A Comparison between a Combined Exercise and Recreation Therapy Intervention and an Exercise Only Intervention in Post-Treated Breast Cancer Patients

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ABSTRACT

JAMIE IVES: A Comparison between a Combined Exercise and Recreation Therapy Intervention and an Exercise Only Intervention in Post-Treated Breast Cancer Patients (Under the direction of Dr. Claudio Battaglini)

This study investigated the effects of combining exercise and recreation therapy as a comprehensive intervention to mitigate breast cancer treatment side effects. Fourteen post treated breast cancer patients were randomly assigned to either an exercise only (EX only) or exercise + recreation therapy (EX + RT) group. The EX only group participated in an individualized exercise prescription 3 days/week for eight weeks. The EX + RT group received the same exercise prescription plus an additional 30 minutes of recreation therapy (Biofeedback) 3 days/week for eight weeks. The results revealed no significant differences in the changes in VO₂max or fatigue between the EX + RT and EX only groups. There was, however, a significant difference in the changes in quality of life (QOL) between groups (p=.009). This finding supports the benefits of combining exercise and recreation therapy as a well rounded intervention in the management of breast cancer patient QOL.
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CHAPTER I

Introduction

One form of cancer that is of current interest to many researchers is breast cancer. Breast cancer is the 2nd most common form of cancer in American women and the 2nd most deadly (American Cancer Society, 2008). In fact, the odds of a woman having breast cancer in her lifetime are 1 in 8, and approximately 182,460 new cases of breast cancer will be diagnosed in American women in 2008 (American Cancer Society, 2008). Due to improvements in breast cancer diagnosis and treatment, the death rates from this cancer have been decreased but are still 1 in 35. Even with the improvements in treatment protocol, about 40,480 American women are expected to die from breast cancer in 2008 (American Cancer Society, 2008).

One of the primary concerns with breast cancer is the prevalence of negative, debilitating side effects that result from cancer and cancer treatment. Breast cancer treatment is associated with a plethora of side effects that lead to physical de-conditioning, psychological deficits, and the loss of functionality (Battaglini, Dennehy, Groff, Kirk, & Anton, 2006). Some of the most common side effects that affect those undergoing breast cancer treatment include depression, anxiety, pain, fatigue, dyspnea, nausea, cachexia, increased body fat, reduced flexibility and decreased quality of life (Battaglini et al., 2006). Chemotherapy in particular has been associated with myocyte injury and death (Billingham, Bristow, & Glatstein, 1977), as well as skeletal muscle edema (Kuno, Richardson, & Zink-Brody, 1996), while radiation is associated with muscle fiber/mitochondrial degeneration...
(Hsu, Chai, & Lee, 1998) and decreased neuromuscular efficiency (Monga, Jaweed, & Kerriga, 1997). In addition, both radiation and chemotherapy can create cardiovascular defects such as myocardial fibrosis (Renzi, Straus, & Glatstein, 1992), coronary and carotid artery arteriosclerosis (Stewart & Fajardo, 1992), and left ventricle impairments (D’Avella, Cicciarello, & Angileri, 1998). In a recent study by Jones et al. (2007), chemotherapy treated breast cancer patients had a significantly lower stroke volume, cardiac output, cardiac power output, and VO$_2$peak than aged matched healthy controls on a graded cardiopulmonary exercise test (Jones et al., 2007). Cancer treatment is also associated with impaired functioning of many physiological systems, including the urinary, gastrointestinal, and immune systems (Brooks, Fahey, & White, 2004). Clearly the combination of physiological and psychological detriments resulting from cancer treatment is a potent force in affecting well being and overall quality of life of the cancer patient.

Although the side effects of individuals undergoing cancer treatment are numerous, the most common cancer treatment side effect reported in the literature is fatigue (Battaglini et al., 2006; Dimeo, 2001; Adamsen et al., 2004; Ream & Richardson, 1999; Piper, Lindsey, & Dodd, 1987; Minton & Stone, 2008). According to the American Cancer Society, cancer related fatigue impacts 72 – 95% of all cancer patients receiving or recovering from treatment (Jemal, Murray, & Ward, 2005). Ream and Richardson define cancer related fatigue as an unpleasant symptom of tiredness and exhaustion that affects the entire body (Ream & Richardson, 1999). Often, cancer patients describe fatigue as not being able to have enough energy to accomplish everyday routines and activities, while becoming exhausted after performing minimal activity (Battaglini et al., 2006; Winningham, 1991). Furthermore, while fatigue to many people may be nothing more but a temporary symptom
of exhaustion, fatigue to the cancer patient is persistent, and is unrelieved by rest or sleep (Piper et al., 1987). Fatigue can affect a cancer patient at any point along the cancer continuum, from diagnosis to years into recovery, and the effects of cancer related fatigue seem to be worse in individuals undergoing multimodal treatment (Winningham, 1991; Galvao & Newton, 2005). Cancer related fatigue is unique in that it is a multi-dimensional side effect, affecting the patient physiologically, psychologically and socially (Battaglini et al., 2006). For example, cancer and cancer treatment compromises the patient’s ability to perform as well on physical tasks, induces stress, anxiety, and depression and limits social interactions (Battaglini et al., 2006; Dimeo, 2001). The culmination of such side effects makes cancer related fatigue a central player in the decreased quality of life found in cancer patients (Adamsen et al., 2004). Therefore, is not difficult to see why this form of fatigue is such a prevalent and debilitating side effect.

In spite of many types of therapies used to combat cancer treatment side effects (including such medications as Erythropoietin Alfa for anemia, Neulasta for myelosupression, selective serotonin re-uptake inhibitors for nausea, and Methylphenidate for depression), over 50% of cancer survivors still have difficulty conducting normal everyday activities (Battaglini et al., 2006). Furthermore, many of the medications taken to mitigate cancer treatment side effects provide only temporary relief (Battaglini et al., 2006). As a result, the concerns with treatment side effects have become more prevalent, and the risks for long term physiological and psychological impairments develop. The medical community continues to search for alternative therapies to reduce such negative side effects and to improve the lives of cancer patients.
Exercise therapy (either aerobic, strength training, or combined forms) has been demonstrated as an acceptable and beneficial alternative therapy to mitigate some of the side effects of cancer treatment (Battaglini et al., 2006; Winningham, 1991; Galvao & Newton, 2005). In the past, most cancer patients had been advised to rest and avoid any physical activity that could further increase fatigue and compromise immune function, yet many scientists are now advising the opposite (Winningham, 1991; Galvao & Newton, 2005; Dimeo, Stieglitz, & Novelli-Fischer, 1999; Courneya & Friedenreich, 2000; Kerry et al., 2007; Courneya, Friedenreich, & Sela, 2003). Exercise, when completed at low to moderate levels, and under supervision of well trained staff, may combat symptoms such as nausea, pain, depression, and decreased functionality (Winningham, 1991; Galvao & Newton, 2005; Dimeo et al., 1999; Courneya and Friedenreich, 2000; Kerry et al., 2007; Courneya et al., 2003; Dimeo, Fetscher, & Lange, 1997; Singh, Cheema, & Gaul, 2006). In addition, exercise, when completed during cancer treatment or post treatment, decreases levels of cancer related fatigue (Adamsen et al., 2004; Dimeo et al., 1999; Kerry et al., 2007; Dimeo, Schwartz, Wesel, Voight, & Thiel, 2008; Alfano et al., 2007). Studies of exercise therapy during and/or post cancer treatment also suggest that exercise may enhance energy production, improve appetite, facilitate the removal of cellular metabolites and toxins, stimulate red and white blood cell production, improve immunity, increase protein synthesis and muscle formation, and increase quality of life (Segal, Evans, & Johnson, 2001). Although specific norms for the proper intensity, frequency, and duration have yet to be standardized, the literature shows that exercise therapy is a promising alternative.

Even though exercise may be a powerful intervention in assisting cancer patients to cope with physiological and psychological side-effects of treatment, it is possible that not all
psychological needs of women treated for breast cancer are being met by the use of exercise interventions (Battaglini et al., 2006). For example, the fear of cancer reoccurrence, lack of concentration, cluttering of the mind, stress resulting from various work, family, or financial circumstances, loss of hopefulness, and even the difficulty adjusting to physical self perception are all impairments that may not be completely addressed by exercise alone. Therefore, the use of other interventions that focus on alleviating these psychological needs may complement exercise, promoting a more comprehensive approach in the mitigation of disease and treatment related side-effects. One therapy that is receiving attention as a possible alternative therapy is recreation therapy.

Recreation therapy is a systematic process utilizing various forms of recreation and leisure activities to help improve physical, psychological, social, and emotional functioning (National Council for Therapeutic Recreation Certification, 2004). Common forms of recreation therapy include adventure therapy (Walsh-Burke, 1992), biofeedback (McKinney, Antoni, & Kumar, 1997), music therapy (McKinney, 2005), creative writing, drama, group events, humor therapy, leisure education, social skills training, pain management, and therapeutic games among others (National Council for Therapeutic Recreation Certification, 2004). Recreation and leisure are particularly vital for individuals with cancer, because of the negative impacts that the cancer and treatment have on the physiological and psychological state (Battaglini et al., 2006). Shannon (2005) found that oftentimes, women with breast cancer are advised by medical teams to avoid leisure activities due to associated risks of injury, but that these women would have liked to engage in recreation and leisure as a coping strategy if possible. Avoiding recreation, leisure, and exercise should be viewed as the wrong course of action because it tends to augment the negative side effects of cancer
treatment (Shannon, 2005). To many individuals, recreation and leisure provides an outlet to enjoy life and is an effective medium to treat psychosocial issues.

The research on the impact of recreation therapy on cancer treatment side effects is limited, but studies that have utilized some forms of this treatment shown promising results (McGhee & Skalko, 2001). Such research suggests the possibility that a combination of recreation therapy with exercise therapy may be more effective than exercise therapy alone at improving the physiological and psychological deficits associated with cancer treatment. To date, no programs or research studies have attempted to combine exercise with recreation therapy in the attempt to improve physiological and psychological parameters in post-treated breast cancer patients. Knowing the complexity of the cancer process, as well as the debilitating state that patients usually encounter after diagnosis, during and post-treatment, interventions designed to mitigate both physical and psychological decline are vital.

**Statement of the Purpose**

The purpose of the study is to compare the effects of a combined exercise and recreation therapy intervention on selected physiological and psychological parameters to an exercise only intervention in post treatment breast cancer patients.

**Hypotheses**

H1: There will be a significant difference in changes in VO$_{2\text{Max}}$ between the combined exercise and recreation therapy group and the exercise only group during the 8 week study protocol.

H2: There will be a significant difference in changes in fatigue between the combined exercise and recreation therapy group and the exercise only group during the 8 week study protocol.
**H3:** There will be a significant difference in changes in Quality of Life between the combined exercise and recreation therapy group and the exercise only group during the 8 week study protocol.

**Definition of Terms**

**Recreation therapy (RT):** a systematic process utilizing various forms of recreation and leisure activities to help improve physical, psychological, social, and emotional functioning (National Council for Therapeutic Recreation Certification, 2004).

**Exercise therapy (EX only):** physical training consisting of a combination of aerobic training, strength training, and flexibility training (Battaglini et al., 2006; Galvao & Newton, 2005).

**Combined exercise and recreation therapy (EX + RT):** a comprehensive intervention consisting of a balance of exercise therapy and recreation therapy.

**Cancer related fatigue:** an unpleasant symptom of tiredness and exhaustion that affects the entire body, often described as not being able to have enough energy to accomplish everyday routines and activities (Adamsen et al., 2004; Jemal et al., 2005).

**VO_{2\text{Max}}:** the maximal rate at which an individual can consume oxygen for exercise, often measured in L/min or ml/kg/min (Brooks et al., 2004).

**Quality of life:** overall satisfaction and enjoyment of life due to the combined effect of physical and psychological factors like stress, mood, and fatigue and sociodemographic factors like education, income, job and stage of disease (Yo, 2007).

**Assumptions**

1. All patients enrolled in the study strictly followed the pre-testing guidelines prior to reporting for testing.
2. The impact of the different cancer treatments and drugs resulted in similar treatment related side effects experienced by the patients enrolled in the study.

3. Subjects honestly and accurately answered the questionnaires used to assess fatigue and QOL.

4. No subjects presented any co-morbidities that could compromise performance in any of the fitness parameters assessed during the study.

5. Any changes in physiological and/or psychological parameters were a direct result of the intervention, and not any extraneous variables.

**Delimitations**

1. All subjects willingly volunteered to participate in the Get REAL & HEEL Breast Cancer Program and are residents in one of the 13 counties of the NC Triangle Affiliate of the Susan G. Komen for the Cure.

2. All subjects have been diagnosed with Stage I, II, or III invasive breast cancer and had completed all planned cancer treatment and surgery within six months of the beginning of the study.

3. The age range for participation in the study was 25 – 75 years.

4. All subjects were cleared by their oncologists prior to participating in the study.

5. All exercise and recreation therapy sessions were held at the Get REAL & HEEL facility at the University of North Carolina at Chapel Hill.

**Limitations**

1. The sub-maximal test used for the assessment of VO$_{2\text{Max}}$ may present some measurement error since some subjects may have never used a treadmill before and may feel uncomfortable performing the test.
2. The study consists of a relatively small sample size.

3. The wide age range of the subject pool will affect measured variables as well as the exercise prescription.

4. The fact that all subjects came from the same region of North Carolina will make it more difficult to apply the findings to other locations.

