Université d'Ottawa • University of Ottawa

Effects of a 12-week walking program on cardiovascular fitness and quality of life in breast cancer patients receiving adjuvant chemotherapy.

By

© **Liisa Vexler**

In Partial Fulfillment of the Degree of
Master of Arts in Sports Studies

Presented to the School of Graduate Studies and Research

University of Ottawa

May 1999

Vexler, Liisa R. "Effects of a 12-week walking program on cardiovascular fitness and quality of life in breast cancer patients undergoing adjuvant chemotherapy." ***Master's thesis: University of Ottawa, School of Human Kinetics*** **1999.**

ABSTRACT

BACKGROUND. Previous studies have shown that aerobic activity such as a walking program help to maintain cardiovascular fitness, body composition, and QOL in breast cancer patients undergoing adjuvant therapy.

METHODS. Twenty women with histologically proven stage I-II breast cancer were randomized into either an experimental or control group. The patients began the program the same week that they began their chemotherapy treatments. Ten patients participated in a supervised walking program at the Ottawa Regional Cancer Centre which consisted of walking around a track for a minimum of twenty minutes three times per week, and on their own at home a minimum of two times per week, while ten patients served as served as a control group. Cardiovascular fitness, body composition, and quality of life (QOL) were compared at the time of entry into the study and 12 weeks later.

FINDINGS. The results of the present study suggest that a 12-week walking program, in this sample of stage I-II breast cancer patients undergoing adjuvant chemotherapy, does not affect QOL or body composition. Only one measure of cardiovascular fitness was affected. The findings may have been more significant if not for the fact that 50% of the usual care group became physically active.

ACKNOWLEDGEMENTS

I would like to thank Dr. Maurice Jetté for his professional advice and guidance. I also wish to extend thanks to Darren Johnson for giving his time and insight, as well as Dr. Roanne Segal for helping me to gain a better understanding of the complexities of cancer research.

As well, thank you to Drs. Michelle Fortier and Glen Kenny, the members of my thesis committee for their comments and constructive criticism.

Finally, I would like to give my thanks and my love to my family, mom, dad, and Dan, for always supporting me in any way possible.

LIST OF TABLES

TABLE OF CONTENTS

INTRODUCTION

The most recent statistics released by the National Cancer Institute of Canada predict that in 1998, breast and prostate cancer will continue to have been the most frequently diagnosed cancers in the country. One in nine women will have developed breast cancer in her lifetime. The potential years of life lost to breast cancer will have been the highest of all cancers at 99 000. In 1998, we can expect that 5100 deaths were due to breast cancer in Canada. (NCIC, 1998)

Adjuvant chemotherapy prolongs survival in primary breast cancer patients. Women with Stage I-II disease currently have options for treatment; node negative patients and node positive patients make up two large sub-groups within which many factors help to determine the selection and duration of adjuvant therapy. (Rosen et al., 1989)

Generally, systemic therapy and/or radiotherapy are available to breast cancer patients. Radiotherapy controls local disease within the breast and nearby structures while systemic therapy, which includes chemotherapy and hormonal therapy, treat systemic micrometastases.

Node negative patients have a relatively low rate of developing distant metastases. However, depending on various prognostic factors, the recurrence rate can change from less than 10% to more than 45% over a span of 20 years. (Fisher et al., 1989) For patients with node involvement, the probability of developing distant metastases may be greater than 45% at 5 years. However, this risk can be reduced by 20-30% with a

standard course of adjuvant therapy. (McGuire et al., 1990) This often results in prolonged treatment periods which extend over many months.

Furthermore, adjuvant chemotherapy often causes symptoms such as nausea, vomiting, poor appetite, and fatigue. Patients and their physicians observe a decline in the patient's functional capacity during the span of the treatment. Many women fear overexertion and are uncertain of what they are capable of doing. During this period, patients often become very inactive, and some even bedridden.

Prior to therapy, the initial exercise capacity of a patient is somewhat low. Patients are usually directed to "engage in light physical activity" during the treatment period, although no formal direction or prescription is usually given for exercise. The ensuing inactivity contributes to their debilitation through muscle atrophy, weight gain, or dimunition of range of motion and a general reduction in cardiovascular function. Fatigue is also compounded, the consequences of which may prolong the post-treatment recovery period.

At the Ottawa Regional Cancer Centre, an Oncology Rehabilitation Program has been offered to cancer patients over the past two years. The program has developed along two basic initiatives; general rehabilitation and a more site specific research avenue.

Purpose

The purpose of this study was to determine the effects of a 12- week walking program in breast cancer patients undergoing adjuvant chemotherapy, on measures of cardiorespiratory fitness and body composition.

Sub-purpose

This study also assesses the effects of the walking program on quality of life (QOL) in these patients.

Hypothesis

Breast cancer patients undergoing adjuvant chemotherapy and taking part in a 12-week walking program will maintain a greater level of fitness as measured by predicted maximal oxygen consumption (VO_2 max), number of stages completed in the modified CAFT test, heart rate and blood pressure at the completion of each stage, and grip strength through the course of their adjuvant chemotherapy as compared to those who do not take part in the walking program. These same patients will also maintain their body composition as measured by height, weight, girth, and sum of skinfolds (SOS) through the course of their adjuvant chemotherapy as compared to those patients who do not take part in the walking program.

Quality of life as measured by the SF-36, the FACT-B, and the STAI will be maintained in the supervised exercise group as compared to those patients who do not take part in the walking program.

Implications of the study

This study provides data on the value of a rehabilitation program for breast cancer patients. It provides insight into the benefits of this program on both cardiorespiratory fitness and quality of life.

Delimitations

Results obtained from this study are specific to a sample of stage I-II female breast cancer patients in the first three months of their adjuvant chemotherapy treatments. These results may not be generalized to other cancer populations undergoing an exercise program such as employed in this study, or during other cycles in the course of treatment.

Limitations

This study evaluates the effects of a 12- week walking program on fitness level in breast cancer patients undergoing adjuvant chemotherapy. Some of the subjects in the control decided to exercise on their own. However, the control subjects were questioned to this effect, and the implications of the results of this questioning are outlined in the discussion section.

Definitions

Adjuvant therapy for breast cancer patients: Treatments post-surgery to prevent micrometastases and to ensure there is no remaining localized disease. They include systemic therapy (chemotherapy or hormonal therapy) or radiotherapy, alone or very commonly in combination.

Stage I breast cancer: Patient has a tumor which is less than 2cm in its greatest dimension. There are no lymph nodes affected and no apparent metastases.

Stage II breast cancer: Patient has tumor which is 2-5 cm in its greatest dimension, or less than 2cm in its greatest dimension with affected lymph nodes.

Metastasis: Systemic spread of cancer cells.

Quality of Life: The perception by an individual or group that their needs are being satisfied and that they are not being denied opportunities to achieve happiness and fulfillment. Overall quality of life addresses not only functional abilities, but also psychological state, symptoms, side effects, social ability, somatic sensation, emotional relationship with physician, and family interaction. (WHO, 1998)

LITERATURE REVIEW

INTRODUCTION

The most recent statistics published by the National Cancer Institute of Canada predict that breast cancer will continue to be one of the two most frequently diagnosed cancers in this country in women.

Cancer is the second most common cause of death in the United States. Until 1991, the percentages of deaths due to cancer rose consistently since the 1960's when records began to be kept. This is partially due to the fact that cancer is a disease of the aging, and the population is growing older. Two thirds of cancer deaths occur after the age of 65.

Four out of ten cancer patients survive five years; the relative survival rate is fifty percent. In Canada, estimations for new cases in 1998 are currently at 129 200, and 62 700 deaths from cancer are predicted. Prostate and breast cancers will continue to be the most diagnosed cancers in men and women, respectively. More than 50% of new cancer cases can be attributed to three types of cancer; for women they are breast, colorectal and lung, and for men they are prostate, lung and colorectal. Lung cancer is the leading cause of cancer death among both women and men (NCIC, 1998).

