food.

10. Do not alter your diet while you are keeping a food record.

11. Please indicate what activities you participated in during each of the days that you record your diet.

Name:____________________________   Date:_________

<table>
<thead>
<tr>
<th>Time</th>
<th>Food Items and Method of Preparation</th>
<th>Amount Eaten</th>
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</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
**EXAMPLE OF HOW TO KEEP YOUR FOOD RECORD**

<table>
<thead>
<tr>
<th>Time</th>
<th>Food Items and Method of Preparation</th>
<th>Amount Eaten</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 am</td>
<td>Banana, fresh</td>
<td>1 medium</td>
</tr>
<tr>
<td>8:00 am</td>
<td>Coffee, 8 ounces</td>
<td></td>
</tr>
<tr>
<td></td>
<td>With sugar</td>
<td>1 teaspoon</td>
</tr>
<tr>
<td></td>
<td>With half and half cream</td>
<td>1 teaspoon</td>
</tr>
<tr>
<td>8:30 am</td>
<td>Cornflakes cereal</td>
<td>1 cup</td>
</tr>
<tr>
<td></td>
<td>With 2% milk</td>
<td>½ cup</td>
</tr>
<tr>
<td>12 noon</td>
<td>Bread, whole wheat</td>
<td>2 slices</td>
</tr>
<tr>
<td></td>
<td>With mustard</td>
<td>2 teaspoons</td>
</tr>
<tr>
<td></td>
<td>With mozzarella cheese</td>
<td>1 slice</td>
</tr>
<tr>
<td></td>
<td>With Turkey</td>
<td>6 deli thin slices</td>
</tr>
<tr>
<td></td>
<td>Rold Gold Pretzels</td>
<td>12 pretzels</td>
</tr>
<tr>
<td>3:00 pm</td>
<td>Oreo cookies</td>
<td>3 cookies</td>
</tr>
<tr>
<td></td>
<td>Regular Dr. Pepper</td>
<td>12 ounces</td>
</tr>
<tr>
<td>6:00 pm</td>
<td>Chicken Breast, grilled</td>
<td>6 ounces</td>
</tr>
<tr>
<td></td>
<td>Baked Potato</td>
<td>1 medium</td>
</tr>
<tr>
<td></td>
<td>Broccoli, steamed</td>
<td>½ cup</td>
</tr>
<tr>
<td></td>
<td>Dinner Roll</td>
<td>2 small rolls</td>
</tr>
<tr>
<td></td>
<td>With margarine</td>
<td>1 tablespoon</td>
</tr>
<tr>
<td>Time</td>
<td>Item</td>
<td>Quantity</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>9:00pm</td>
<td>Milk, 2%</td>
<td>8 ounces</td>
</tr>
<tr>
<td></td>
<td>Vanilla Ice Cream</td>
<td>1 cup</td>
</tr>
<tr>
<td></td>
<td>With strawberries, fresh</td>
<td>½ cup</td>
</tr>
</tbody>
</table>
APPENDIX I

PEDOMETER LOG

Week ____  Subject ID  __________
Day One Date:_____
Time pedometer was put on: __________  Time pedometer was taken off:_________
Was the pedometer worn today if yes how many steps?______________
Was pedometer removed during the day (e.g. while swimming, showering)?How long___
What general activities did you do today?_______________________________

Day Two Date_____
Time pedometer was put on: __________  Time pedometer was taken off:_________
Was the pedometer worn today if yes how many steps?______________
Was pedometer removed during the day (e.g. while swimming, showering)?How long___
What general activities did you do today?_______________________________

Day Three Date__________
Time pedometer was put on: __________  Time pedometer was taken off:_________
Was the pedometer worn today if yes how many steps?______________
Was pedometer removed during the day (e.g. while swimming, showering)?How long___
What general activities did you do today?_______________________________

Day Four Date_____
Time pedometer was put on: __________  Time pedometer was taken off:_________
Was the pedometer worn today if yes how many steps?______________
Was pedometer removed during the day (e.g. while swimming, showering)?How long___
What general activities did you do today?

Day Five Date ______
Time pedometer was put on: ___________ Time pedometer was taken off: ___________
Was the pedometer worn today if yes how many steps? ___________
Was pedometer removed during the day (e.g. while swimming, showering)? How long ___________
What general activities did you do today? ________________________________

Day Six Date ____________
Time pedometer was put on: ___________ Time pedometer was taken off: ___________
Was the pedometer worn today if yes how many steps? ___________
Was pedometer removed during the day (e.g. while swimming, showering)? How long ___________
What general activities did you do today? ________________________________

Day Seven Date ____________
Time pedometer was put on: ___________ Time pedometer was taken off: ___________
Was the pedometer worn today if yes how many steps? ___________
Was pedometer removed during the day (e.g. while swimming, showering)? How long ___________
What general activities did you do today? ________________________________
REFERENCES


BIOGRAPHICAL SKETCH

Erica Schleicher obtained her Bachelors of Science degree in exercise and sports science at The University of Alabama in 2013. She is working on her Masters of Science in exercise physiology at Florida State University with an expected graduation date of May 2015. She has presented her research at the Southeast American College of Sports Medicine conference where she won third place for Masters research.