**Significance of the Study**

Cancer and cancer treatment are associated with the development of a number of debilitating side effects that impact the cancer patient physiologically, psychologically, and socially. Exercise therapy has been successfully utilized as an intervention to mitigate many of the side effects of cancer treatment, and can provide benefits to the breast cancer patient at any point along the cancer continuum. However, even though exercise does aid in the mitigation of treatment side effects, it may not address all specific aspects of psychological decline that lead to decreased quality of life, decreased physical fitness and increased fatigue. Therefore, it is postulated that a combination of exercise with recreation therapy may provide cancer patients with the opportunity to more specifically address some of the psychological and physiological decline that exercise alone may not be able to provide. Given the nature of cancer treatment side effects, examining the combination of exercise and recreation therapy activities as a well rounded approach in addressing the physiological and psychological needs of women with breast cancer is paramount. Such an examination will provide the medical community with valuable information as to the most efficacious intervention strategy in the mitigation of these debilitating side effects.
CHAPTER II
Review of Literature

For the purpose of organization, this review of literature was organized into four primary sections: What is breast cancer?, breast cancer treatments and treatment side effects, the impact of exercise in mitigating side effects of breast cancer treatment, and the use of recreation therapy in mitigating side effects of breast cancer treatment. Summaries of research findings were included within each section.

What is breast cancer?

Breast cancer is defined as the uncontrolled and malignant growth of cells in the breast tissue (American Cancer Society, 2008). Most often breast cancer originates in the ducts of the breast, which are the minute tubes that transfer milk to the nipple; however, it may also originate in lobules of the breast or in other breast tissue (National Cancer Institute, 2007). While it is possible for breast cancer to spread to other areas of the body, if the cancer originated from the breast then it is termed breast cancer (American Cancer Society, 2008). In addition, although men can get breast cancer, the diagnostic rate is much more common in women (American Cancer Society, 2008) and it is breast cancer within women that is the focus of this research study.

Breast cancer is classified by the stages 0 to IV, depending on how large the tumor is and whether or not it has spread. Stage 0 cancer is the earliest stage of breast cancer and is termed in situ, meaning that it is non invasive. At this stage, the cancer consists of abnormal cells within the lining of the ducts or lobules of the breast. Stage I cancer is the early form of
invasive breast cancer, where the tumor is no more than 2 centimeters (cm) across and the cancer cells haven’t spread beyond the breast tissue. To be termed stage II cancer, one of the following requirements must be met: the tumor is no more than 2cm across and the cancer has spread to the underarm lymph nodes, the tumor is 2-5 cm across and may have spread to the underarm lymph nodes, or the tumor is greater than 5 cm across but has not spread to the underarm lymph nodes. Stage III breast cancer is divided into three different sub-stages with different qualifications. In stage IIIA cancer, the tumor is less than 5 cm across and has spread to underarm lymph nodes that are attached to each other or to other structures, or the tumor is greater than 5 cm across and has spread to the underarm lymph nodes. Stage IIIB cancer consists of a tumor of any size that has grown into the chest wall or the skin of the breast, and may have spread to the underarm lymph nodes or underarm lymph nodes that are attached to each other and other structures, or to lymph nodes behind the breast bone. Stage IIIC cancer consists of a tumor of any size that spreads to the underarm lymph nodes and the lymph nodes behind the breast bone or to the lymph nodes above or below the collar bone. The final stage, Stage IV breast cancer, is termed distant metastatic cancer, meaning the cancer has spread to other areas of the body (National Cancer Institute, 2007).

Breast cancer is the third most common cancer in the world (Galvao & Newton, 2005) and is the 2nd most common and 2nd most deadly form of cancer in American women (American Cancer Society, 2008). According to the American Cancer Society, approximately 182,460 new cases of breast cancer will be diagnosed in American women in 2008, and over 40 thousand American women are expected to die from breast cancer in the same year (American Cancer Society, 2008). Due to early detection, and improvements in diagnosis and treatment, death rates from breast cancer have decreased, but at 1in 35, are still
concerning. In addition, it is proposed that women have a 1 out of 8 chance of developing breast cancer at some point in their lifetime (National Cancer Institute, 2007).

**Breast cancer treatments and treatment side effects**

Breast Cancer treatments include chemotherapy, radiation therapy, hormonal therapy, and surgery. Such therapies may be utilized individually to treat breast cancer or may be paired together as a form of multimodal treatment. Although these treatments can be successful in eliminating cancer from the body, each one is characterized by a wide array of debilitating side effects. Some forms of chemotherapies been associated with myocyte injury and death (Billingham et al., 1977), myocardial fibrosis (Renzi et al., 1992), nausea, vomiting, hair loss, mouth sores, loss of appetite, low white blood cell counts, and low platelet counts (American Cancer Society, 2008, Zacharia et al., 2007). In a recent study, Jones and colleagues discovered that chemotherapy treated breast cancer patients had a significantly lower stroke volume, cardiac output, cardiac power output, and VO$_2$peak than aged matched healthy controls on a graded cardiopulmonary exercise test (Jones et al., 2007).

Radiation therapy is often accompanied by muscle fiber/mitochondrial degeneration (Hsu, et al., 1998), decreased neuromuscular efficiency (Monga et al., 1997), swelling of the breast, changes in skin color, and in some cases, lymphedema (American Cancer Society, 2008). Side effects of surgery include changes in breast shape, possible wound infection, fluid buildup in the wound (American Cancer Society, 2008), and compromised range of motion at the shoulder (Lauridsen, Overgaard, Overgaard, Hessov, & Cristiansen, 2008; Gosselink et al., 2003). Hormonal therapy is often associated with nausea, blood clots, joint stiffness, hot flashes, and vaginal discharge (Mom, Buijs, Willemse, Mourits, & De Vries, 2006; National Cancer Institute, 2007). The hormonal therapy tamoxifen is associated with endometrial
cancer and thromboembolic disease, while aromatase inhibitors are associated with musculoskeletal side effects, such as myalgia and bone loss (Perez, 2007).

Additional side effects of breast cancer treatment include depression, anxiety, pain, fatigue, loss of appetite, and decreased quality of life (Dimeo et al., 1999; 2008; Korstjens, Mesters, Van der Peet, Gijsen, & Van den Borne, 2006; Longman, Braden, & Mishel, 1999; Courneya & Friedenreich, 1999; Battaglini et al., 2008; Montazeri, 2007). However, of those mentioned, the most common cancer treatment side effect reported in the literature is fatigue (Battaglini et al., 2006; Dimeo, 2001; Adamsen et al., 2004; Ream & Richardson, 1999; Piper et al., 1987; Minton & Stone, 2008; Mock et al., 2005). Cancer-related fatigue, which affects 72-95% of breast cancer patients, is a persistent physical and psychological symptom that can affect the cancer patient at any point along the cancer continuum and it is usually unrelieved by rest or sleep (Ream & Richardson, 1999; Jemal et al., 2005; Piper et al., 1987). Often the combination of cancer-related fatigue with other related side effects results in a greater decline of the patient’s quality of life and well-being (Schwartz, 1999).

Pharmaceutical drugs are usually employed in the mitigation of cancer treatment side effects; however, the relief from this form of treatment is often temporary and the price of the medications can be expensive (Battaglini et al., 2006). As a result, many in the medical community are turning their attention to alternative forms of therapy being utilized in the mitigation of cancer treatment side effects. Some of the recent alternative therapies that have been explored include exercise therapy, and more recently recreation therapy (Winningham, 1991; Dimeo et al., 1999; Galvao & Newton, 2005; National Council for Therapeutic Recreation Certification, 2004; McGhee & Skalko, 2001). These therapies may be able to
provide more cost effective, long term relief in attenuating the debilitating physiological and psychological side effects associated with breast cancer treatment.

**The impact of exercise in mitigating side effects of breast cancer treatment**

At this point, it should be noted that although exercise therapy has been utilized during the administration of cancer treatments (such as chemotherapy) as well as after all cancer treatments, the focus of this literature review as well as this study, is on the benefits of exercise therapy in post treated cancer patients.

Exercise has been shown to be a very successful alternative therapy in the mitigation of the physiological side effects of cancer treatment (Winningham, 1991; Dimeo et al., 1997; Galvao & Newton, 2005; Kerry et al., 2007; Courneya et al., 2003). Cancer patient exercise training studies (including cardiovascular, strength, and flexibility training) suggest that exercise may enhance energy production, improve appetite, facilitate the removal of cellular metabolites and toxins, stimulate red and white blood cell production, improve immunity, and increase protein synthesis and muscle formation (Segal et al., 2001). Exercise may also increase total caloric intake and improve body composition in breast cancer patients (Battaglini et al., 2008). Additional potential benefits of cardiovascular exercise include improved physical performance and VO$_{2\text{max}}$, increased hemoglobin levels, increased blood volume, and reduced physical fatigue (Dimeo et al., 1997). Such improvements result in enhanced functionality, and improved overall health and wellness prospects in these patients. Resistance training in cancer patients is associated with improvements in muscular strength, increased lean muscle mass, decreased body fat, and is not associated with increased lymphedema (DeBacker et al., 2007; Cheema & Gaul, 2006). These improvements are vital because cancer treatments are often associated with muscle fiber and mitochondrial
degeneration and decreased neuromuscular efficiency (Monga et al., 1997; Hsu, et al., 1998; Billingham et al., 1977). In addition, flexibility and stretching exercises have proved instrumental in attenuating some of the decreased range of motion that can occur at the shoulder joint as a result of surgery or inactivity (Cheema & Gaul, 2006; Schneider, Hsieh, Sprod, Carter, & Hayward, 2007).

In a recent meta analysis conducted by McNeely and colleagues, researchers analyzed 14 different studies to determine the effects of exercise on breast cancer survivors. The sample sizes of most of the studies were small, and there was some heterogeneity of exercise treatment in the studies; however, the results of most of the studies suggested that exercise was beneficial in mitigating some of the side effects of cancer treatment. Three areas where exercise had the most statistically significant effects were in improving maximal oxygen uptake (VO$_{2\text{max}}$), improving overall quality of life, and decreasing fatigue (McNeely et al., 2006). Research on the impact of exercise on these three variables will now be described in more depth.

**The impact of exercise on VO$_{2\text{max}}$ in Cancer Patients**

Many studies have highlighted the impact of exercise on increasing maximal oxygen uptake (VO$_{2\text{max}}$), in post treated cancer patients. Herrero and colleagues developed a pilot study to determine the effect of a combined cardiovascular and resistance training program on various physiological parameters, including VO$_{2\text{max}}$. Sixteen breast cancer survivors were randomly assigned to either a control group (n=8), or a treatment group (n=8), for the study duration of 8 weeks. The treatment group completed combined cardiovascular and resistance training exercise 3 times per week at 90 minutes duration, while the control group received usual care. The results of the study were, among other things, that after 8 weeks of exercise,
VO2max in the exercise group increased an average of 3.9 ml/kg/min, which was significantly different from baseline measures (p<.05). In addition, there were no differences in pre to post VO2max measurements in the control group (Herrero et al., 2006).

Courneya and colleagues analyzed the impact of a 15 week aerobic training program on VO2max in post treated breast cancer patients. A total of 53 patients (mean age of 59), were randomly assigned to either an exercise group (n=25) or a control group (n=28) and participated various tests including a baseline VO2max test. For 15 weeks, the control group received no exercise treatment while the exercise group performed supervised cycle ergometry 3 times per week for 15-35 minutes per session at an intensity equal to 70-75% of VO2max. At the end of 15 weeks, final assessments were taken. The results of the study were that VO2max increased by .24 L/min in the exercise group whereas it decreased by .05 L/min in the control group. The mean difference between the groups was .29 L/min, and the difference of the change scores between groups was significant (p<.001). As an additional point, the researchers found that improved oxygen consumption was correlated with increased quality of life ((r = 0.45; P <.01) in these patients (Courneya et al., 2003).

Schneider and colleagues presented the effects of exercise training on the cardiopulmonary function of breast cancer survivors who were either post treatment or undergoing treatment. In this study, 113 women diagnosed with breast cancer were randomly assigned to a during exercise group (n=17) or a post treatment exercise group (n= 96). Baseline cardiopulmonary measures (heart rate, blood pressure, predicted VO2max, time on treadmill, and oxygen saturation) were assessed via a 3-minute stage Bruce Exercise Test. The exercise intervention was monitored, individually prescribed based on each patient needs, and administered 2 to 3 times per week for 6 months. Each exercise session lasted
approximately 60 minutes, and included 10 minutes of warm-up activity, 40 minutes of cardiovascular training and resistance training, and 10 minutes of cool-down and stretching. Exercise intensity for the cardiovascular work was approximated at 40 – 75 % of maximum heart rate calculated by the Heart Rate Reserve (HRR) method. Strength training focused on total body exercise and was completed at a moderate intensity. Post intervention measurements were taken at the end of the 6 months treatment. The results indicated that in the during treatment exercise group, the only variables showing significant differences from baseline to final measurements were systolic blood pressure and time on the treadmill. However, breast cancer patients in the post treatment exercise group showed significant reductions in systolic blood pressure, diastolic blood pressure, and resting heart rate (p<.05) with improvements in time on the treadmill and predicted VO$_{2max}$ (p<.05). These results suggest not only that exercise improves cardiopulmonary function, but that post treatment exercise may be more efficient than during treatment exercise in this matter (Schneider, Hsieh, Sprod, Carter, & Hayward, 2007).