As indicated above, the incidence of breast cancer continues to rise. Most of the increase can be seen in women over the age of 60. Mortality rates for breast cancer have declined by a small amount since 1990, essentially among women aged 59 and older. This can be attributed to improved screening and treatment methods. One in nine women will develop breast cancer at some time in her life. (NCIC, 1998) Since 1986 there has been a 1.5% annual increase in the incidence of breast cancer. However, in the same

period there has been a rapid increase in the number of women undergoing mammography which suggests a correlation between these two increases.

The mortality rate for breast cancer is 0.028% (NCIC, 1998). The five-year survival rate is 75% but with early detection the chances of surviving five years increase to 90%. However, breast cancer is the leading cause of death in adult women under 54 years of age.

This review of literature will discuss some of the established risk factors for breast cancer, exercise in the prevention and rehabilitation of breast cancer, as well as treatment for breast cancer and the side effects of chemotherapy.

RISK FACTORS

Much research has been conducted into the prevention of breast cancer. Of the established risk factors associated with this disease, age is the strongest followed by heredity. Along with these are hormone levels, hormonal therapy, and body composition. These will be reviewed along with the associated risk factors of smoking, diet, exercise, and alcohol consumption.

AGE

Age is the most important risk factor for breast cancer. At the age of 50, the risk of a woman developing a tumor in the breast is 1 in 50; at the age of 60, this ratio goes up to 1 in 24. For a female who lives to the age of 85, there is a 1 in 9 chance of developing a neoplasm.

The most plausible mechanism to explain the association between age and breast cancer is exposure to endogenous sex hormones, most importantly estrogen. It is logical that an older woman would have had more exposure to these hormones than a younger one since she has been alive longer and more time has passed since menarche.

HEREDITY

A family history of breast cancer in first degree relatives is the most important risk factor for the disease aside from age accounting for 5-10% of breast cancer cases (Skolnick et al., 1997); if a woman's mother and sister have been treated for the disease the risk can be as high as 1 in 2. This family linked breast cancer usually occurs at a young age.

In the past two decades, molecular studies have investigated the complexity of the genetic alterations that occur in breast cancer cells. Forty different genes or loci have been found to be altered in breast carcinomas. Although a high proportion of these genes appear to be mutated, their mechanisms and their role in the different stages of cancer development are still poorly understood.

BRCA1 and BRCA2 are two major determinants of the inherited predisposition of breast cancer which have been isolated. As a consequence, it is now possible to screen families with a positive history of breast carcinomas for the identification of mutations carriers. (Radice & Pierotti, 1997)

Five to ten percent of women with breast cancer carry an inherited mutation in either the BRCA1 or BRCA 2 genes. Surprisingly, whereas these mutations have been identified in a growing number of breast or breast and ovarian cancer families, few mutations have been reported in sporadic forms of breast or ovarian cancer. (Skolnick et al., 1997; Casey, 1997)

Genetic screening for breast cancer is problematic and far from straightforward. The value of this type of testing must be evaluated by the patient and the physician for each individual as many psychosocial and ethical issues are raised. Currently, the most effective form of primary prevention is prophylactic mastectomy. (Baron & Borgen, 1997) However, recently the drug Tamoxifen has been shown to be effective in preventing breast cancer occurrence. (Powles TJ, 1998)

HORMONAL FACTORS

The sex hormone estrogen has both a mitotic and proliferative effect on the ductal cells of the breast. It is for this reason that estrogen has been linked with breast cancer. It has been hypothesized that a reduction of exposure to estrogen over a woman's lifetime will reduce her risk of developing the disease.

Female sex

Females have higher risk of breast cancer than males most likely due to the previously mentioned higher levels of the hormone estrogen which is known to have a mitotic effect on the cells of the ductal epithelium in the breast.

Early menarche

Earlier menarche is a risk factor for breast cancer as this will consequently lead to greater exposure to estrogen in a woman's lifetime. A review of case-control studies suggests that for each year that menarche is delayed there is a decrease in breast cancer risk of 20%. (Moisan et al., 1990)

Late menopause

A woman will be exposed to a greater lifetime amount of estrogen with late menopause than with an earlier one, as menopause leads to estrogen deprivation. From data on this topic, it would seem that the total duration of a woman's menstrual life affects risk of the disease. (Frisch et al., 1992)

Obesity

As will be discussed in greater detail in a separate section on body composition, greater levels of obesity, particularly abdominal obesity, are associated with a higher risk of breast cancer due to higher levels of circulating estrogen. This additional estrogen is produced in adipose tissue.

Late age first pregnancy or nulliparity

The hypothesis that estrogen is related to breast cancer incidence has substantial evidence to support it. It has been shown that there is an international variation in length of menstrual cycle which is congruent with risk trends. Bernstein et al. (1991) suggest that low risk Japanese women have longer menstrual cycles than the US women who are known to be at higher risk and are therefore exposed to fewer cycles over their lifetime. Women with irregular menstrual cycles seem to be at a decreased risk as are women who had late onset of menarche. Even women who had early menarche but irregular cycles for the first few years are less likely to get the disease. Those at highest risk are those who had early onset of menarche followed by an immediate regular ovulatory menstrual cycle. The proposed mechanism to explain the association between estrogen and breast cancer is the stimulation of the development of breast cells, more specifically duct cells. Estrogen is also known to positively influence fat deposits in the hip and abdomen regions at puberty. This is a reciprocal relationship as obese individuals have a higher level of estrogen.

BODY COMPOSITION

Obesity is considered a risk factor for breast cancer. This risk stems most importantly from the conversion of estrogen in the peripheral adipose tissue. After menopause, the ovaries cease functioning. Consequently, the main source of estrogen is the conversion of 4-androsten-3, 17-dione to estrone in adipose tissue. (Bertuzzi et al., 1981, as quoted in Shephard, 1995) The circulation of estrone and estradiol in the blood is strongly associated with obesity. (Cauley et al., 1989)

Obesity is also associated with a reduction in sex hormone binding globulins, thus increasing the amount of circulating free estradiol. (Siiteri, 1987)

Women with greater visceral obesity are at higher risk as well as those who gain weight in adulthood (Shephard, 1995). A greater body mass in pre-menopausal women may be protective due to increased frequency of anovulation and reduced levels of progesterone. There is also evidence that heavier pre-menopausal women have a shortened luteal phase to their cycle and are therefore exposed to the affecting hormones for a shorter period of time.

OTHER RISK FACTORS

Hormone Replacement Therapy

Hormone replacement therapy (HRT) for menopausal women may be linked to an increased risk of breast cancer, although the literature on this subject is controversial. However, many of the known risk factors for breast cancer are estrogen dependent. In addition, it has been shown that estrogen's main action on ductal epithelium is mitotic and proliferative. (Eden, 1992)

Diet

In an attempt to link diet with breast cancer incidence, fat consumption, caffeine intake, antioxydants, and dairy products have all been studied for their role in the development of this disease.

Since the 1980's, a large number of prospective studies have been started in order to find a relationship between fat consumption and breast cancer. Willett and Hunter (1994), Welsch (1994), and Chlebowski and Grosvernor (1994) have reviewed this topic extensively. According to Willet and Hunter, those studies that have been published have shown no significant results. Relative risk was not substantially altered for the high versus low calorie adjusted fat intakes. Moreover, they found that reduction of fat below 30 percent did not reduce the risk of developing the disease. Furthermore, in no study was saturated fat associated with a higher risk of breast cancer; however, results of studies into type of fat consumed and breast cancer varied.

The Nurses' Health Study (1996) showed a protective effect of monounsaturated fat. A study by Martin-Moreno et al.(1994) confirmed this result although an Italian study by Toniolo et al. (1989) found no signicant relationship. These findings are particularly intriguing considering the low rates of breast cancer in the southern European countries where consumption of foods containing monounsaturated fats are abundant.

Caffeine intake has been linked with osteoporosis, endometriosis, and fibrocystic breast disease in addition to its association with breast cancer. The mechanism that accounts for these associations is a change in levels of endogenous hormones (androgens, estrogens) and sex hormone-binding globulin. (Ferrini & Barrett-Connor, 1996)

Antioxidants have been identified as beneficial in the fight against cancer. Torun et al. (1995) measured beta-carotene, vitamin E, vitamin C and malondialdehyde (MDA) levels in cancer patients and healthy subjects. Levels of antioxidants were significantly lower in the cases than in the controls. MDA levels were significantly higher in the cases as compared to the controls.

A protective effect related to intake of milk and risk of breast cancer has been evaluated although it is not certain whether this link is dietary or habitual. (Knekt et al., 1996)

Smoking

Smoking has been identified as a minor risk factor for breast cancer. The major studies on this topic have been conducted by Calle et al. (1994), Bennicke et al.(1995), and Scanlon et al. (1995). It would seem that those with a long history of smoking have an increased risk, and this risk increases as the number of years of smoking increases, and as the number of cigarettes consumed per day increases. Passive smoking (second-hand) also had a relative-risk ratio of greater than one.

Alcohol Intake

This topic has remained relatively unpublicized because of the uncertainty of the causal nature of the relationship between alcohol intake and breast cancer. Alcohol remains a controversial area even for prevention of heart disease due to the risk of addiction. The point at which a transition from moderate consumption to uncontrolled drinking occurs has not been identified. Studies in this area have been undertaken by Reichman, Judd, Longcope et al. (1993), Hankinson et al. (1995), Longnecker (1994), Fuchs et al. (1995), and the Netherlands Cohort Study (van den Brandt et al., 1995).

They all indicated a possible link between alcohol (consumption of more than two drinks per day) and an increased risk of developing breast cancer. The probable mechanism is the positive effect that alcohol has on endogenous estrogen levels.

Exercise

A number of studies have investigated the association between breast cancer and exercise. Although the mechanisms for association are not clear, epidemiological evidence suggests that a link does exist. See the separate section on exercise for a detailed overview of the literature.

EXERCISE

Prevention of cancer: Animal studies

The first curative and preventive association between malignancy and sport was proposed by E. Van Aaken in 1969 mainly based on a statistical investigation of long distance runners. His focus was mainly based on oxygen uptake at the expense of psychosomatic and immunological factors. (as quoted in Uhlenbruck & Order, 1991)

Several animal studies have pointed to a reduced risk of breast cancer based on an improvement in immune function with exercise. This effect is mediated by an increase in natural killer cell cytotoxicity and is not due to an increase in the number of NK cells. (Peters et al., 1994)

Uhlenbruck posed some key questions regarding immunology and exercise. He questioned whether there is a stimulation of the immune system with exercise and whether exercise creates a protection against infections and cancer.

It is known that exercise causes a release of certain cytokines including interleukin-1 and interleukin-6 as well as a general stimulation of cells important to the immune system such as macrophages. A hypothesis was developed stating that the more infections an individual has had, the less the chance that they will develop cancer. Endurance training has a similar effect on the immune system as infection. According to Uhlenbruck and Order (1991), it can be postulated that individuals who participate regularly in endurance exercise will be less susceptible to malignancies and metastases. Bases on this theory, they conducted an experiment to study the effects of treadmill training on tumor growth and metastasis in BALB/c mice. Using the experimental tumor model fibrosarcoma L-1 of BALB/c mice, differences in size, growth, and metastatic

spread have been shown depending upon type and more importantly intensity of training and upon mode of application and inoculation of tumor cells.

The results showed that the best protective effect against cancer was observed when the mice performed pre- and post-inoculation training. These effects are contemplated in relation to humans and the possibility of preventing infections and cancer.

Prevention of cancer: Human studies

Frisch et al. (1987) conducted a study examining the lower lifetime occurrence of breast cancer and cancer of the reproductive system among former college athletes. The subjects were 5398 college alumni who graduated between 1925 and 1981. They responded to a detailed questionnaire sent in December 1981. Among those who responded were 2622 former athletes and 2776 non-athletes. An athlete was defined as someone on varsity, house or intramural team that practiced at least twice a week, or anyone who trained regularly (i.e. running at least 2 miles 5 days per week). Women who were athletes in college had a significantly lower lifetime occurrence of cancers of the reproductive system and breast cancer than non-athletes. The athletes had a later age of menarche and later menopause, both factors which are associated with greater fatness. Pertinent to these results is the fact that a greater risk of breast cancer and cancer of the endometrium is associated with early menarche. (Apter et al., 1983), later menopause, and greater relative obesity (Forney et al., 1981).

The NHANES I (National Health and Nutrition Examination Study) population study (Albanes et al., 1989) first examined the relationship between self-reported physical activity and all types of cancer between 1971 and 1975. These results were followed-up

through the NHEFS (Epidemiologic Follow-Up Study) between 1982 and 1984. There were 5138 men and 7407 women between the ages of 25 and 74 who took part in the study. The subjects were asked about their non-recreational activity level and their recreational activity level. The data indicated that in relation to non-recreational physical activity level, inactive men had a relative risk ratio of 1.8 compared to active men and inactive women had a relative risk ratio of 1.4 compared to active women (for all cancers). These findings were unchanged when adjusted for cigarette smoking, body composition, body mass index, and other potential threats to internal validity.

Only 10% of subjects reported being inactive in their non-recreational activity. Conversely, more than half the women and one third of the men reported that they were recreationally inactive. Perhaps due to the consistency of non-recreational activity and the relative inconsistency of the recreational activity, the latter had little association to cancer.

Prevention of breast cancer

There are several plausible biological mechanisms to explain the association between exercise and risk of breast cancer:

- the effect of exercise on sex hormones
- the effect of exercise on body composition and energy balance
- the effect of exercise on immune function

As indicated previously, sex hormones contribute to the risk of developing breast cancer. Physical activity influences the risk of breast cancer mainly through hormone-related pathways. In women, these hormones, of which there are five main ones, control the ovulatory-menstrual cycle.

In this section, the mechanisms by which exercise might alter breast cancer risk are described. Gonadotropins are secreted by the pituitary gland. This hormone causes the secretion of follicular stimulating hormone (FSH) and leutinizing hormone (LH). FSH stimulates the growth of the follicle which induces the ovaries to manufacture and secrete estrogen. Estrogen is also secreted by the adrenal glands, and can be synthesized by androgens in adipose tissue. The three types of estrogen circulating in the body are estrone, estriol and estradiol.

As indicated earlier, there has been a great deal of evidence linking estrogen with breast cancer incidence. This association is presumably due to its role in the promotion of cell proliferation. More recently, progesterone has been connected either independently or in combination with other hormones, to this disease. This effect is most likely due to estrogen's ability to stimulate proliferation of breast cells, which may be enhanced by the presence of progesterone.

The cumulative number of ovulatory-menstrual cycles is therefore positively correlated with breast cancer incidence due to exposure to circulating estrogen and progesterone. The menstrual cycle has 3 separate phases, each associated with independent levels of circulating sex hormones. This first day of this phase is the first day of the cycle. The next phase is the follicular phase which lasts approximately two weeks. In this phase, the estrogen concentrations in the blood reach a peak. This inhibits FSH production and promotes the release of LH by the pituitary gland. The LH concentration increases at approximately the 14^{th} day of the cycle, and stimulates the release of the ovum from the follicle—ovulation. At this point, the uterine wall is prepared for implantation. The final phase is called the luteal phase. It is initiated at

ovulation and completed on the first day of menstrual flow. During this phase the follicle ruptures and becomes the corpus luteum. This secretes estrogen, and the production of progesterone is begun which in turn inhibits the production of LH. However, if the ovum has been fertilized the levels of estrogen and progesterone remain elevated to prevent the formation of new follicles. Otherwise, the corpus luteum diminishes in size and hormonal activity, as estrogen and progesterone levels decrease, and pituitary gland causes the secretion of FSH and the cycle begins again.

Physical activity is associated with changes in the production and circulation of estrogen and other sex hormones. An acute response to exercise in untrained women is an increase in the production of estradiol and progesterone, markedly in the luteal phase, and a higher rate of production of LSH during the follicular phase.