**The impact of Exercise on Quality of Life in Cancer Patients**

There is an assortment of research detailing the impact of exercise on cancer patient quality of life. Milne and colleagues reported on the association between quality of life and exercise activity in West Australia breast cancer survivors. In this study, breast cancer survivors, (n=558) who had recently completed adjuvant therapy, completed a survey that included the Functional Assessment of Cancer Therapy-Breast (FACT-B) quality of life scale and the Godin Leisure Time Exercise Questionnaire (GLTEQ). The results showed that only 31% of breast cancer survivors were meeting the recommended physical activity requirements after treatment. In addition, breast cancer survivors who met physical activity...
requirements scored significantly higher (p<.001) on the FACT-B quality of life scale than inactive breast cancer survivors. The researchers concluded that although the research involved questionnaires and not treatment groups, it appeared that greater physical activity post cancer treatment was associated with increased quality of life in post treated breast cancer patients (Milne, Gordon, Guilfoyle, Wallman, & Courneya, 2007).

In 2008, Milne and colleagues designed a treatment based study to gain further insight on the relationship between exercise and quality of life. A total of 58 breast cancer survivors who were within 2 years of completing adjuvant therapy were randomly assigned to an immediate exercise group (IEG; n=29) or a delayed exercise group (DEG; n=29). The IEG completed 12 weeks of supervised aerobic and resistance training 3 days per week while the DEG completed the exercise program during the next 12 weeks. Quality of life, measured via the FACT-B questionnaire, was assessed at baseline and at weeks 6, 12, 18, and 24 in both groups. Concerning the results of the study, an omnibus analysis of variance revealed a significant group by time interaction effect for Quality of Life (p<.001). Specifically, quality of life in the IEG group was significantly higher (p<.001) than quality of life in the DEG group from baseline to 12 weeks (mean group difference 26.1 points). In addition, the increase in quality of life in the DEG group from weeks 12-24 (29.5 points) was significantly greater than the week 12-24 increase in quality of life in the IEG (6.5 points; p<.001). The rapid improvements in the DEG quality of life once they began exercise training, coupled with the leveling off of the IEG quality of life upon completion of exercise treatment led the researchers to conclude that exercise treatment is vital to increasing overall quality of life in breast cancer patients (Milne, Wallman, Gordon, & Courneya, 2008).
Courneya addressed the relationship between exercise and quality of life in a group of 52 post cancer treatment and post menopausal women. Patients were allocated into either an exercise group (n=25) or a usual care control group (n=25) for a 15 week study design. The exercise group received supervised cycle ergometry exercise training 3 days per week at a duration of 15-35 minutes per session. The intensity of each session was approximately 70-75% of VO$_{2\text{max}}$, which was assessed prior to the intervention. The usual care group did not receive any exercise therapy. Included in the pretest and posttest measures was a FACT-B quality of life assessment. The results of the study indicated that the exercise group achieved significantly greater improvements in quality of life (p<.001) from pre to post intervention than did the usual care group (Courneya et al., 2003).

Taking a slightly different approach, Daley and colleagues analyzed a randomized trial of the effects of aerobic exercise therapy on Quality of Life in post treated breast cancer patients. The aim of this study was to discover if changes in quality of life during interventions were due to the exercise or simply due to the increased attention that patients received. A total of 108 women who had been treated for breast cancer 12 to 24 months previously were randomly assigned to three groups; aerobic exercise therapy (n=34), exercise-placebo (n=36), or usual care (n=38). Before the intervention, baseline quality of life measures (including FACT-B) were assessed. The aerobic exercise group participated in 8 weeks of cardiovascular exercise, 3 days per week, and 50 minutes per session. Exercise was of moderate intensity, ranging between 65%-85% of age adjusted HR maximum and a RPE of 12 to 13. The exercise-placebo group participated in 8 weeks of supervised passive stretching sessions. The sessions were also 50 minutes in duration and occurred 3 days per week. During these sessions, HR was maintained below 40% of Heart Rate Reserve, and no
additional counseling was given. The usual care group received no specific treatment. At the end of the 8 week intervention, quality of life was measured again. The study results showed that there was a significant difference (p= .002) between baseline and endpoint quality of life scores in the aerobic exercise group, but not in the exercise-placebo, or usual care group. Researchers concluded that the quality of life differences were related to the exercise effect, and were not a result of increased patient attention (Daley et al., 2007).

The Impact of Exercise on Fatigue in Cancer Patients

Research has also indicated that exercise is effective in mitigating treatment related fatigue in post treated breast cancer patients. In one study, Alfano and colleagues conducted a prospective analysis of the relationship between exercise and a number of variables (including cancer related fatigue), in breast cancer survivors. A total of 545 post treatment breast cancer patients who were on average 6 months post-diagnosis, were assessed in person or via telephone at the outset of the study (retrospective report of pre –cancer physical activity), at 29 months post-diagnosis (post-diagnosis physical activity questionnaire), and at 39 months post diagnosis (fatigue, pain, hormone symptoms, and quality of life questionnaires). One of the major results of this study was that patients reporting greater post-diagnosis physical activity also reported less cancer related fatigue (p<.01). In addition, greater pre diagnosis physical activity was also associated with decreased cancer related fatigue (p<.01). The researchers stated that moderate to vigorous physical activity rather than light activity or household activity was more effective in reducing fatigue. The overall results of the prospective analysis suggest that breast cancer survivors can reduce fatigue and be more efficient at completing everyday activities through the inclusion of regular physical and recreational activity (Alfano, et al., 2007).
Dimeo and coworkers analyzed the effects of a combined aerobic and resistance training exercise program on persistent cancer related fatigue in post treated cancer patients. In this study a total of 32 cancer patients who had mild to severe persistent fatigue (scores >25 on the Brief Fatigue Inventory), participated in a 3 week long exercise program. The exercise program included 3 days per week of activity and consisted of 30 minutes walking on a treadmill, followed by full body resistance and coordination exercises. Prior to participation in the program as well as immediately after the program, a number of variables, including fatigue, were assessed. At the completion of the study, the researchers observed a significant reduction in global fatigue (p<.0001; measured by the Functional Assessment of Cancer Therapy scale) in the treatment group. However, no reduction in cognitive fatigue was evident. Therefore, the conclusion was that a 3 week exercise program is effective in reducing mental and physical aspects of cancer treatment related fatigue, but not cognitive fatigue. The researchers marveled that only 3 weeks of physical activity were associated with positive changes in fatigue, and questioned whether increasing the duration of the study would have led to eventual improvements in cognitive fatigue. (Dimeo, Schwartz, Wesel, Voigt, & Thiel, 2008). This could be addressed in future research.

Taking a different approach, Pinto and others investigated the impact of a home based physical activity program on factors such as overall physical activity and fatigue. Eighty six women (mean age of 53 years) who had completed all treatment for stage 0 to II breast cancer were randomly assigned to either a physical activity group or a usual care control group. The participants in the physical activity group received 12 weeks of exercise counseling via telephone, as well as weekly exercise tip and instruction handouts. A battery of assessments (including the FACT-B fatigue scale) was administered at baseline, at the end
of week 12, and at 6 and 9 month post baseline follow-ups. Among the results of the study were that the physical activity group reported less fatigue than the control group at week 12 and during both follow up assessments (p=.001). The researchers concluded that a home based exercise program can be effective in helping breast cancer patients recover from cancer treatment, and can mitigate negative side effects such as cancer treatment related fatigue (Pinto, Frierson, Rabin, Trunzo, & Marcus, 2005).

**The impact of recreation therapy in mitigating the side effects of breast cancer treatment**

While the majority of the research suggests that exercise therapy is effective in mitigating side effects of breast cancer treatment, the results of some studies (Pinto, 2005; McNelley et al., 2006) as well as concerns from experts in the field (Battaglini et al., 2006) imply that exercise therapy isn’t necessarily the complete panacea of treatment side effects. For example, fear of cancer reoccurrence, lack of concentration, cluttering of the mind, and other psychological impairments caused by the diagnosis and treatment of the disease may not be completely addressed by exercise alone (Battaglini et al., 2006). Therefore, some researchers are now advocating the use of other interventions that focus on alleviating these psychological needs as a complement to exercise in the mitigation of cancer treatment side-effects. There is interest that a combination of such therapies may be more efficient than exercise alone in improving quality of life, possibly improving VO$_{2\text{max}}$, and decreasing fatigue. As the title of this section indicates, one alternative therapy that is receiving more attention in this matter is recreation therapy.

Recreation therapy, the restorative combination of various forms of recreation and leisure activities, often includes components such as adventure therapy (Walsh-Burke,
1992), biofeedback (McKinney et al., 1997), music therapy (McKinney, 2005), creative writing, humor therapy and leisure education among other activities (National Council for Therapeutic Recreation Certification, 2004). The purpose of recreation therapy is to increase the individual’s recreation and leisure experiences, thereby improving psychological, physiological, social, and emotional functioning. This is especially important to the breast cancer patient, since the side-effects of cancer treatment negatively affect many of these parameters (i.e. VO$_{2\text{max}}$, quality of life, and fatigue) (Battaglini et al., 2006). Along these lines, Shannon interviewed 8 breast cancer survivors and found that each one valued recreation and leisure therapy as a way to cope with cancer, while having a positive outlet to enjoy life. In total, the literature examining the efficacy of recreation therapy as an alternative treatment is limited, and predominately qualitative, but many studies focusing on this form of treatment have producing promising results (McGhee & Skalko, 2001).

Johnson conducted a qualitative analysis on the importance of humor therapy as a coping skill and a means of breast cancer recovery. In this study, Johnson interviewed nine breast cancer survivors, attempting to identify their use of humor, its influence on their spirituality, and their perceptions of how nurses used humor in caring for them during breast cancer treatment. A key finding from these interviews was that all participants identified humor as an important coping dynamic. The patients as a whole felt that humor played a role in their spirituality, that humor gave meaning and purpose to their lives, and that nurses’ use of humor helped to foster deeper and more trusting relationships (Johnson, 2002).

In a related study, Lengacher and coworkers conducted a cross sectional survey to determine the frequency of use of alternative therapies in women with breast cancer. A total of 105 women were given a Complementary Therapies Survey, which included questions
about 33 different alternative therapies. When the frequency of the use of all therapies was tabulated, the research team discovered that 21% of the women regularly used humor or laughter therapy as a treatment therapy (Lengacher et al., 2002). Even though the use of humor therapy in this study did not appear as robust as in the Johnson interviews, both studies imply that humor therapy may be a vital form of recreation therapy to the cancer patient.

Journaling and creative writing have been utilized during breast cancer treatment as a form of recreation therapy which suggests that this may be a useful therapy in post treated patients as well. The research in this area is very limited, but some initial studies provide encouraging information. For example, Smith and colleagues analyzed the effects of journaling on 43 women who had been newly diagnosed with breast cancer. The purpose was to examine the role that expressive writing had on overall mood during a 12 week long support group. The journal writing was analyzed by a linguistic inquiry and word counting program, and several writing characteristics such as positive and negative emotion words, average word count, ratio of positive and negative words, word count, and number of entries were examined. A regression analysis revealed that increased levels of stress and anxiety after the group intervention were associated with predominance of negative emotion in writing, while increased quality of life was associated with a predominance of positive emotion in writing (p<.05). Researchers concluded that these findings suggest the need for additional analyses on naturalistic journaling as a therapy for breast cancer. For instance, how often should patients write, how much should they write, and what should the focus of the writing be? In addition, how can patients best utilize journaling as a way to cope with cancer, and cancer treatment (Smith, Anderson-Hanley, Langrock, & Compas, 2005).
Rancour and Brauer presented a case study stressing the use of journaling as a means of coping with breast cancer surgery as well as altered body image. The researchers discussed how breast cancer surgery, which can result in the loss of part of or all of the affected breast and surrounding tissues, is a dramatic event that poses a difficult challenge. Published books and articles were analyzed, and it was determined that journaling, along with Gestalt therapy and psychosynthesis, has been effective in helping patients come to accept breast alterations post surgery. Letter writing in particular, was found to be a vital aspect of journaling that helped female patients to readjust. The conclusion of the case study was that oncology nurses should use letter writing with breast cancer patients as a means of encouraging journaling, and to assist patients in coping with surgery (Rancour & Brauer, 2003).

Leisure awareness, education, and counseling may also be a beneficial part of recreation therapy. Robertson defines all three of these terms, and discusses how all should be combined together for the complete benefit to the patient. Leisure awareness involves helping people become aware of that leisure is a positive event that they can incorporate in their lives; leisure education is the process of providing knowledge of various leisure activities; leisure counseling involves identifying various factors that impede optimal leisure functioning and how to resolve those factors to gain the maximum benefits from recreation therapy (Robertson, 2004). Leisure counseling, in particular, may play a key role in increasing the leisure activity, because as Shannon discovered in her interviews, women may have the knowledge about leisure activities, they may not translate that knowledge into positive behavior. For example, she found that although women with breast cancer “knew”
that they should exercise, relax, and engage in wholesome activities, they did not follow through or attempt to do them (Shannon, 2005).