Over the long term however, exercise causes shortening of the luteal phase, and a decreased concentration of FSH both at rest and after exercise. Moreover, athletic women are prone to ammenorhea and anovulatory menstrual cycles. (Bernstein et al., 1991)

A study in Quebec by Moisan, Meyer, and Gingras (1990) suggested that girls who were engaged in strenuous physical activity were more likely to have later menarche than inactive girls. In addition, evidence suggests that athletes who began training at an early age eat less fat than those trained at a later age . (Frisch et al., 1992)

Not only does exercise reduce exposure to estrogen through reduction in cumulative number of ovulatory-menstrual cycles, it also alters body composition. Individuals who exercise are more likely to have greater amounts of lean tissue and reduced body fat. This lower amount of fat has been shown to be protective only in post-

menopausal women. Heavier pre-menopausal women have more frequent anovulatory cycles and reduced levels of progesterone so their rate of breast cell proliferation may be reduced.

As previously mentioned, post-menopausal women with lower levels of adipose tissue are in a lower risk category than their larger counterparts. At menopause, there is a cessation of function in the ovaries. Therefore, the only source of estrogen comes from the conversion of androgens to estrogen in adipose tissue. Consequently, it would follow that the less adipose tissue available for this reaction, the less circulating estrogen. (Forney et al., 1981)

In both pre- and post-menopausal women, obesity is associated with a reduction in sex hormone binding globulins. This reduction in globulins required to remove estrogen from the blood leaves an increased amount of circulating free estradiol. (Siiteri, 1987) Since no clear, specific association exists between exercise and the risk of breast cancer, speculation has led researchers to believe that it may be the lifestyle of the exerciser as a whole. In other words, a combination of factors that are reducing the individual's risk. Exercise is conducive to a healthy lifestyle, and a healthy lifestyle is conducive to exercise (and a reduced risk of breast cancer).

A cohort of 4,706 women who were former US college students were assessed for breast cancer incidence and mortality. The definition of physical activity for this group was sports play during college. The risk ratio was 0.96 (p value = 0.92) for greater than or equal to 5 hours per week relative to less than 5 hours per week of sports play. (Paffenbarger et al., 1987)

A retrospective follow-up study of 924 physical education teachers and 3239 language teachers was conducted to examine the relationship between life-long physical activity and risk of breast cancer. (Vihko et al., 1992) The Finnish Cancer Registry found 128 cases of malignant breast cancer among these women. The standardized incidence ratio for the physical education teachers was 1.28 and it was 1.59 for the language teachers. Interestingly, this ratio before menopause was 0.93 for physical education teachers and 1.51 for language teachers.

Bernstein et al. (1994) examined the relationship between physical exercise and reduced risk of breast cancer in young women. The study attempted to determine whether regular physical exercise during the reproductive years reduced the risk of developing the disease. It was based on epidemiological evidence indicating that the cumulative number of ovulatory menstrual cycles and the accompanying cumulative exposure to ovarian hormones, are risk factors for breast cancer. This case-control study was conducted through interviews with 545 newly diagnosed women with breast cancer and 545 control subjects who were individually matched based on date of birth, race, parity, and neighborhood of residence. On average, women who spent 3.8 hours or more in physical exercise each week had an odds ratio of 0.42 relative to inactive women. The results indicated that the number of hours per week of physical activity from menarche to one year prior to diagnosis was a significant indicator of reduced risk of breast cancer.

Dorgan et al. (1994) evaluated physical activity and the risk of breast cancer in the Framingham Heart Study cohort of 2,307 women aged 35-68 years. In this group, there were 117 incidences of breast cancer. Based on a physical activity index, those in the low activity quartile relative to those in the high activity quartile had a relative risk ratio of 1.6.

A matched case-control study of 902 Australian women between the ages of 20 and 74 investigated the relationship between recreational physical activity and incidence of breast cancer. Expenditure of greater than 4,000 kcal / week relative to none had a relative risk ratio of 0.73. (Friedenreich & Rohan, 1995)

Mittendorf et al. (1995) studied 6,888 cases and 9,539 controls among women aged 17-74 years. The relationship between strenuous physical activity in young adulthood (14-22 years) and incidence of breast cancer was evaluated. The relative risk ratio was 0.5 for those who were involved in daily strenuous physical activity relative to no physical activity.

A smaller case-control study involving 617 cases and 531 controls looked at the association between leisure-time physical activity in young adulthood (15-22 years) and breast cancer incidence. Expenditure of greater than 1.750 kcal/week relative to none elicited a relative risk ratio of 1.1. (Taioli et al., 1995)

A cohort of 25,624 women ages 20 to 54 years at entry into the study, were followed for a median of 13.7 years. In this group, 351 cases of breast cancer were identified. Greater leisure-time activity was associated with a reduced risk of breast cancer with a relative risk of 0.63 for the regular exercisers relative to their sedentary counterparts. The reduction in risk among women who exercised regularly was greater in

pre-menopausal women than post-menopausal women, and greater in younger women (uner 45 years) than in older women (45 years or older). The risk was lowest in lean women (BMI < 22.8) who exercised at least 4 hours per week (relative risk = 0.28). (Thune et al., 1997)

The epidemiologic studies of physical activity and breast cancer risk have yielded inconsistent results. Two of the above cited studies reported significant inverse associations (Bernstein et al., 1994; Mittendorf et al., 1995), two reported an inverse association that was not statistically significant (Frisch et al., 1987; Friedenreich & Rohan, 1995), and three reported no relationship (Paffenbarger et al., 1987; Albanes et al., 1989; Taioli et al., 1995). One reported a direct relationship that was not statistically significant (Dorgan et al., 1994).

Nonetheless, there is a possibility that physical activity during adolescence and young adulthood may be protective against later development of this disease. Five of the studies described above examined this possibility. Two found significantly reduced risk (Bernstein et al., 1994; Mittendorf et al, 1995), one found a nonsignificant reduction in risk (Frisch et al., 1985) and two found no association (Paffenbarger et al, 1987; Taioli et al., 1995). (U.S. Department of Health and Human Services, 1996)

Rehabilitation of breast cancer patients

Limited research has been conducted into the use of exercise in the rehabilitation of cancer patients. A known effect of cancer is fatigue due to increased metabolism of the tumor. This, in combination with depression and often a poor appetite, leads to a loss of lean tissue, weakness, and therefore a lack of physical activity. This becomes a vicious circle as the absence of exercise leads to more loss of muscle and an associated

increase in feelings of weakness. In addition to the primary effects of malignancy, there are the side-effects of treatment. Surgery, chemotherapy, radiotherapy, and hormonal therapy can cause cytotoxicity, prolonged bleeding, suppression of immune function, increased susceptibility to infection, and profound general fatigue.

Friedenreich and Courneya (1996) performed a literature review to assess exercise as rehabilitation for cancer patients. Of the 11 studies they discovered on the topic, it was established that all were conducted on breast cancer patients. It was found that the exercise improved the psychological and physiological (functional capacity & body composition variables) well-being of patients with cancer. These studies had some common limitations. They all used convenience rather than random samples. None of the studies assessed physiological or psychological well-being after cessation of the intervention program, nor did they have a placebo group that devoted the same frequency and duration to an intervention. As well, the intervention programs were generally of short duration and limited to the same types (walking and cycling), time (20-30 minutes), frequency (3 times per week), and intensity (60-85% of maximum heart rate). Finally, no information is available as to the feasibility of recruiting cancer patients into exercise programs, and their adherence and compliance to the programs.

Winningham (1983) used a quasi-experimental design to examine the effect of a cycle ergometer program on functional capacity and feelings of control in women with breast cancer. This study was iimited to patients with stage II disease. The sample was small with 4 subjects in the exercise group, 4 healthy subjects, and 4 controls. The intervention lasted 10-12 weeks. She found that the functional capacity for the exercise group was increased by 24% and that their feelings of control were increased by 14%.

Oddly enough, the control group had a 4% increase in functional capacity probably due to a pre-test practice effect. The control group did however experience a 4% decrease in feelings of control.