One of the most recent forms of recreation therapy gaining interest in the medical community is HeartMath®, a form of biofeedback. Biofeedback is a mind-body, interactive training technique that allows individuals to become aware of and to regulate health function by using physiological signals from their bodies. The signals that are often monitored during biofeedback include brain activity, heart rate, blood pressure, skin conductance levels, and muscle tension (The Association for Applied Psychophysiology and Biofeedback, 2007). Therapists use sensors placed on the hands, head, or muscles of the body to provide audible and/or visual feedback about what is happening in the body. Over time, and through practice, individuals are able to utilize such techniques to regulate involuntary physiological responses and lead healthier lives (The Association for Applied Psychophysiology and Biofeedback, 2007). HeartMath® in particular, is a stress relieving biofeedback technique that allows individuals to regulate their heart rhythms through a series of breathing exercises and meditative techniques (Institute of HeartMath®, 2008). The basic technique of the program is called “Quick coherence,” which is a 3 step technique designed to help induce heart rate coherence. Individuals are instructed to focus on the heart, breathe in and out to a count of five, and then shift focus to positive feelings of love and appreciate. The specific purpose of the HeartMath® system therefore, is to elicit psychological and physiological benefits by teaching individuals how to improve heart rate coherence and heart rate variability.

Heart rate coherence is a measure of emotional stability, mental acuity, order, and physiological efficiency in the body. It represents the coherence of the rhythmic activity of
the heart and the coherence between different physiological systems (McCraty et al., 2002; McCraty & Tomasino, 2006). Research has shown that heart rate coherence is affected by the role that emotions play in physiological functioning as well as from the contribution of the heart in emotional functioning (McCraty & Childre, 2002). McCraty and Tomasino found that a sustained level of positive emotions led to increased coherence of heart rhythm patterns and greater harmony among physiological systems, while negative emotions such as anxiety and stress lead to more irregular rhythms and decreased harmony among physiological systems (McCraty & Tomasino, 2006). In short, decreased heart rate coherence, is associated with negative emotions and negative side effects. Breast cancer patients, who undergo large amounts of psychological and physiological stress, may be at a higher risk for decreased heart rate coherence (Lebel, Rosberger, Edgar, & Devins, 2007; Curess et al., 2000).

Potential psychological benefits of increased heart rate coherence include mental clarity, improved cognition, increased well being and feelings of emotional stability, as well as enhanced social functioning. (McCraty, 2002). On the physiological front, Von Ah and coworkers found (in a study of 54 cancer patients) that increased heart rate coherence and positive emotions such as optimism helped to attenuate the deficit to immune functioning (particularly decreased Natural Killer Cell Activity) that is associated with cancer (Von Ah, Kang, & Carpenter, 2007). Additional physiological correlates of increased coherence include: increased synchronization between the two branches of the autonomic nervous system, a shift toward more parasympathetic nervous system activity, increased heart-brain synchronization, increased respiratory efficiency, increased cardiac output in conjunction with increased fluid exchange and capillary absorption, increased ability of the
cardiovascular system to adapt to circulatory requirements, and metabolic energy savings (McCraty, 2002; Lehrer et al., 2003; ). Moreover, sustained levels of heart rate coherence have been associated with improved dehydroepiandosterone (DHEA) / cortisol ratios. Improved heart rate coherence in conjunction with increased positive emotions is associated with augmented DHEA levels but decreased levels of cortisol. Improved DHEA/cortisol ratios have been related to such benefits as reduced stress reactivity and improved homeostasis (McCraty, 2003; McCraty & Childre, 2002). Analyzing such research suggests that the HeartMath® biofeedback techniques may even be beneficial in helping patients improve their scores on physiological tests, including VO\textsubscript{2max} tests.

Heart rate variability is the measure of the naturally occurring beat to beat changes within the heart which represents an indication of autonomic function and physiological coherence (Institute of Heart Math®, 2008). Higher heart rate variability is associated with ordered rhythm changes in the heart, while low heart rate variability is associated with disordered, erratic changes. As with heart rate coherence, heart rate variability is affected by the emotional state, with heart rhythms becoming more erratic during negative emotions such as anger and anxiety, and more ordered during positive emotions such as love and appreciation (McCraty & Childre, 2003). Again, in breast cancer patients, it is likely to see lower heart rate variability with low heart rate coherence. The benefits of high heart rate variability are similar to those of low heart rate coherence and include improved cognition and perception, improved immune responses, and improved cardiovascular responses (Institute of Heart Math®, 2008; McCraty, 2002; McCraty & Tomasino, 2006).

Fortunately, research from Institute of HeartMath® suggests that HeartMath® biofeedback therapy helps to improve heart rate coherence and heart rate variability as well
The psychological and physiological benefits that result from such improvements (McCraty, 1999). Published studies include ones where HeartMath® was employed to assist middle school children, congestive heart failure patients, hypertensive individuals, individuals with HIV, individuals with diabetes, former soldiers with post traumatic stress disorder, and even breast cancer patients (McCraty, Atkinson, Tomasino, Goelitz, & Mayrovitz, 1999; Luskin, Reitz, Newell, Quinn, & Haskell, 2002; McCraty, Atkinson, & Tomasino, 2003; Rozman, Whitaker, Beckman, & Jones, 1996; McCraty, Atkinson, & Lipsenthal, 2000; Ginsberg, Berry, & Powell, 2008; Groff, Battaglini, O’Keefe, Edwards, & Peppercorn, 2007). The wide array of research continues to grow and there are many prospective HeartMath® studies in the works (Institute of HeartMath®, 2008).

Other forms of biofeedback have also garnered increased attention, including two programs developed by the Wild Devine Project: Healing Rhythms (HR) and The Journey to the Wild Devine© (JWD) (The Wild Devine Project, 2009). The HR software is a 15 step biofeedback program that teaches one how to develop a positive mental and physical state, by controlling stress and being mindful of various physiological feelings. The 15 step program consists of 3 focal parts: Self Discovery, Creating Happiness, and Developing Life Skills. The software utilizes a combination of heart rate variability and skin conductance levels (a measure of sweat gland activity sensed as the autonomic nervous system activates) as a way to allow individuals to control various biofeedback events. Through developing greater heart rate variability, and concentrating on breathing and total body relaxation, individuals can develop a sense of a peaceful mind and healthy body. The JWD software is different in that it teaches individuals how to use a breathing technique known as the “heart breath,” for the purpose of stress reduction and emotion management. In actuality, the heart
breath technique is comparable to the “Quick Coherence” technique in HeartMath®, but does not have the same name. In JWD, heart rate and skin conductance levels are used to help the individual complete a series of biofeedback events, all of which are intertwined into a personal journey of self awareness. Each biofeedback related event requires the individual to either stimulate a state of excitement or relaxation, with the end goal of helping the individual better manage emotions (The Wild Devine Project, 2009).

Summary

Research has shown that both exercise therapy and recreation therapy are beneficial to the breast cancer survivor. Exercise therapy is associated with improved physiological parameters as well as improved psychological parameters. However, to say that exercise is the ultimate treatment in mitigating all psychological deficits of breast cancer treatment may be incorrect. Recreation therapy is associated with improved psychological benefits, and, depending on the therapy, may cause some physiological benefits as well. After reviewing the literature, it was postulated that a combination of both forms of therapy may be the most comprehensive treatment plan for the post treated breast cancer patient. It was hypothesized that a combined exercise and recreation therapy intervention would be more successful than an exercise only intervention in mitigating some of negative physiological and psychological side effects (decreased VO₂max, increased fatigue, decreased quality of life) associated with cancer treatment.
CHAPTER III

Methods and Procedures

Study Protocol

This was a retrospective study with data gathered from the Get REAL & HEEL Breast cancer program in Chapel Hill, North Carolina. The patients were randomly assigned to either an exercise only group (EX) or to a combined exercise and recreation therapy group (EX+RT). After the randomization process, subjects underwent an initial battery of baseline physiological and psychological assessments. Following the initial assessments, each patient received either an EX or EX+RT intervention, 3 times per week, for the 2 month duration of the study. At the completion of the intervention, patients underwent a final assessment consisting of the exact same battery of assessments administered at baseline.

Subjects

The women participating in the Get REAL & HEEL Breast Cancer Program were enrolled in the study between 2007 and 2008. Study volunteers consisted of 14 women who had completed all major treatment for breast cancer (surgery, chemotherapy and/or radiation) within six months of the beginning of the study. The criteria for participation in the study included: confirmed diagnosis of stage I-III invasive breast cancer; within six months of having completed all planned surgery, radiation therapy and chemotherapy; and ages ranging from 30 to 75 years. Women receiving adjuvant hormonal therapy or adjuvant trastuzumab (such as Tamoxifen, Herceptin) were also eligible. Patients were excluded from participating in the study if they presented any of these conditions: cardiovascular, acute or chronic
respiratory disease (unless the disease would not compromise the patient’s ability to participate in the exercise therapy program); acute or chronic bone, joint, or muscular abnormalities that would compromise the patient’s ability to participate in the exercise therapy program; adequate renal function with creatinine < 1.5 mg/dL; immune deficiency that would compromise the patient’s ability to participate in the program (Absolute Neutrophil Count (ANC) < 1.5µL, Platelet (Plt) < 90 GL (900,000 mm³, and/or Hematocrit (Hct) < 30%); or metastatic disease.

**Recruitment of Subjects**

All patients were residents in one of the 13 counties of the NC Triangle Affiliate of the Susan G. Komen for the Cure, and were introduced to the study through either an oncology physician and/or nurse, a brochure, a friend or relative, or through a website search. If a patient expressed interest in participating in the study, the patient was advised to contact a research team member by calling a phone number printed in the advertisement flier that was provided to physicians and nurses of local hospitals. During the phone call, the prospective participant received in-depth clarification regarding the study protocol and the specifics on how to enroll in the study. Additionally, the research team member scheduled the prospective patient an appointment to visit the study facility for further eligibility screening. Patients were asked to fax their medical oncologist consent form approving participation in the study prior to the first visit to the study facility. If participants were not able to fax the consent form before the first visit, then they were allowed to bring the consent form with them to the initial visit. During the initial visit, after completion of the eligibility screening and verification of the medical oncologist’s participation approval, researchers obtained informed consent approved by the University Biomedical Internal Review Board
and the HIPPA authorization for use and disclosure of health information for research purposes. Also during the initial visit, a research assistant discussed pre-assessment guidelines and scheduled the initial battery of assessments.

**Assessment Protocols**

A battery of physiological and psychological assessments was administered at baseline (week 1) and again at the conclusion of the study (week 8). The assessment of psychological functioning was performed prior to the administration of all physiological assessments, at the initial intake interview, and included: Revised Piper Fatigue Scale (Piper et al., 1998) and the Functional Assessment of Cancer Therapy-Breast Cancer (FACT-B) Quality of Life scale (Cella et al., 1998). After completion of the fatigue and quality of life assessments, patients were asked to remain seated quietly for five minutes and then resting vitals [resting heart rate (RHR) assessed via Pacer Polar heart rate monitor (Lake Success, NY), blood pressure (BP) via Diagnostix 700 aneroid sphygmomanometer (Hauppauge, NY) and Litmann stethoscope (St. Paul, MN)] were assessed. Height and weight were obtained following the assessment of resting vitals using a balance beam physician scale equipped with a height rod (Health-o-meter 402KL Rye, NY). Cardiovascular endurance was then assessed using the Modified Bruce Protocol (Quinton Q65 treadmill, Fitness Equipment, Bothell, WA) (Heyward, 2006). Rating of perceived exertion during the cardiovascular endurance test was monitored using a modified Borg scale (Borg, 1982). The RPE scale ranged from 0 -11 with 0 representing no exertion and 11 representing maximal exertion.

Following the cardiovascular endurance assessment, dynamic muscular endurance was evaluated using a standardized push-up and partial curl-up test (Heyward, 2006) and a sub-maximal testing protocol designed at the Rocky Mountain Cancer Rehabilitation Institute
(RMCRI, Greeley, CO) (Schneider, Dennehy, & Carter, 2003) using selected (Magnum Fitness Retro Series Machine, South Milwaukee, WI) machines and dumbbells (Power Systems Sports, Knoxville, TN). The RMCRI protocol consisted of patients executing repetitions of bicep curls, lat pulldown, leg extension, and leg curl exercises until reaching a Rate of Perceived Exertion (RPE) of 7 on the modified Borg Perceived Exertion Scale (0-11 scale) (Borg, 1982). Weight used in this assessment was based on a predetermined % of their body weight calculated according to their age and sex. Flexibility of the hamstrings and lower back was measured using a modified sit-and-reach box (Acuflex I, Novel Products, Inc., Rockton, IL) and was the last of the physiological assessment performed.

**Interventions**

The individualized prescriptive exercise intervention was designed in accordance with the American College of Sports Medicine (ACSM) exercise guidelines for elderly populations (American College of Sports Medicine, 2006) as well as specific guidelines published in an Exercise and Cancer Recovery text book (Schneider et al., 2003). In addition, the recreation therapy activities were conducted in accordance to the Leisure and Well-Being Model (Hood & Carruthers, 2008). Because of the large age range criteria required for participation in the program, as well as the lack of specific guidelines for exercise in cancer patients, the above guidelines were the most appropriate for this study.

Patients assigned to the EX only group exercised 3 times per week under the supervision of an exercise specialist for the duration of the entire study. Resting vitals were taken before the start of each exercise session, and each exercise session lasted approximately 60 minutes. The composition of the exercise sessions included 10-20 minutes of cardiovascular exercise on a treadmill (StarTrac 5400TR, Irvine, CA), cycle ergometer
(Life Fitness 9500HR, Schiller Park, Ill.), or elliptical machine (Life Fitness 91X, Schiller Park, Ill.) followed by 20-30 minutes of resistance training, and ended with a 10-minute flexibility and cool-down period. Depending on the physical state of the patients prior to each exercise session, the intensity and volume of training was modified to accommodate each patient’s needs. Cardiovascular exercise was performed with intensities varying between 40%-65% of Heart Rate Reserve. Exercise intensity during the aerobic exercise sessions was monitored via Pacer Polar heart rate monitors (Lake Success, NY).

For the resistance portion of the exercise session, patients completed 8-12 different types of resistance exercises that used all major muscle groups. All exercises were performed using weight machines, free weights (hand dumbbells), elastic bands, or therapeutic balls (fit balls). The resistance exercises that were used during the program included: lateral and frontal shoulder raises with dumbbells, horizontal chest press, lat pull down, alternating bicep curls with dumbbells, triceps extension, leg press, leg extension, leg curl, standing calf raises, and three different types of abdominal exercises (regular crunches, oblique crunches, and lower abdominal). For the development of a training effect, the increases in load during the study followed the ACSM guidelines (American College of Sports Medicine, 2006) for resistance exercise training methods. The number of repetitions for each exercise ranged from 8-12, and intensities were set at an RPE between 3 and 7 using a modified Borg scale (Borg, 1982). As patients were able to perform 12 repetitions with a reported RPE of 3, the load was increased to create a training effect. Patients performed a minimum of 1 and a maximum of 3 sets of each exercise per session. During the first two weeks of the program, all patients performed only one set of each exercise and then progressed to 2 and 3 sets for the subsequent weeks. The movements for each exercise were
performed at a moderate, controlled speed (three seconds of the concentric phase followed by three seconds of the eccentric phase of the movement during each repetition for each exercise). The rest interval period between each set and between each exercise varied from thirty seconds to one minute, according to the participant’s needs.

For patients assigned to the EX+RT group, the exercise intervention followed the exact same structure of the EX group; the only difference was the addition of the RT intervention. Each patient received 60 minutes of exercise as well as 30 minutes of recreation therapy, 3 times per week, for the duration of the study. The recreation therapy (RT) was completed either before or immediately after the exercise therapy. The RT intervention was composed of biofeedback techniques using HeartMath® emWave PC, as well as The Wild Divine Project’s Healing Rhythms (HR) and The Journey to the Wild Divine© (JWD) software. Furthermore, all sessions were prescribed and administered by a certified/licensed recreation therapist. The RT intervention was designed based on both the results of the psychological assessments administered at baseline and the needs of each patient.

Furthermore, all RT was structured around the five guiding principles (savoring leisure, authentic leisure, leisure gratification, mindful leisure, and virtuous leisure) of the Leisure and Well-Being Model (Hood & Carruthers, 2008).

**Statistical Analysis**

The independent variable of this study was the intervention type, either EX therapy, or EX + RT therapy. The dependent variables of the study were VO$_{2\text{Max}}$, Quality of Life, and fatigue. Change scores were computed between the pretest and posttest means for all three dependent variables in both intervention groups. From the change scores, three independent samples t-tests were used to compare each intervention group on each dependent variable.
The alpha level of the t-tests was set *a priori* at .05 for all statistical analyses, and no statistical adjustment was made for the t-tests. Even though failing to set a statistical adjustment for three t-test comparisons increased the risk of Type I error, it was assumed that the risk was not large enough to necessitate adjusting the alpha level. Descriptive statistics were presented as means and standard deviations. Confidence intervals of the means were also provided, as well as an analysis of effect size. Specifically, the effect size of each t test analysis was computed via the Cohen’s *d* method (small effect size, *d* = .2 : medium effect size, *d* = .5 : large effect size, *d* > .8). The statistical software SPSS version 16.0 for Windows was used for the analyses of the data. The following is a specific breakdown of how each hypothesis was addressed.

**H1:** There will be a significant difference in changes in VO$_{2\text{max}}$ between the combined exercise and recreation therapy group and the exercise only group during the 8 week study protocol.

Hypothesis 1 was analyzed via an independent samples t-test using the delta-score (Post-Pre scores) obtained from the analyses of the predicted VO$_{2\text{max}}$ test administered at baseline (Pre) and at the end of the 8 week intervention (Post).

**H2:** There will be a significant difference in changes in fatigue between the combined exercise and recreation therapy group and the exercise only group during the 8 week study protocol.

Hypothesis 2 was analyzed via an independent samples t-test using the delta-score (Post-Pre scores) obtained from the analyses of the Revised Piper Fatigue scale administered at baseline (Pre) and at the end of the 8 week intervention (Post).
**H3**: There will be a significant difference in changes in Quality of Life between the combined exercise and recreation therapy group and the exercise only group during the 8 week study protocol.

Hypothesis 3 was analyzed by via an independent samples t-test using the delta-score (Post-Pre scores) obtained from the analyses of the FACT-B Quality of Life scale administered at baseline (Pre) and at the end of the 8 week intervention (Post).
CHAPTER IV

Results

The purpose of this study was compare the effects of a combined exercise and recreation therapy intervention on selected physiological and psychological parameters to an exercise only intervention in post treated breast cancer patients. All data were entered into an electronic database for analysis. All data were analyzed on SPSS version 16.0 for Windows, a statistical software program. An alpha level of 0.05 was used for all statistical procedures, and descriptive statistics were presented in the form of means and standard deviations (SD).

Subjects

Fourteen female subjects, ages 49-71 years (Mean = 57.3, SD = 6.3) volunteered to participate in this study. All subjects were post treated breast cancer patients and were recruited to the Get REAL & HEEL breast cancer program at the University of North Carolina at Chapel Hill. General subject characteristics are summarized in Table 1 below.

Table 1. Subject Characteristics

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<th>Age (years)</th>
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<td>Post-Treated Breast Cancer Patients</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EX+RT Group n = 7</td>
<td>55.1</td>
<td>6.0</td>
<td>165.3</td>
<td>5.2</td>
</tr>
<tr>
<td>Post-Treated Breast Cancer Patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EX Only Group n = 7</td>
<td>59.4</td>
<td>6.2</td>
<td>163.4</td>
<td>7.9</td>
</tr>
</tbody>
</table>

The pre intervention and post intervention descriptive statistics for the variables VO₂max, fatigue, and overall quality of life are presented in Table 2.
Table 2. Descriptive Statistics of Pre and Post Intervention Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>EX+RT Group Pre-Intervention (Mean±SD)</th>
<th>EX Only Group Pre-Intervention (Mean±SD)</th>
<th>EX+RT Group Post-Intervention (Mean±SD)</th>
<th>EX Only Group Post-Intervention (Mean±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO$_{2\text{max}}$ (ml/kg/min) (Modified Bruce Protocol)</td>
<td>28.1 ± 4.8</td>
<td>30.9 ± 4.7</td>
<td>32.4 ± 4.4</td>
<td>33.8 ± 7.1</td>
</tr>
<tr>
<td>Fatigue (Revised Piper Fatigue Scale)</td>
<td>4.2 ± 1.9</td>
<td>5.1 ± 2.8</td>
<td>.9 ± 1.2</td>
<td>2.7 ± 2.1</td>
</tr>
<tr>
<td>QOL (FACT-B)</td>
<td>104.4 ± 23.2</td>
<td>119.7 ± 15.2</td>
<td>122.7 ± 17.2</td>
<td>120.2 ± 16.9</td>
</tr>
</tbody>
</table>

Hypothesis One

Hypothesis 1, there will be a significant difference in the changes in VO$_{2\text{max}}$ between the combined exercise and recreation therapy group and exercise only group during the 8 week study protocol, was analyzed using an independent samples t-tests. The dependent variable of this analysis was VO$_{2\text{max}}$, and the independent variable was the intervention type (EX+RT vs. EX Only). The VO$_{2\text{max}}$ delta scores (post – pre) within each intervention group were compared for this analysis. The descriptive statistics of the analysis of hypothesis 1 are presented in table 3.

Table 3. Descriptive Statistics of Hypothesis 1 (VO$_{2\text{max}}$)

<table>
<thead>
<tr>
<th></th>
<th>Delta Score</th>
<th>SD</th>
<th>Std. Error</th>
<th>95% CI</th>
<th>of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td></td>
<td>lower</td>
<td>upper</td>
</tr>
<tr>
<td>Post-Treated Breast Cancer Patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EX+RT Group n = 7</td>
<td>4.36</td>
<td>2.97</td>
<td>1.12</td>
<td>1.61</td>
<td>7.11</td>
</tr>
<tr>
<td>Post-Treated Breast Cancer Patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EX Only Group n = 7</td>
<td>2.91</td>
<td>2.90</td>
<td>1.09</td>
<td>.23</td>
<td>5.59</td>
</tr>
</tbody>
</table>
The results of the independent samples t-test analysis performed on hypothesis 1 are presented in Table 4. No significant differences in the changes in VO$_{2\text{max}}$ between the EX+RT and EX only group were observed (p=.373).

**Table 4. Independent Samples T-test Results of Hypothesis 1 (VO$_{2\text{max}}$)**

<table>
<thead>
<tr>
<th>T</th>
<th>df</th>
<th>Effect Size</th>
<th>Sig. 2 tailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX+RT vs. EX Only</td>
<td>.002</td>
<td>12</td>
<td>.494</td>
</tr>
</tbody>
</table>

**Hypothesis Two**

Hypothesis 2, there will be a significant difference in the changes in fatigue between the combined exercise and recreation therapy group and exercise only group during the 8 week study protocol, was analyzed using an independent samples t-tests. The dependent variable of this analysis was delta score of fatigue during the 8 weeks protocol, and the independent variable was the intervention type (EX+RT vs. EX only). The descriptive statistics of the analysis of hypothesis 2 are presented below in table 5.

**Table 5. Descriptive Statistics of Hypothesis 2 (Fatigue)**

<table>
<thead>
<tr>
<th>Delta Score</th>
<th>SD</th>
<th>Std. Error Mean</th>
<th>95% CI of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-Treated Breast Cancer Patients EX+RT Group n = 7</td>
<td>-3.3</td>
<td>1.25</td>
<td>.47</td>
</tr>
<tr>
<td>Post-Treated Breast Cancer Patients EX Only Group n = 7</td>
<td>-2.4</td>
<td>1.77</td>
<td>.67</td>
</tr>
</tbody>
</table>
The results of the independent samples t-test analysis performed on hypothesis 2 are presented in Table 4. No significant difference in the changes in fatigue between the EX+RT and EX only group were observed (p=.293).

**Table 6. Independent Samples T-test Results of Hypothesis 2 (Fatigue)**

<table>
<thead>
<tr>
<th></th>
<th>T</th>
<th>df</th>
<th>Effect Size</th>
<th>Sig. 2 tailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX+RT vs. EX Only Delta Scores</td>
<td>.253</td>
<td>12</td>
<td>-.587</td>
<td>.293</td>
</tr>
</tbody>
</table>

**Hypotheses Three**

Hypothesis 3, there will be a significant difference in the changes in Quality of Life between the combined exercise and recreation therapy group and exercise only group during the 8 week study protocol, was analyzed using an independent samples t-tests. The dependent variable of this analysis was delta score of Quality of Life during the 8 weeks protocol, and the independent variable was the intervention type (EX+RT vs. EX Only). The descriptive statistics of the analysis of hypothesis 3 are presented below in table 7.

**Table 7. Descriptive Statistics of Hypothesis 3 (Quality of Life)**

<table>
<thead>
<tr>
<th></th>
<th>Delta Score Mean</th>
<th>SD</th>
<th>Std. Error Mean</th>
<th>95% CI of Mean lower</th>
<th>Mean upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-Treated Breast Cancer Patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EX+RT Group n = 7</td>
<td>18.33</td>
<td>12.19</td>
<td>4.61</td>
<td>7.05</td>
<td>29.61</td>
</tr>
<tr>
<td>EX Only Group n = 7</td>
<td>.54</td>
<td>8.81</td>
<td>3.33</td>
<td>-7.61</td>
<td>8.69</td>
</tr>
</tbody>
</table>
The results of the independent samples t-test analysis performed on hypothesis 3 are presented in Table 8. A significant difference in the changes in quality of life between the EX+RT and EX only group was observed (p=.009).

Table 8. Independent Samples T-test Results of Hypothesis 3 (Quality of Life)

<table>
<thead>
<tr>
<th></th>
<th>T</th>
<th>df</th>
<th>Effect Size</th>
<th>Sig. 2 tailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX+RT vs. EX Only</td>
<td>.754</td>
<td>12</td>
<td>1.673</td>
<td>.009</td>
</tr>
<tr>
<td>Delta Scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER V

Discussion

The management and mitigation of treatment related side effects is of the utmost importance in the care of the post treated breast cancer patient. This is true because these side effects (including fatigue, depression, anxiety, and negative changes in metabolism) are linked to negative changes in overall quality of life as well as reductions in cancer survivorship rates in these patients (Rossman & Shrock, 2009). Various drug therapies have been utilized to target cancer treatment side effects; however, such therapies are often expensive, and statistics show that even with medications, over 50% of cancer survivors still experience difficulty conducting day to day activities (Battaglini et al., 2006). As a result, the medical community continues to search for alternative therapies that not only meet patient needs, but also prove effective in mitigating the physiological and psychological side effects of treatment.

Exercise therapy (either aerobic, strength training, or combined forms) has received increasing amounts of attention as an acceptable and beneficial alternative therapy to mitigate some of the side effects of cancer treatment. Yet, even though exercise has been shown to be an excellent post treatment therapy, there are concerns that it may not address all of the psychological side effects of treatment. Consequently, other forms of therapy that target psychosocial functioning, such as recreation therapy, in combination with exercise, may provide post treated breast cancer patients with a more comprehensive intervention that accurately focuses on the patients’ physical and psychological needs. Therefore, the purpose
of this particular study was to compare the effects of a combined exercise and recreation therapy intervention on selected physiological and psychological parameters to an exercise only intervention in post treatment breast cancer patients. The significance of the study was not only to examine the effects of combining exercise and recreation therapy as a more well rounded approach in the mitigation of cancer treatment side effects, but also to provide the medical community with empirical evidence on the effectiveness of a novel therapy approach.