MacVicar and Winningham (1985) performed a similar study examining the effects of exercise on promotion of functional capacity in cancer patients. The intervention was essentially the same as the above described study. The symptom-limited graded exercise test (SLGXT) was used to assess functional capacity and the profile of mood states (POMS) was used to assess total mood disturbance. Again, a relatively small sample of subjects was used with 6 in the exercise group, 6 healthy subjects, and 4 controls. It was found that the exercise group increased functional capacity by 21% and the controls decreased in functional capacity by 2%. Both the exercise group and the healthy subjects experienced a reduction in total mood disturbance while the controls experienced an increase.

Winningham and MacVicar (1988) conducted a study with a similar intervention on a sample of women with stage II-IV breast cancer. There were 16 in the exercise group, 14 in a placebo group, and 12 controls. This was a randomized control trial stratified by age and functional capacity. The subjects were evaluated for frequency of nausea and symptoms using a symptom check-list. Interestingly, the exercisers had increased symptoms as compared to the placebo group and the controls. They did, however, experience less frequency of nausea than their counterparts in the other 2 groups.

MacVicar, Winningham & Nickel (1989) conducted a study again using the same intervention. The sample included 18 patients with stage II breast cancer, 11 patients in a

placebo group and 16 controls. As above, this was a randomized control trial stratified solely by functional capacity. The subjects were assessed by means of the SLGXT. The functional capacity of the exercise group increased by 40% which was significantly greater than both the placebo and control groups.

Winningham et al. (1989), using the same intervention protocol, examined the effect of exercise on body weight and body composition in stage II breast cancer patients. It was found that the body weight of both the controls and the exercise group went up. The percentage of body fat decreased in the exercise group and increased in the control group. However, the amount of lean tissue increased in the exercise group, accounting for the increase in body weight (lean tissue decreased in the controls).

Nelson (1991) performed a retrospective case-control study involving 54 patients with stage I breast cancer among whom 40 were exercisers and 14 were not, and 54 controls among whom 46 were exercisers and 8 were not. The instrument of measure was the Health Promoting Lifestyle Profile, a self-administered questionnaire. It was found that the correlation coefficient between self-esteem and exercise was $r=0.34$. There was no significant difference between the perceived health of the cases and the controls.

Mock et al. (1994) undertook a randomized controlled trial to evaluate the effect of a walking program on quality of life and functional capacity. The subjects had stage I-II breast cancer. The exercise group consisted of 9 subjects and there were 5 in the control group. The intervention lasted 4-6 months and involved walking for 10-45 minutes at the patient's own intensity. This was performed 4-5 times per week. It was found that the Karnofsky performance status, was not different between the control group

and the exercise group. The Cooper 12-minute walking test showed that the aerobic fitness of the exercisers was increased and it was greater than in the controls at the time of the post-test. Interestingly, at mid-test the controls scored higher on the psychosocial adjustment to illness scale than the exercisers. At that same point, the controls had less symptoms than the exercisers based on a brief symptom inventory that was completed. Self-concept was not different between groups. Using the Body-Image visual analogue scale, it was determined that there was a decrease in scores for the controls. At mid-test and at post-test, the controls had more symptoms of fatigue, nausea, depression, and sleep problems than the exercise group as measured by Symptom assessment scales.

In their review of exercise as rehabilitation for cancer patients, Friedenreich and Courneya (1996) make recommendations on different aspects of research that may be undertaken in the future. They suggest selecting a larger sample from a defined population to avoid selection bias. Valid placebo groups are recommended in order to separate exercise effects from placebo effects such as attention, involvement, and expectation. One possibility for this might be using what the authors call "minimal exercise" for the placebo group. In addition, a related study might compare exercise with other quality-of-life interventions such as relaxation and psychotherapy which have also been shown to be helpful for cancer patients.

The American College of Sports Medicine has suggested that 15 to 20 weeks is the minimum amount of time needed for realization of fitness improvements in healthy patients. All except two of the exercise interventions reviewed were 12 weeks or less. Therefore, longer interventions might provide stronger data. Furthermore, examination of the timing of the interventions with respect to treatments should be done in order to

assess when the optimal time to begin an exercise program might be. The college also recommends considering other modes, intensities, durations, and frequencies for the intervention to determine at what level quality-of-life benefits might be achieved. Aerobic and non-aerobic activities should be examined. (American College of Sports Medicine, 1990)

It would be favorable to assess other components of health related fitness in addition to body composition and functional capacity. Balance, power, muscular strength and endurance, and flexibility are all important factors in activities of daily living. It would also be interesting to evaluate whether physiologic changes are necessary to reap the psychological benefits of exercise, or whether these psychological changes can occur independent of physiology.

Lastly, Friedenreich and Courneya (1996) recommend research into recruitment, compliance, and adherence to exercise programs. The determinants of these factors including demographic, social, and cognitive characteristics of study subjects; stage of disease; modality of treatment; and mode, frequency, intensity, and duration of the exercise program.

Many independent studies have indicated a stimulating influence of exercise on the immune system and psychological behavior. It is also well established that there is a direct link between psychological behavior and the immune system, as psychological behavior may be immunosuppressive. This effect can be shown by, among other things, decreased activity in natural killer cells. Since exercise has been known to reduce anxiety and depression, indirectly it may be affecting the cellular immune functions.

In order to assess the influence of moderate exercise training on NK cytotoxicity

and personality traits, Peters et al. (1994) designed a study in which a moderate exercise training program, performed 2-3 times per week for 7 months, was given to 24 women with breast cancer. The amount and activity of natural killer cells were analyzed under resting conditions at the beginning, after 5 weeks, and at the end of the study. Personality traits were measured with the FPI-R questionnaire at the same times.

It was found that the amounts of natural killer cells remained the same, but their cytotoxic activity was increased by the end of the study. The cytotoxic activity increased from 18.9% lysis to 28.9% lysis at 5 weeks, to 28.3 at the end, a marked significant increase. In addition, the discomfort of the patients decreased, and after 5 weeks satisfaction of life was improved. At the end of the study, a strict connection of this betterment with frequency of exercise was observed ($r=0.64$). These results are consistent with the hypothesis; moderate exercise, even in cancer patients, has a stimulating effect on the natural killer cell activity. This outcome is also in agreement with that found by Uhlenbruck and Order (1991) which is discussed in the section on exercise in the prevention of breast cancer.

The results of the above studies were not supported by Nieman et al. (1995). They randomly assigned 16 women with diagnosed breast cancer to exercise and non-exercise groups for 8 weeks. The intervention consisted of 60 minutes of weight training and aerobic exercise 3 times per week. The subjects were tested for strength, aerobic performance, lymphocyte subsets, and natural killer cell cytotoxic activity (NKCA).

The results indicated a slight increase in strength and aerobic capacity in the exercise group. However, the NKCA remained unchanged, as did the concentrations of

circulating NK and T cells. The size of the sample and the length of the intervention may be reasons for the discrepancy in the outcome of this study to that of Peters et al. (1994).

Reduced rates of metabolism and decreased physical activity in breast cancer patients receiving adjuvant chemotherapy were investigated by Demark-Wahnefried et al. (1997). Resting metabolic rate, diet-induced thermogenisis, energy intake, physical activity, and body composition were assessed before the initiation and throughout the course of adjuvant chemotherapy in 20 premenopausal patients with stage I-II breast cancer. Complete data on 18 subjects suggested that resting metabolic rate decreased significantly from baseline to midtreatment and rebounded to levels similar to those at baseline on completion of chemotherapy. In addition, levels of physical activity and energy intake decreased during treatment compared with baseline levels.

One more recent randomized study undertaken by Mock et al. (1997) found that those women participating in a walking program during radiation therapy scored significantly higher on physical functioning than the usual care group, as well as symptom intensity. The walking program consisted of an individualized, self-paced program performed at home throughout treatment. The most frequently and intensely reported symptom was fatigue.