**The Impact of the EX +RT and EX Only Interventions on \(\text{VO}_{2\text{max}}\)**

No significant difference in the change scores of \(\text{VO}_{2\text{max}}\) (\(p=.373\)) was found between the combined exercise and recreation therapy (EX+RT) and the exercise only (EX only) groups. After analyzing the impact of the EX +RT and EX interventions, there was found a 15.3% change from pre to post test \(\text{VO}_{2\text{max}}\) in the EX+RT group, and a 9.4% change from pre to post test \(\text{VO}_{2\text{max}}\) in the EX only group. Although the percent change in the EX + RT group was higher, the differences failed to reach statistical significance. Statistically, these results suggest that recreation therapy does not provide an additive effect to exercise in improving aerobic capacity in post treated breast cancer patients. However, the difference of 5.9% change between groups may be of some clinical relevance, especially when considering such a physically deconditioned population. So, in this vein, the difference between groups should be noted.

Additionally, it had been postulated that biofeedback therapy, due to heart rate variability and heart rate coherence training, might be able to provide enough of a physiological stimulus to improve \(\text{VO}_{2\text{max}}\) more in the EX + RT group. Even though no statistical significance was observed for differences in \(\text{VO}_{2\text{max}}\) between groups, the 5.9%
difference may demonstrate some possible influence of the HeartMath®, HR, and JWD biofeedback on VO$_{2\text{max}}$. It is possible that learning the biofeedback techniques, including breathing control and the development of concentration and emotional self-regulation, had some beneficial effects on the exercise portion of the intervention within the EX + RT group. This could help explain some of the clinical difference in VO$_{2\text{max}}$ that existed between groups, particularly if the biofeedback therapy helped the patients become more comfortable and focused during the post test assessment. The possibility for such an effect would be somewhat similar to athletic training, where an athlete may try to assimilate a practice session or competitive event by using various techniques to become more engaged and alert. If an athlete is able to do this successfully, then there is a possibility for a positive impact on the training session or event, allowing for greater improvements to occur (Crews, 1992).

With regards to the study design, there are several possible reasons why no significant differences were observed in the changes in VO$_{2\text{max}}$ between the EX + RT and EX only groups. First of all, it is possible that the 8 weeks intervention was not long enough to produce a significant difference between groups. Similar research (that which analyzes the effect of exercise training on VO$_{2\text{max}}$ in cancer patients) has often included study designs of more than 8 weeks. For example, Courneya et al. (2003) analyzed the effects of exercise training in breast cancer patients over a 15 week period, while Schneider et al. (2007) analyzed the same effects of training over a period of 6 months. In recreation therapy studies, Luskin et al. (2002) studied the effects of 10 weeks of HeartMath® biofeedback training on emotional stress, stress management and depression in 33 Congestive Heart failure patients. In addition, McCraty et al. (2003) investigated the effects of 3 months of HeartMath® biofeedback therapy on blood pressure and stress in hypertensive individuals.
while Groff et al. (2007) studied the effects of 6 months of HeartMath®, HR, and JWD therapy and exercise therapy in post treated breast cancer patients. Therefore, it would be interesting to see if a longer duration study, with more biofeedback recreation therapy sessions, would have produced different results.

Another confounding variable that could have affected the results was the fact that some patients in the EX + RT group missed some of their schedule recreation therapy sessions. For example, during the first week of the intervention, 4 patients only received 1 out of 3 scheduled sessions. Part of the reason for this resulted from the fact that the intervention was individualized for each patient, and some patients were not able to make it in for sessions as a result of various reasons (not feeling well, additional illnesses, doctor’s appointments, family trips, etc…). Then, during the next 7 weeks, 5 additional sessions were missed by the entire EX + RT group. Although the vast majority of recreation therapy sessions were attended, it can’t go unnoticed that the missed sessions could have affected the end results.

Additional questions surround the length of the recreation therapy sessions, and the type of recreation therapy given. Would the results have been different if recreation therapy sessions were longer - for example, 1 hour instead of 30 minutes? Also, what if other forms of recreation therapy were used in conjunction with the biofeedback therapy? With regards to the first point, longer sessions may not have been feasible with this population, considering that the EX + RT group already received one hour of exercise training before the recreation therapy sessions. Adding time to the recreation therapy may have been too much of a commitment for the patients. Also, the recreation therapy sessions in this study were based off of previous research (Groff et al., 2007) which has found that this amount of
recreation therapy is effective. With regards to the second point, it is imperative to point out that at the Get REAL and HEEL program, other forms of recreation therapy are utilized (i.e journaling, creative writing, group ropes course, music therapy, humor therapy, etc…). However, to avoid any additional confounding variables, and in order to test the idea that biofeedback training may be able to impact VO$_2$max, it was important to ensure that this was the only form of recreation therapy utilized during the study.

Finally, sample size may have been a key potential factor affecting the end results of the study. With an overall total of 14 subjects, and only 7 patients per intervention group, the sample size was quite small. If the sample size was increased (even by just a few subjects), and the variability (SD) between groups decreased, then the power of the analysis would have increased, resulting in a decreased p value in the t test analysis. The power of an analysis represents the likelihood of committing a Type II statistical error, or the likelihood of rejecting a false null hypothesis. So it seems possible that the clinical difference between groups may have been statistically significant if, in fact, the sample size was increased. However, this cannot be stated with certainty, suggesting the need for further research.

To date, no other studies in the literature have compared the effects of a combined exercise and recreation therapy intervention in breast cancer patients. Also, no known studies have analyzed the effects of recreation therapy on VO$_2$max in breast cancer patients. However, there are studies that have analyzed the effects of exercise on VO$_2$max within this population. Comparing the results of a few similar studies with our study may provide some information on the effectiveness of the combined exercise and recreation therapy intervention. For example, Cheema and Gaul (2006) investigated the effects of 8 weeks of aerobic and strength training on VO$_2$peak in 27 post treated breast cancer patients. The
exercise prescription consisted of 2 days of full body strength training (no duration given) and 3 days per week of aerobic training (15-30 min per session at 65-85% MHR). The study results were that the patients’ VO_{2peak} improved an average of 1.5 ml/kg/min from pre to post test, which was a 6.2% change (Cheema & Gaul, 2006). Contrast this with the delta mean changes of the EX + RT group of our study, which was 4.36 ml/kg/min (15% difference) and the delta mean of the EX only group was 2.91 ml/kg/min (9.3% difference). This comparison suggests that the EX + RT group of our study seemed to elicit similar or even superior responses in changes in VO_{2max} than the exercise group in the Cheema and Gaul (2006) study. Since both studies presented nearly identical exercise training protocols, further research is needed in order to clarify this possibility.

Furthermore, Hsieh et al. (2008) analyzed the effects of a 6 month combined aerobic and strength training intervention on predicted VO_{2max} in 27 post treated breast cancer patients. The exercise prescription in this study consisted of 2-3 days/week of 60 minute duration exercise sessions. The aerobic training exercise intensity ranged from 40-75% of heart rate reserve, and the resistance training consisted of full body exercise working all major muscle groups. The study results were that the patients’ VO_{2max} improved an average of 4 ml/kg/min from pre test to post test, which was a 19% difference, a percent change difference that is greater than that seen in either of the groups in our study, but similar in overall change to our study’s EX + RT group (4.36 ml/kg/min change) (Hsieh, Sprod, Hydock, Carter, Hayward, & Schneider, 2008). Does this make it clear then, that exercise is the only therapy that improves VO_{2max}? Does recreation therapy provide an additive benefit? Truthfully, this cannot yet be determined. Although the exercise prescriptions in the Hsieh et al. (2008) study and our study were quite similar (combined aerobic/resistance training, 3
days per week, 60 minutes duration), the overall duration of 6 months in the Hsieh et al. (2008) study may have accounted for the differences between study results. As mentioned before, the 8 weeks intervention in the current study may not have allotted enough time for significant differences in changes in VO$_{2\text{max}}$ between groups to occur.

Lastly, the different methods of assessing VO$_{2\text{max}}$ are factors making the overall comparisons between all 3 studies quite difficult and complex. In the Cheema and Gaul (2006) study, the researchers used a max test to determine VO$_{2\text{max}}$ while in ours and the Hsieh et al. (2008) studies, the Modified Bruce submaximal protocol was used. Previous research has shown that the prediction of VO$_{2\text{max}}$ (using submaximal tests) may overestimate VO$_{2\text{max}}$ in trained individuals while it can underestimate it in sedentary, or non trained individuals (Jones, Eves, Haykowsky, & Douglas, 2008). Knowledge of this could complicate the comparison of studies, particular between our study and the Cheema and Gaul (2006) study. Regardless, the differences that were found between the studies at least stimulates interest as to the possible benefits of recreation therapy on VO$_{2\text{max}}$.

**The Impact of the EX + RT and EX Only Interventions on Fatigue**

No significant difference in the changes scores of fatigue (p=.293) was found between the EX+RT and the EX only groups. After analyzing the impact of the EX + RT and EX only interventions, a 78.6% change from pre to post test fatigue scores was found in the EX+RT group (delta mean = -3.3), and a 47.1% change from pre to post test fatigue scores was found in the EX only group (delta mean = -2.4). Although the percent change in the EX + RT group was higher, the differences failed to reach statistical significance.

Once again, some aspects of the study design might have contributed to why no significant difference in fatigue was found between the two study groups. As mentioned
previously, some patients missed a number of recreation therapy sessions during the study. These missing sessions could have had an effect on the post test fatigue scores in the EX + RT group. The sample size was also small (n=14: n= 7 per group), and this could have been a reason why there wasn’t a significant difference between groups even though there were greater (and possibly clinically relevant) changes in fatigue in the EX + RT group. Again, it is possible that increasing the sample size could have lowered the overall p value of the analysis (if the variability between groups or SD also decreased), increasing the power of the analysis and thus the likelihood of significance. Another issue to take into consideration is whether or not the participants answered the questionnaires correctly and/or honestly. Although the Piper fatigue inventory is a reliable measure of fatigue, it is still a questionnaire where the patients provide subjective answers. So patients not responding accurately or honestly, or patients not understanding questions correctly could have resulted in fatigue scoring that was not accurate or indicative of true fatigue. Finally, what if other forms of recreation therapy were utilized during the 8 weeks intervention? Would this have made a difference? To place greater control on the study outcomes, only biofeedback therapy was utilized in this study; however, the inclusion of additional therapies could be an option for future research.

The possibility also exists, that at 8 weeks, the intervention was not long enough to stimulate any differences in the changes in fatigue between groups. For example, would significant differences between groups have been more of a possibility if the study was 6 months or one year versus 8 weeks? As mentioned, some of the HeartMath® based research in the literature has included studies of 10 weeks, 3 months, and 6 months, so this premise does, in fact, have some merit (Luskin et al., 2002; McCraty et al., 2003; Groff et al., 2007).
However, in contrast to this, some investigators who have utilized exercise as the sole post cancer treatment therapy have found significant differences in fatigue in less than 8 weeks time. For example, Milne and colleagues found that 6 weeks of combined aerobic and resistance training in an exercise group resulted in decreased levels of fatigue (p<.001) when compared to the exercise group’s baseline fatigue and when compared to a non exercise control group (p<.001) (Milne et al., 2007). Similarly, Dimeo and others noted a 25% reduction in global fatigue after only 3 weeks of combined aerobic and resistance training in 32 cancer patients (Dimeo et al., 2008). With this in mind, it would have been interesting to see what would have happened if the duration of our study was longer. Some additional comments on this point will be made in the recommendations for future research section.

One of the thoughts behind hypothesis 2 was that although exercise has been shown to effectively combat global cancer treatment related fatigue, it may not completely address all specific aspects of fatigue (i.e cognitive fatigue) experienced by breast cancer survivors. For example, Dimeo and colleagues found that a 3 week program of combined aerobic and resistance training (32 breast cancer patients) was effective in mitigating physical aspects of fatigue but not cognitive fatigue (Dimeo et al., 2008). It was postulated that recreation therapy would provide additional benefits to target all aspects of fatigue that exercise alone may not target. The results of our study do not support this claim, but more research needs to be done to provide additional information. One study that may provide some insight on this issue was completed by Dimeo and coworkers in 2004. These investigators looked at the effects of 3 weeks of aerobic exercise training (stationary biking 5 days/week) and relaxation training recreation therapy (45 min. 3 days/week) on 69 post treated lung and gastrointestinal patients. The researchers found that, at the end of 3 weeks, fatigue had decreased 21% in the
exercise training group (p<.01) and 19% in the relaxation group (p<.01), but that there was no significant differences in the change scores between groups. In other words, while both exercise training and recreation therapy were effective in reducing fatigue, neither therapy was more effective (Dimeo, Thomas, Raabe-Menseen, Propper, & Mathias, 2004). This study didn’t involve breast cancer patients, didn’t involve biofeedback as the mode of recreation therapy, nor did it compare an EX +RT vs. an EX only group, so it is difficult to glean a great deal of information from it. Yet it does provide support that both therapies are effective, and at the very least helps suggest that additional research be done in the area, possibly comparing EX only groups, RT only groups, as well as combined groups. In summation, there is still much to learn as to whether combining EX and RT is more effective in mitigating cancer related fatigue than either therapy alone.