Schwarz (1998) examined patterns of exercise and fatigue in physically active cancer survivors by way of a cross-sectional, descriptive survey. Using a sample of 219 men and women responded to a call for subjects in 4 sports magazines. They completed an investigator-developed, mailed survey. The author found that the majority of the respondents were physically active before diagnosis and continued to exercise during their treatments with modifications in their activity level. Cancer-related fatigue was

experienced by 69% of the patients during treatment, with 52% describing this fatigue as affecting their whole body. Although 26% of the study participants felt most fatigued before exercise, exercise and rest were the most commonly used strategies for managing their symptoms. The investigator concluded that although the majority of respondents reported decreasing their activity level during treatment, the belief among them was that regular exercise would make them less likely to have health problems. These respondents used exercise both as an intervention to reduce cancer-related fatigue, and as a means to have more energy.

Special Considerations for breast cancer patients

There are many factors that must be taken into account when prescribing an exercise program for a cancer patient. The psychological status of the patient must be considered as well as their altered physical/medical condition.

Exercise appears to increase the quality of life of a patient with breast cancer. Through its mood-elevating effect, it can stimulate the appetite, encourage the maintenance of lean tissue, slow the clinical course of the disease, and eventually set back the age at death. (Pearson, 1978 as quoted in Shephard, 1993)
Physiologic considerations must be taken into account when exercising a cancer patient. Possible electrolyte imbalances, dehydration, and an increased risk of bone fractures must be taken into account. If any bone metastases are suspected or diagnosed, it is important to prescribe non-weight bearing forms of exercise. Anemia or low platelet counts presented together should also be grounds for caution.

If a weight training program is to be given, it is important to consider the fact that balance may be poor, bruising will probably occur easily, and there is a possibility of pathological fractures. As a result, it is preferable to construct a program around exercise machines rather than free weights as they offer greater stability.

When working with a cancer patient, an adaptable attitude should be kept with regard to completion of the prescription, as on any given day, the exercise tolerance of the patient may be reduced as a result of secondary effects from the disease or its treatment. These may include nausea and fatigue following chemotherapy, dehydration, muscle weakness and cramping, or even possibly the presence of intravenous tubes. (American College of Sports Medicine, 1991)

QUALITY OF LIFE

Several well-validated quality of life (QOL) instruments have been developed over the last ten years. They can be divided into two main groups-- general and disease-specific measures. (Jensen et al., 1995) During all stages of cancer treatment, QOL is an important outcome to measure. The patients' perception of their own health as interventions and treatments impact it, is an increasingly important outcome in health care.

QUALITY OF LIFE & BREAST CANCER

Hughes (1993) examined breast cancer patients' psychological and functional status at the time of diagnosis and during the initial phase of treatment. They studied a population of newly diagnosed Stage I-II patients undergoing either modified radical mastectomy of lumpectomy with radiation. Subjects completed instruments designed to measure uncertainty, QOL, functional status, and reaction to diagnosis on two separate

occasions: At the time of diagnosis but before treatment selection and then approximately eight weeks after surgery. Data indicated that patients' perceptual uncertainty, and various aspects of their functional status declined over the initial course of treatment.

QOL assessments were obtained every three months for two years from patients receiving adjuvant therapy on two International Breast Cancer Study Trials. The QOL measures assessed included patient derived perceived coping, well-being, mood, physical well-being and appetite. The analysis for 265 patients indicated that all measures improved as time increased from entry into the study. The data also indicated that QOL measures were affected by differences in types of treatment. (Hurny et al., 1992)

Ozyilkan et al. (1998) examined the impact of diagnosis and treatment on the quality of life in breast cancer patients. Sixteen women with breast cancer (during chemotherapy and 4 months after adjuvant chemotherapy) and 15 healthy women controls participated in this study which employed a 42-item QOL questionnaire. The total QOL score was not statistically different between the groups. However, general well-being, physical symptoms and activity, and sleep disturbance showed significant regression in breast cancer patients compared to the controls. Appetite and physical symptoms and activity significantly improved in the group after chemotherapy compared to the group during chemotherapy.

Tate et al. (1998) assessed QOL and life satisfaction among women with physical disabilities or breast cancer using a cross-sectional study design. Through the SF 36 questionnaire, the Functional Assessment of Cancer Therapy (FACT), the Functional Living Index-Cancer (FLIC), and the Satisfaction with Life Scale (SWLS), the investigators found that women with chronic problems (breast cancer and those post-

polio) reported poorer health status than those with traumatic conditions (amputation, spinal cord injury). Physical functioning and well-being were poorer in the group with traumatic conditions, than in the group with chronic problems. Life satisfaction for women with chronic conditions was best predicted by age, education, and spiritual well-being. The authors of this study concluded that QOL as measured by the impact of illness on an individual is best predicted by physical and functional well-being, whereas satisfaction with one's life was the best predicted by functional ability.

QUALITY OF LIFE & PHYSICAL ACTIVITY IN HEALTHY POPULATIONS AND OTHER CLINICAL POPULATIONS

The literature indicates that physical activity is a means to improve quality of life in both healthy populations as well as clinical populations. Improved mood, decreased degree of depression, increased functional capacity and improved energy levels have all been associated with physical activity in healthy populations.

Aerobic exercise as therapy for cardiac patients and those with chronic obstructive pulmonary disease as well as other clinical populations, has been used successfully as a means to improve Quality of life. In the two groups specified, improvements have been noted in psychological, functional and physiological measures with regular physical activity. (American Association of Cardiovascular and Pulmonary Rehabilitation, 1991; O'Connor et al., 1989; Oldridge et al.,1991; Pashkow, 1993)

DIAGNOSIS OF BREAST CANCER

Once the presence of an abnormality has been confirmed, the next step in the process is diagnosis. Breast biopsy is indicated if a dominant breast mass exists or there is pathologic discharge from the nipple. As the breasts are made up of glandular tissue, determining what is a dominant mass is often a challenge in itself.

Biopsy (surgery no. 1)

There are four techniques for breast biopsy: fine-needle aspiration, core-cutting needle biopsy, incisional biopsy, and excisional biopsy. Fine-needle aspiration is an office procedure which can be done without making an incision in the breast. However, it has a false-negative result rate of more than 10%. Core-cutting needle biopsy is similar to fine-needle aspiration except that a core of tissue is obtained for histologic examination, and more details about the tumor structure are available. Excisional biopsy removes the entire tumor and thus provides complete information on tumor size and characteristics. It is done as a complete lumpectomy and a margin of surrounding normal breast tissue is removed as well. If a breast mass is too large, incisional biopsy is performed. This is mostly the case in women with metastatic disease or locally advanced breast cancer.

Lumpectomy

This procedure involves the removal of the primary tumor and a variable margin of the surrounding normal breast tissue. As well, it is usually accompanied by an axillary dissection. Its purpose is to maintain local tumor control while conserving the cosmetic appearance of the breast. This surgery alternative is almost always accompanied by irradiation. In general, the larger the surgical resection, the less intensive the radiation therapy needs to be.

Modified Radical Mastectomy

Modified radical mastectomy is the standard operative procedure for treatment of patients with invasive breast cancer. This includes removal of the entire breast and some or all of the axillary lymph nodes. The pectoralis minor may be removed or transected, but is often preserved. This technique evolved from the radical mastectomy which also removed the entire breast, and the pectoralis major and minor without the axillary lymph nodes. This technique which failed to cure a large number of women was also associated with significant long-term morbidity due to limited arm range of motion and chronic lymphedema.

Modified radical mastectomy avoids both of the above problems. In addition, breast reconstruction is more easily performed after this type of procedure.

Breast Reconstruction after Mastectomy

Breast reconstruction is an option for women undergoing mastectomy. This procedure can be done at the time of mastectomy or as a secondary procedure.

STAGING

Staging occurs once the entire tumor has been removed. Patients are grouped according to the severity of their disease for the purpose of assisting the choice of treatment for individual patients, estimating prognosis, and comparing results of different treatment programs. The most widely used clinical staging system is based on "tumor-nodes-metastases" (TMN). The subjects in this study are patients with stage I-II breast cancer. The definition of these stages appear in the first chapter.

TREATMENT

As previously indicated, following surgery the cancer is staged. According to the stage of the patient's disease, a treatment strata is determined. These include adjuvant, neoadjuvant, or palliative. Within each strata, chemotherapy, radiation, or hormonal therapy may be used, either alone or in combination.

CHEMOTHERAPY

The toxicity of chemotherapeutic drugs is both acute and long-lasting. There is a risk of cardiomyopathy when these toxic agents are introduced into the body. The effects of chemotherapy are dose and drug dependent; however, there is almost always fatigue associated with this treatment. In addition, nausea, mucositis, alopecia, arthritis and myelosuppression may be experienced. Certain drugs may affect the central nervous system and/or may cause edema and/or fibrosis. (Holleb et al., 1991)

CONCLUSION

It has been estimated that only one quarter of all breast cancer diagnoses can be attributed to established risk factors. The etiology of the disease remains for the most part undiscovered, and until this information is retrieved, many risk factors will remain unidentified. Furthermore, the mechanisms by which the noted risk factors function have yet to be elucidated, and it can easily be said that the complexities of the area are extensive.

However, based on this review, it must be noted that the benefits of exercise are apparent for a reduction in breast cancer risk. Although there is no conclusive primary mechanism linking exercise and breast cancer, there are many secondary effects of physical activity that are extremely beneficial including reduction in exposure to

estrogen, reduced adiposity, the tendency towards accompanying exercise with other healthy lifestyle habits, and a reduction in psychological stress.

Studies have been done on exercise as rehabilitation for breast cancer patients. This research has shown that in specific populations of these patients, exercise may help to enhance quality of life, it may decrease some side-effects of treatment, and in some cases it may improve functional capacity.

Until now, there have been no randomized control trials involving breast cancer patients undergoing adjuvant chemotherapy. This study will attempt to assess the effects exercise has on cardiovascular fitness, body composition and quality of life in this population.

REFERENCES

1. Albanes D, Blair A & Taylor P. Physical activity and risk of cancer in the NHANES I population. *American Journal of Public Health* 1989;79:744-50.
2. American Association of Cardiovascular and Pulmonary Rehabilitation: Guidelines for Cardiac Rehabilitation Programs. Champaign, IL: Human Kinetics, 1991.
3. American College of Sports Medicine. The recommended quality and quantity of exercise for developing and maintaining cardiorespiratory and muscular fitness in healthy adults. *Med Sci Sports Exer* 1990;22:265-74.
4. Apter D & Vihko R. Early menarche, a risk factor for breast cancer, indicates early onset of ovulatory cycles. *Journal of Clinical Endocrinology &Metabolism* 1983;57(11):82-6.
5. Baron RH & Borgen PI. Genetic susceptibility for breast cancer and primary prevention options. *Oncology Nursing Forum* 1997;24(3):461-8.
6. Bennicke K, Conrad C, Sabroe S & Sorenson HT. Cigarette smoking and breast cancer. *BMJ* 1995;310(6992):1431-3.
7. Bernstein L, Pike MC, Ross RK & Henderson BE. Age at menarche and estrogen concentrations of adult women. *Cancer Causes & Control* 1991;2(4):221-5.
8. Bernstein L, Henderson BE, Hanisch R, Sullivan-Halley J & Ross RK. Physical exercise and reduced risk of breast cancer in young women. *Journal of the National Cancer Institute* 1994;86:1403-08.
9. Bertuzzi A, Daidone MG, DiFronzo G & Silvestrini R. Relationship among estrogen receptors, proliferative activity and menopausal status in breast cancer. *Breast Cancer Research and Treatment* 1981;1:253-62.

10. Calle EE, Miracle-McMahill HL, Thun MJ & Heath CW Jr. Cigarette smoking and risk of fatal breast cancer. *American Journal of Epidemiology* 1994;139(10):1001-7.

11. Casey G. The BRCA1 and BRCA2 breast cancer genes. *Curr Opin Oncol* 1997;9(1):88-93.

12. Cauley JA, Gutai JP, Kuller LH et al. The epidemiology of sex hormones in post-menopausal women. *American Journal of Epidemiology* 1989;129:1120-31.

13. Chlebowski RT & Grosvernor M. The scope of nutrition intervention trials with cancer-related endpoints. *Cancer* 1994;74(9 suppl):2734-8.

14. Demark-Wahnefried W, Hars V, Conaway MR, Havlin K, Rimer BK, McElveen G, Winer EP. Reduced rates of metabolism and decreased physical activity in breast cancer patients receiving adjuvant chemotherapy. *American Journal of Clinical Nutrition* 1997;65(5):1495-501.

15. Department of Health and Human Services. Physical activity and health: A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.

16. Dorgan JF, Brown C, Barrett M, Splansky GL, Kreger BE, D'Agostino RB, Albanes D & Schatzkin A. Physical activity and risk of breast cancer in the Framingham Heart Study. *American Journal of Epidemiology* 1994;139(7):662-9.

17. Eden J. Oestrogen & the breast: The management of the menopausal woman with breast cancer. *Medical Journal of Australia* 1992;157:247-9.

18. Ferrini RL & Barrett-Connor E. Caffeine intake and endogenous sex steroid levels in post-menopausal women. The Rancho Bernardo Study. *American Journal of Epidemiology* 1996;144(7):642-4.

19. Fisher B, Redmond C, Wickerham L, Wolmark N, Bowman D, Couture J, Dimitro NV, Margolese R, Legault-Poisson S & Robidoux A. Systemic therapy in patients with node negative breast cancer: a commentary based on two NSABP clinical trials. *Annals of Internal Medicine* 1989;111:703-712.

20. Forney JP, Milewich L, Chen GT, Garlock JL, Schwarz BC, Edman CD & MacDonald PC. Aromatization of androstenedione to estrone by human adipose tissue in vitro. Correlation with adipose tissue mass, age and endometrial neoplasia. *Journal of Clinical Endocrinology & Metabolism* 1981;53(1):192-9.

21. Friedenreich CM & Courneya KS. Exercise as rehabilitation for cancer patients. *Clinical Journal of Sport Medicine* 1996;6:237-244.

22. Friedenreich CM & Rohan TE. Physical activity and risk of breast cancer. *European Journal of Cancer Prevention* 1995;4(2):145-51.

23. Frisch Re, Gotz-Webergen AV, McArthur JW, Albright T, Witschi J, Bullen B, Birnholz J, Reed RB & Hermann H. Delayed menarche & amenorrhea of college athletes in relation to age of onset of training. *JAMA* 1981;246(14):1559-63.

24. Frisch RE, Wyshak G, Albright NL, Albright TE, Schiff I & Witsch J. Former athletes have a lower lifetime occurrence of breast cancer and cancers of the reproductive system. *Advances in Experimental Medicine & Biology* 1992;322:29-39.

25. Fuchs C, Stampfer MJ, Colditz GA, Giovannucci EL, Manson JE, Kawachi I, Hunter DJ, Hankinson SE, Hennekens CH, Rosner B, Speizer FE & Willet WC. Alcohol consumption and mortality among women. *New England Journal of Medicine* 1995;332(19):1245-50.

26. Hankinson SE, Willett WC, Manson JE, Hunter DJ, Colditz GA, Stampfer MJ, Longcope C & Sperzer FE. Alcohol, height, and adiposity in relation to estrogen and prolactin levels in postmenopausal women. *Journal of the National Cancer Institute* 1995;87:1297-1302.

27. Holleb AI, Fink DJ & Murphy GP. American Cancer Society Textbook of Clinical Oncology. American Cancer Society Inc., USA, 1991;678-88.

28. Howe GR. Dietary fat and breast cancer risks: An epidemiologic perspective. *Cancer supplement* 1994;74:1078-84.

29. Hughes KK. Psychosocial and functional status of breast cancer patients. The influence of diagnosis and treatment choice. [Review] *Cancer Nurse* 1993;16(3):222-29.

30. Hurny C, Bernhard J, Gelber RD, Coates A, Castiglione M, Isley M, Dreher D, Peterson H, Goldhirsch A & Senn HJ. Quality of life measures for patients receiving adjuvant therapy for breast cancer: an international trial. The International Breast Cancer Study Group. *European Journal of Cancer* 1992;28(1):118-24.

31. Jensen, Hjermstad M, Fossa SD, Bjordal K & Kaasa S. Test/retest study of the European Organization for Research and Treatment of Cancer Core Quality of Life Questionnaire. *Journal of Clinical Oncology* 1995;13(5):1249-54.