The Impact of the EX +RT and EX Only Interventions on Quality of Life

A significant difference in the change scores of Quality of Life (p=.009) was found between the EX+RT and the EX only groups. After analyzing the impact of the EX + RT and EX only interventions, a 17.5% change from pre to post test QOL was found in the EX+RT group (delta mean = 18.33), and a .42% change from pre to post fatigue scores was found in the EX only group (delta mean = .54). These results suggest that recreation therapy may provide an additive effect to exercise in improving Quality of Life in post treated breast cancer patients. If so, then this would be in agreement with recent meta-analyses which have concluded that mind-body interventions such as biofeedback, relaxation, guided imagery, and supportive group therapy reduce depression and anxiety and improve mood and quality of life in cancer patients (Barsevick, Sweeny, Haney, & Chung, 2002; Greer, 2002).
One impressive outcome of this analysis revolves around the effect size. The effect size of the t test comparing the delta scores between groups, $d = 1.673$, is considered extremely large according to Cohen’s $d$ effect size analysis. Even though a large effect size in a significant finding is important, one should always look at the mean of the variables analyzed and determine if the significant difference is, in fact, of clinical relevance. In this case, the effect size would suggest that the superior improvements in pre to post test QOL within the EX + RT group would be noticeably different than improvements in pre to post test QOL within the EX only group. Furthermore, in this study, it should be noted that the combination of exercise and recreation therapy was the only therapy that improved the QOL of the breast cancer patients. An exploratory analysis revealed a significant difference in QOL from pre to post test within the EX + RT group ($p=.007$), but no significant difference in QOL from pre to post test within the EX only group ($p=.876$). The large effect size of the delta score t test analysis, coupled with the fact that the EX only group did not show improvements in QOL during the intervention only adds more support to the possible benefits of recreation therapy, as well as to the belief that a combination of exercise and recreation therapy is a more comprehensive approach in the mitigation of cancer treatment side effects.

The large difference in the changes in QOL observed between groups is very encouraging, but not necessarily surprising, given that a growing body of evidence is now highlighting the benefits of recreation therapy as a major mind-body approach within cancer care. Rossman and Shrock advocate the use of recreation therapy as a focal part of integrative cancer care because it can “give patients a positive focus and sense of participation in life, can distract them from worrying and catastrophizing, can help give them
a reason for hope, can improve concentration, and can help patients learn and practice beneficial skills that can offset the negative side effects of cancer treatment.” (Rossman & Shrock, 2009). As an example, Yoo and coworkers recently assessed the effects of muscle relaxation, biofeedback, and guided imagery in 60 breast cancer patients. The researchers discovered that at the end of the study, the treatment group had greater improvements in quality of life and less depression, anxiety, and nausea than a usual care control group (Yoo, Ahn, Kim, Kim, & Han, 2005). Abrams and Weil promote further research for mind-body techniques and recreation therapy because such therapies are cost effective, have low patients risks, and because such treatments often allow for unlimited home practice (Abrams and Weil, 2009). In addition, although research does not conclusively support it, there is a belief that recreation therapy may be able to ultimately affect cancer survival, since it is becoming clear that recreation therapy affects quality of life and because quality of life is predictive of cancer survival (Rossman & Shrock, 2009). Clearly, more research needs to be done to provide evidence to such claims, utilizing biofeedback via HeartMath® as well as various other forms of recreation therapy in conjunction with exercise.

In line with this thought, it is imperative to compare the results of our study with the results of additional cancer and quality of life research. Such comparisons will provide a better understanding as to the relationship of combining exercise with recreation therapy as a more comprehensive approach in the mitigation and management of cancer treatment side effects. The results of 7 of these studies, as well as very study descriptions, are presented in table 9. Of the 7 studies, 4 are of breast cancer patients, 1 is of lung cancer patients, 1 is of other cancer patients, and 1 is of diabetic patients. Moreover, 3 of the studies utilized the
same quality of life scale as our study (FACT-B) and the other 4 studies utilized other accepted quality of life scales.

To compare one study, Turner and colleagues investigated the effects of 8 weeks of combined aerobic and resistance training on quality of life in 11 breast cancer survivors. Patients completed 40-60 minutes low impact aerobics at 70-90% MHR, as well as full body resistance training for 3 days per week. They also completed the Fact-B quality of life questionnaire both before and after the intervention. Turner and colleagues found that QOL improved in these patients from pre to post test (p=.04), and that QOL had improved 9% by the end of the study (Turner, Hayes, & Reul-Hirche, 2004). However, in our study, QOL improved in the EX + RT group by 17.5% at a p value of .009, which amounts to a difference of 8.5% between the two studies. Obviously, the 2 study protocols here were different; however, both studies lasted 8 weeks and the quality of life scale utilized was the same. So to the naked eye, such a difference is quite fascinating, and it stirs interest as to the possible additional benefits that recreation therapy may have in improving overall quality of life.

Several of the other studies in table 9 offer similar comparisons, including Cheema and Gaul (2006), and Courneya et al. (2003). In Courneya et al. (2007), and Jones et al. (2008) patients other than breast cancer patients were recruited for participation but the results were still similar. In fact, with the exception of the Milne et al. (2008) study, the EX + RT group in our study exhibited greater percent changes in quality of life than any group listed in the exercise based studies in table 9.

In the Milne et al. (2008) study, an immediate exercise group (IEG) received 12 weeks of combined aerobic and resistance training (wk 1-12), while a delayed exercise group (DEG) received 12 weeks of training after week 12 (wks 12-24). The study results included
midpoint measures at week 6 of each group’s intervention. At week 6 of the IEG intervention, the percent change in quality of life was slightly less than the percent change in quality of life of the EX + RT group in our study (14% vs. 17.5%). However at week 6 of the DEG intervention, the percent change in this group’s quality of life was much higher than that found in our study’s EX + RT group (31% vs. 17.5%). To explain this, it might have been possible that the DEG decreased in QOL while having to wait to receive exercise therapy and then rebounded with large improvements in QOL after beginning the intervention. Milne and coworkers stated that the large improvements in QOL could have been related to the initial lower QOL scores of the participants, or the fact that most participants were on hormone therapy at the time of the trail (Milne et al., 2008).

As for the McCraty et al. (2000) study, which was the only non exercise based study in table 9, the 32.3 % increase in quality of life measured from pre to post test provides further support for the beneficial effects of recreation therapy (McCraty et al., 2000). However, this study did not include cancer patients as subjects, and so the results are not necessarily applicable. Few studies examining the relationship between recreation therapy and quality of life are available, but the results from the McCraty et al. (2000) study could still help explain why the percent change in QOL in the EX + RT group was so large.

Overall, comparing the results of our study with other quality of life research at least suggests that the combined exercise and recreation therapy approach may be more effective in improving breast cancer patient QOL than exercise therapy alone. The reasoning behind this could be because of the beneficial effects of recreation therapy, and in this case, biofeedback therapy via HeartMath®, HR, and JWD. Some of the possible benefits of the biofeedback training that may have impacted QOL may have been improved emotional self
efficacy, increased focus, and learned stress relief techniques via controlled breathing and relaxation. Through the biofeedback therapy, patients may have learned how to shift perspectives and focus on those things in life that bring happiness, well-being, and improved quality of life. Additionally, each biofeedback program was structured around the five guiding principles (savoring leisure, authentic leisure, leisure gratification, mindful leisure, and virtuous leisure) of the Leisure and Well-Being Model (Hood & Carruthers, 2008). It is possible that the integration of exercise with more mindful living (stimulated via biofeedback training) was what drove the improved quality of life response in the EX + RT group. However, more research to confirm or reject this claim is vital, as this point cannot be determined for certain.
### Table 9. Significant Findings from Quality of Life Research

<table>
<thead>
<tr>
<th>Authors</th>
<th>Study Design</th>
<th>QOL Results (Pre &amp; Post Means, Percent Change, P Value)</th>
<th>Pre ± SD</th>
<th>Post ± SD</th>
<th>% Change</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milne et al., 2007</td>
<td>58 Breast Cancer Survivors Immediate/Delayed Exercise Group</td>
<td>IEG</td>
<td>89.7 (+13.0)</td>
<td>102.3 (+8.4) wk. 6</td>
<td>14%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>12 wk. aerobic/resistance training</td>
<td>DEG</td>
<td>82.6 (+14.3)</td>
<td>108.3 (+15.1) wk. 6</td>
<td>31%</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Turner et al., 2004</td>
<td>11 Breast Cancer Survivors 8 weeks, 3 d/wk aerobic/resistance ex.</td>
<td></td>
<td>98.1 (+17.4)</td>
<td>106.9 (+17.1)</td>
<td>9%</td>
<td>.04</td>
</tr>
<tr>
<td>Cheema and Gaul, 2006*</td>
<td>27 Breast Cancer Survivors 8 weeks, 3d/wk aerobic/resistance ex.</td>
<td></td>
<td>8.2 (+.9)</td>
<td>8.8 (+.8)</td>
<td>7.3%</td>
<td>.01</td>
</tr>
<tr>
<td>Courneya et al., 2003</td>
<td>53 Breast Cancer Survivors Ex. n = 25: control n = 28 15 weeks, 3 d/wk cycle ergometry</td>
<td></td>
<td>110.5 (+19.0)</td>
<td>119.6 (+16.9)</td>
<td>8.2%</td>
<td>none</td>
</tr>
<tr>
<td>Courneya et al., 2007**</td>
<td>242 Cancer Patients (during treatment) Aerobic ex. group vs. Resistance group Exercise during treatment (avg. 17 wk)</td>
<td></td>
<td>AT 135.7 (+29.0)</td>
<td>144.7 (+25.2)</td>
<td>6.6%</td>
<td>.345</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RT</td>
<td>132.2 (+23.5)</td>
<td>140.0 (+24.8)</td>
<td>6.6%</td>
<td>.345</td>
</tr>
<tr>
<td>Jones et al., 2008***</td>
<td>20 Lung Cancer Patients 14 weeks, 3 d/wk cycle ergometry</td>
<td></td>
<td>98 (+16)</td>
<td>108 (+14)</td>
<td>10.2%</td>
<td>.07</td>
</tr>
<tr>
<td>McCratty et al., 2000****</td>
<td>22 Diabetic Patients 2 days of HeartMath® training 6 months additional home based training</td>
<td></td>
<td>2.20 (+1.85)</td>
<td>2.91 (+1.44)</td>
<td>32.3%</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

* - World Health Organization Quality of Life Assessment Scale – Abbreviated Version used for the study
** - FACT – A (Anemia) Scale used for the Study
*** - FACT – L (Lung) Scale used for the Study
**** - Quality of Life Inventory used for the study
All other studies used FACT – B (Breast) Quality of Life scale
IEG = Immediate Exercise Group  DEG = Delayed Exercise Group  AT = Aerobic Training  RT = Resistance Training
Recommendations for future Research

The results of this study advocate that further research be conducted in the area of cancer treatment side effect management. There is still much to learn about the relationship of exercise and recreation therapy with regards to how these therapies can work together to mitigate the physiological and psychological detriments of treatment. Our study at least provides preliminary support that a combination of such therapies may provide a more comprehensive approach in mitigating the negative side effects of breast cancer treatment; however, this cannot yet be confirmed. Future research should begin by comparing more treatment groups in order to get a better picture of how exercise and recreation therapy can affect such parameters as aerobic endurance, fatigue, and quality of life. For example, our study only compared two groups (EX vs. EX +RT). An even better comparison would examine a recreation therapy only group, as well as a non treatment control group, in addition to the exercise only and exercise/recreation therapy groups. Having a control group would allow researchers to better manage any confounding variables that could affect the study results. Researchers could also investigate more specific subpopulations of cancer treatment. For instance, how would exercise and/or recreation therapy affect patients who had surgery as their only form of cancer treatment? What about those who had surgery and chemotherapy, surgery and radiation, or a combination of surgery, radiation, chemotherapy, and hormone therapy? Examining specific groups and treatments may provide information not only about what is the best form of post treatment therapy, but what therapy is best for each patient, given their cancer treatment history.

An added point for future research is to compare the effects of other forms of recreation therapy than biofeedback in the management of cancer treatment side effects.
Additional therapies such as music therapy, adventure therapy, journaling, and humor therapy could be used individually opposed to exercise or together in comparison with exercise. One important consideration though, is to ensure that all participants complete the same amount of recreation therapy. This problem could be solved by ensuring that all patients included in the data analysis complete a predetermined percentage of recreation therapy sessions. This way, those who regularly miss sessions will not be included in the analysis. Studies should also attempt to increase sample sizes if possible, to increase the power of all analyses, and increase the likelihood of reaching statistical significance. In our study, the number of patients was quite small (n=14), and this could have contributed to 2 out of 3 hypotheses being rejected. Research should also continually work to standardize effective recreation therapy interventions, as well as exercise intervention protocols, as there are currently no definitive standards for either intervention for cancer patients. Eventually standardizing the interventions will provide empirical evidence to the medical community and will better allow oncologists to suggest effective post cancer treatment recovery activities.

Finally, future research should attempt to explore different methodological assessment procedures. For example, is it better to test VO$_{2\text{max}}$ via a submaximal protocol like the one used in our study, (modified Bruce protocol) or would a maximal protocol like that used in Jones et al. (2008) (VO$_{2\text{peak}}$) be better? The submaximal protocol was chosen in our study because it was believed to be a safer way of assessing aerobic endurance in this population, as cancer patients are often fatigued and because their energy levels can vary from one day to the next. However, recent research has shown that a VO$_{2\text{peak}}$ test that is conducted safely and effectively could result in a more accurate exercise prescription (Jones
et al., 2008). Additionally, since biofeedback training has been associated with improvements in heart rate variability and heart rate coherence (which in themselves have been linked to improved cardiovascular physiology), it would be interesting to include these two variables in future research (McCraty, 2002). It would be interesting to see if there is a link between heart rate variability, heart rate coherence, and VO$_{2\text{max}}$ within this population. Also, what if other quality of life or fatigue assessments were used for the psychological assessments? For instance would QOL assessments (other than FACT-B) that focus more on the psychological impacts of treatment and therapy be more effective? How about different fatigue assessments? These questions could certainly be addressed in future research.

**Conclusion**

Breast cancer patients often suffer a plethora of debilitating physiological and psychological side effects as a result of cancer and cancer treatment. Fortunately, exercise and more recently, recreation therapy have been utilized in the mitigation and management of these detrimental side effects. This study investigated the possibility that a combination of exercise and recreation therapy via biofeedback training, would be more effective than exercise alone in reducing fatigue, and improving VO$_{2\text{max}}$ and quality of life in post treated breast cancer patients. The results of the study indicate that the combined exercise and recreation therapy approach may be more effective than exercise alone in improving patient quality of life, but not fatigue and VO$_{2\text{max}}$. Several methodological limitations, including a small sample size, study duration, and a lack of full completion of recreation therapy sessions, may have confounded the study results, implicating a need for future research. At the very least, the potential benefits of recreation therapy in conjunction with exercise, in improving breast cancer patient quality of life, are supported.
APPENDIX A

Revised Piper Fatigue Scale
Revised Piper Fatigue Scale

Directions: For each of the following questions, circle the number that best describes the fatigue you are experiencing now. Please make every effort to answer each question to the best of your ability. Thank you very much.

1. How long have you been feeling fatigued? (check one response only)
   a. Minutes ______
   b. Hours ______
   c. Days ______
   d. Weeks ______
   e. Months ______
   f. Other (please describe): ____________________________

2. To what degree is the fatigue you are feeling now causing you distress?
   No distress             A great deal of distress
   0  1  2  3  4  5  6  7  8  9  10

3. To what degree is the fatigue you are feeling now interfering with your ability to complete work or school activities?
   None          A great deal
   0  1  2  3  4  5  6  7  8  9  10

4. To what degree is the fatigue you are feeling now interfering with your ability to visit or socialize with your friends?
   None          A great deal
   0  1  2  3  4  5  6  7  8  9  10

5. To what degree is the fatigue you are feeling now interfering with your ability to engage in sexual activity?
   None          A great deal
   0  1  2  3  4  5  6  7  8  9  10

6. Overall how much is the fatigue, which you are experiencing now, interfering with your ability to engage in the kind of activities you enjoy doing?
   None          A great deal
   0  1  2  3  4  5  6  7  8  9  10

7. How would you describe the degree of intensity or severity of the fatigue which you are experiencing now?
   Mild          Severe
   0  1  2  3  4  5  6  7  8  9  10

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To what degree would you describe the fatigue which you are experiencing now as being:

<table>
<thead>
<tr>
<th></th>
<th>Pleasant</th>
<th></th>
<th>Unpleasant</th>
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<tbody>
<tr>
<td>8.</td>
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<td>9 10</td>
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<tr>
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<th>Agreeable</th>
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<th>Disagreeable</th>
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<th>Destructive</th>
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<th>Negative</th>
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<th>Abnormal</th>
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<th>Weak</th>
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</thead>
<tbody>
<tr>
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<td>9 10</td>
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<table>
<thead>
<tr>
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<th>Awake</th>
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<tbody>
<tr>
<td>14.</td>
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<tr>
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<th>Refreshed</th>
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<th>Tired</th>
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<tbody>
<tr>
<td>16.</td>
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<td>9 10</td>
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<table>
<thead>
<tr>
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<th>Energetic</th>
<th></th>
<th>Unenergetic</th>
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</thead>
<tbody>
<tr>
<td>17.</td>
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<td>9 10</td>
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<table>
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<tbody>
<tr>
<td>18.</td>
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<td>9 10</td>
<td></td>
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<table>
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<th>Relaxed</th>
<th></th>
<th>Tense</th>
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</thead>
<tbody>
<tr>
<td>19.</td>
<td>0 1 2 3 4 5 6 7 8</td>
<td>9 10</td>
<td></td>
</tr>
</tbody>
</table>
20. To what degree are you now feeling:
   Exhilarated
   0  1  2  3  4  5  6  7  8  9  10

21. To what degree are you now feeling:
   Able to concentrate
   0  1  2  3  4  5  6  7  8  9  10

22. To what degree are you now feeling:
   Able to remember
   0  1  2  3  4  5  6  7  8  9  10

23. To what degree are you now feeling:
   Unable to concentrate
   0  1  2  3  4  5  6  7  8  9  10

24. Overall, what do you believe is most directly contributing to or causing your fatigue?

25. Overall, the best thing you have found to relieve your fatigue is:_____________________

26. Is there anything else you would like to add that would describe your fatigue better to us?

27. Are you experiencing any other symptoms right now?
   No
   Yes Please describe:_____________________

---
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Revised Piper Fatigue Scale Calculations

Calculate each section separately. The answer should be between 0 and 10.
Add each of the total numbers and divide by 22 to get overall score of 0 to 10.

Missing Data
Follow this procedure if patient answered at least 75%-80% of the questions in each section.
1. add the values of the questions answered in that section
2. divide by the number of questions answered in that section
3. substitute that number for the missing number
4. calculate total score for that section by using the substituted number

Example:
#5 is commonly not answered

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<th>Behavioral/Severity</th>
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<tbody>
<tr>
<td>#2 - distress</td>
<td>6</td>
</tr>
<tr>
<td>#3 - work/school</td>
<td>5</td>
</tr>
<tr>
<td>#4 - socialize</td>
<td>7</td>
</tr>
<tr>
<td>#5 - sex</td>
<td></td>
</tr>
<tr>
<td>#6 - activities</td>
<td>8</td>
</tr>
<tr>
<td>#7 - severity</td>
<td>5</td>
</tr>
</tbody>
</table>

Total \( \frac{31}{6} = 5 \) Substitute 6.2 for #5

<table>
<thead>
<tr>
<th>Behavioral/Severity</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td>#2 - distress</td>
<td>6</td>
</tr>
<tr>
<td>#3 - work/school</td>
<td>5</td>
</tr>
<tr>
<td>#4 - socialize</td>
<td>7</td>
</tr>
<tr>
<td>#5 - sex</td>
<td>6.2</td>
</tr>
<tr>
<td>#6 - activities</td>
<td>8</td>
</tr>
<tr>
<td>#7 - severity</td>
<td>5</td>
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</table>

Total \( \frac{37.2}{6} = 6.2 \)
### Revised Piper Fatigue Scale Calculations

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<tr>
<th>Date:</th>
<th>Date:</th>
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<td><strong>Behavioral/Severity Score</strong></td>
<td><strong>Behavioral/Severity Score</strong></td>
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<tr>
<td>#2 - distress</td>
<td>#2 - distress</td>
<td>#2 - distress</td>
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<td>#3 - work/school</td>
<td>#3 - work/school</td>
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<td>#6 - activities</td>
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<td>#7 - severity</td>
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<td>Total + 6 =</td>
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<td>Total + 6 =</td>
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</tr>
<tr>
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<td>#20 - exhill/depr</td>
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<td>#21 - concentr/not</td>
<td>#21 - concentr/not</td>
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<td>#22 - memory/not</td>
<td>#22 - memory/not</td>
<td>#22 - memory/not</td>
</tr>
<tr>
<td>#23 - think/not</td>
<td>#23 - think/not</td>
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<tr>
<td>Total + 6 =</td>
<td>Total + 6 =</td>
<td>Total + 6 =</td>
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</tbody>
</table>

**Total Score + 22 =** **Total Score + 22 =** **Total Score + 22 =**
APPENDIX B

Functional Assessment Cancer Treatment -Breast
FACT-B (version 2)

Below is a list of statements that other people with your illness have said are important. By filling in one circle per line, please indicate how true each statement has been for you during the past 7 days.

During the past 7 days:

PHYSICAL WELL-BEING

1. I have a lack of energy.........................................................
2. I have nausea...........................................................................
3. I have trouble meeting the needs of my family....................... 
4. I have pain.............................................................................
5. I am bothered by side effects of treatment............................
6. In general, I feel sick............................................................... 
7. I am forced to spend time in bed...........................................
8. How much does your PHYSICAL WELL-BEING affect your quality of life?
   Not at all ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) Very much so

During the past 7 days:

SOCIAL/FAMILY WELL-BEING

9. I feel distant from my friends...................................................
10. I get emotional support from my family..................................
11. I get support from my friends and neighbors........................
12. My family has accepted my illness........................................ 
13. Family communication about my illness is poor.....................

   If you have a spouse/partner, or are sexually active, please answer #4-15. Otherwise, go to #16.
14. I feel close to my partner (or main support).........................
15. I am satisfied with my sex life..............................................
16. How much does your SOCIAL/FAMILY WELL-BEING affect your quality of life?
   Not at all ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) Very much so

During the past 7 days:

RELATIONSHIP WITH DOCTOR

17. I have confidence in my doctor(s)...........................................
18. My doctor is available to answer my questions......................
19. How much does your RELATIONSHIP WITH THE DOCTOR affect your quality of life?
   Not at all ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) Very much so

Please turn to the next page.
FACT-B (version 2)

During the past 7 days:

**EMOTIONAL WELL-BEING**

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all</th>
<th>a little bit</th>
<th>some what</th>
<th>quite a bit</th>
<th>very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>20. I feel sad.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>21. I am proud of how I'm coping with my illness.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>22. I am losing hope in the fight against my illness.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>23. I feel nervous.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>24. I worry about dying.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>25. How much does your EMOTIONAL WELL-BEING affect your quality of life?</td>
<td>Not at all</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
</tr>
</tbody>
</table>

During the past 7 days:

**FUNCTIONAL WELL-BEING**

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all</th>
<th>a little bit</th>
<th>some what</th>
<th>quite a bit</th>
<th>very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>26. I am able to work (include work in home).</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>27. My work (include work in home) is fulfilling.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>28. I am able to enjoy life &quot;in the moment&quot;.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>29. I have accepted my illness.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>30. I am sleeping well.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>31. I am enjoying my usual leisure pursuits.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>32. I am content with the quality of my life right now.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>33. How much does your FUNCTIONAL WELL-BEING affect your quality of life?</td>
<td>Not at all</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
</tr>
</tbody>
</table>

During the past 7 days:

**ADDITIONAL CONCERNS**

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all</th>
<th>a little bit</th>
<th>some what</th>
<th>quite a bit</th>
<th>very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>34. I have been short of breath.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>35. I am self-conscious about the way I dress.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>36. My arms are swollen or tender.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>37. I feel sexually attractive.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>38. I have been bothered by hair loss.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>39. I worry about the risk of cancer in other family members.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>40. I worry about the effect of stress on my illness.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>41. I am bothered by a change in weight.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>42. I am able to feel like a woman.</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
<td>⑤</td>
</tr>
<tr>
<td>43. How much do these ADDITIONAL CONCERNS affect your quality of life?</td>
<td>Not at all</td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
</tr>
</tbody>
</table>

APPENDIX C

Modified Bruce Protocol
Cardio-respiratory Endurance Test

Modified Bruce Protocol: Treadmill
Sub-maximal treadmill test (Time to exhaustion at 75% predicted max)
Test termination: Subjects will be asked to walk/jog at a target sub-maximal intensity of 75% of their percentage of heart rate range (Karvonen % HRR & predicted maximal heart rate) until a RPE (Rate of Perceived Exertion) of 7 is reached on the modified Borg Scale

Karvonen Formula:
\[ \text{Target Heart Rate} = (\text{HR}_{\text{max}} - \text{HR}_{\text{rest}}) \times \text{percent intensity} + \text{HR}_{\text{rest}} \]

Where:
\( \text{HR}_{\text{max}} = 220 - \text{age of the participant} \)
\( \text{HR}_{\text{rest}} = \text{Resting heart rate}, \)
Percent Intensity = Prescribed exercise intensity

Target HR = (_______ - ________) \times 0.75 + ___________

Target HR = ___________

<table>
<thead>
<tr>
<th>Stage</th>
<th>Speed</th>
<th>Grade</th>
<th>Stage Time</th>
<th>HR</th>
<th>RPE</th>
<th>Total Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-up</td>
<td>1.7 mph</td>
<td>0%</td>
<td>3 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>1.7 mph</td>
<td>10%</td>
<td>3 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two</td>
<td>2.5 mph</td>
<td>12%</td>
<td>3 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three</td>
<td>3.4 mph</td>
<td>14%</td>
<td>3 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Four</td>
<td>4.2 mph</td>
<td>16%</td>
<td>3 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Five</td>
<td>5.0 mph</td>
<td>18%</td>
<td>3 min</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( \text{VO}_2 \) calculation formula: \( \text{VO}_2^{\text{max}} = 2.282 (\text{time in min.}) + 8.545 \)

\( \text{VO}_2^{\text{max}} = 2.282 (\text{___________}) + 8.545 \)

\( \text{VO}_2^{\text{max}} = \text{______________} \)

REFERENCES