32. Jette M, Campbell J, Mongeon J & Routhier R. The Canadian Home Fitness Test as a predictor for aerobic capacity. *Canadian Medical Association Journal* 1976;114(8):680-2.

33. Jette M, Landry F, Sidney K. Blood pressure response to the Canadian Aerobic Fitness Test. *Canadian Journal of Public Health* 1991;82(4):267-76.

34. Knekt P, Jarvinen R, Seppanen R, Pukkala E & Aromaa A. Intake of dairy products and the risk of breast cancer. *British Journal of Cancer* 1996;73(5):687-91.

35. Longnecker MP. Alcoholic beverage consumption in relation to risk of breast cancer: meta-analysis and review. *Cancer Causes Controls* 1994;5:73-82.

36. MacVicar M & Winningham ML. Response of cancer patients on chemotherap to a supervised exercise program, abstracted. *Medicine and Science in Sports & Exercise* 1985;17:292.

37. MacVicar M, Winningham M & Nickel J. Effects of aerobic interval training on cancer patients' functional capacity. *Nursing Research* 1989;38:348-51.

38. Martin-Moreno JM, Willett WC, Grogojo L, Banegas JR, Rodriguez-Artalejo R, Fernandez-Rodriguez JC, Maisonneuve P & Boyle P. Dietary fat, olive oil intake and breast cancer risk. *International Journal of Cancer* 1994;58:774-80.

39. McGuire WL, Tandon AK, Allred DC, Chamness GC & Clark GM. How to use prognostic factors in axillary node-negative breast cancer patients. *Journal of the National Cancer Institute* 1990;82:1006-15.

40. Mittendorf R, Longnecker MP, Newcomb PA, Dietz AT, Greenberg ER, Bogdan GF, Clapp RW & Willett WC. Strenuous physical activity in young adulthood and risk of breast cancer. *Cancer Causes & Control* 1995;6(4):347-53.

41. Mock V, Burke MB, Sheehan P,Creaton EM, Winningham ML, McKenney-Tedder S, Schwager LP & Liebman M. A nursing rehabilitation program for women with breast cancer receiving adjuvant chemotherapy. *Oncology Nursing Forum* 1994;21:899-907.

42. Mock V,,Dow KH, Meares CJ, Grimm PM, Dienemann JA, Haisfield-Wolfe ME, Quitasol PW, Mitchell S & Mock V. Effects of exercise on fatigue, physical functioning, and emotional distress during radiation therapy for breast cancer. 1997;24:991-1000.

43. Moisan J, Meyer F, & Gingras S. A nested case-control study of the correlates of early menarche. *American Journal of Epidemiology* 1990;132:953-61.

44. Nieman DC, Cook VD, Henson DA, Suttles J, Rejeski WJ, Ribisl PM, Fagoaga OR & Nehlsen-Cannarella SL. Moderate exercise training and natural killer cell cytotoxic activity in breast cancer patients. *International Journal of Sports Medicine* 1995;16(5):334-7.

45. Nelson JP. Perceived health, self-esteem, health habits, and perceived benefits and barriers to exercise in women who have and have not experienced stage I breast cancer. *Oncology Nursing Forum* 1991;18:1191-7.

46. O'Connor G, Buring J, Yusuf S, Goldhaber SZ, Olmstead EM, Paffenbarger RS Jr. & Hennekens CH. An overview of randomized trials of rehabilitation with exercise after myocardial infarction. *Circulation* 1989;80(2):234-44.

47. Oldridge N, Guyatt G, Jones N, Crowe J, Singer J, Feeny D, McKelvie R, Runions J, Streiner D & Torrance G. Effects on quality of life with comprehensive

rehabilitation after acute myocardial infarction. *The American Journal of Cardiology* 1991;67:1084-89.

48. Ozyilkan O, Baltali E, Tekuzman G, Firat D. The impact of diagnosis and treatment on the quality of life in breast cancer patients. *Neoplasma* 1998;45(1):50-2.
49. Paffenbarger RS Jr., Hyde RT & Wing AL. Physical activity and incidence of cancer in diverse populations: a preliminary report. *American Journal of Clinical Nutrition* 1987;45(1suppl.):312-7.
50. Pashkow F. Issues in contemporary cardiac rehabilitation: A historical perspective. *Journal of the American College of Cardiology* 1993;21(3):822-34.
51. Peters C, Lotzerich H, Niemeier B, Schule K & Uhlenbruck G. Influence of a moderate exercise training on natural killer cell cytotoxicity and personality traits in cancer patients. *Anticancer Research* 1994;14:1033-36.
52. Powles TJ. Status of antiestrogen breast cancer prevention trials. *Oncology* 1998;12(3 suppl 5):28-31.
53. Radice P &Pierotti MA. Molecular genetics of breast cancer. *Quarterly Journal of Nuclear Medicine* 1997;41(3):189-99.
54. Reichman ME, Judd JT, Longcope C, Schatzkin A, Clevidence BA, Nair PP, Campbell WS & Taylor PR. Effects of alcohol consumption on plasma and urinary hormone concentrations in premenopausal women. *Journal of the National Cancer Institute* 1993;85(9):692-3.
55. Rosen PP, Groshen S, Saigo PE, Kinne DW & Hellman S. Pathological prognostic factors in stage 1(T1 N0 M0) and stage II (T1 N1 M0) breast carcinoma: a study of

644 patients with median follow-up of 18 years. *Journal of Clinical Oncology* 1989;7:1239-1251.

56. Scanlon EF, Suh O, Murthy SM, Mettlin C, Reid SE & Cummings KM. Influence of smoking on the development of lung metastases from breast cancer. *Cancer* 1995;75(11):2693-9.

57. Schwartz AL. Patterns of exercise and fatigue in physically active cancer survivors. *Oncology Nursing Forum* 1998;25(3):485-91.

58. Segal R, Evans B, Jette M, Colletta S, Reid B, Tardif G, Harrisson MB & Wells G. The effect of physical activity on quality of life in breast cancer patients receiving adjuvant therapy. *Research Grant Proposal* October , 1995.

59. Shephard RJ. Exercise in the prevention and treatment of cancer. *Sports Medicine* 1993;15:258-80.

60. Shephard RJ. Exercise and cancer: linkages with obesity. *Journal of Obesity* 1995;19:562-8.

61. Siiteri PK. Adipose Tissue as a source of hormones. *American Journal of Clinical Nutrition* 1987;45(1 suppl):277-82.

62. Skolnick MH, Frank T, Shattuck-Eidens D & Tartigian S. Genetic susceptibility to breast and ovarian cancer. *Pathologie Biologie* 1997;45(3):245-9.

63. Taioli E, Barone J & Wynder EL. A case-control study in breast cancer and body mass. *European Journal of Cancer* 1995;31A(5):723-8.

64. Tate DG, Riley BB, Perna R, Roller S. Quality of life issues among women with physical disabilities or breast cancer. *Archives of Physical Medicine & Rehabilitation* 1998;78(12 suppl 5):S18-25.

65. Thune I, Brenn T, Lund E & Gaard M. Physical activity and the risk of breast cancer. *New England Journal of Medicine* 1997;336(18):1269-75.

66. Toniolo P, Riboli Em, Protta F, Charrel M & Capp AP. Calorie-providing nutrients and risk of breast cancer. *Journal of the National Cancer Institute* 1989;81(4):278-86.

67. Torun M, Yardim S, Gonenc A, Sargin H, Menevse A & Simsek B. Serum beta-carotene, vitamin E, vitamin C, and malondialdehyde levels in several types of cancer. *Journal of Clinical Pharmacy & Therapeutics.* 1995;20(5):259-63.

68. Uhlenbruck G & Order U. Can endurance sports stimulate immune mechanisms against cancer and metastasis? *International Journal of Sports Medicine* 1991;12(suppl 1):s63-8.

69. van den Brandt PA, Goldbohm RA & van't Veer PA. Alcohol and breast cancer: results from the Netherlands Cohort Study. *American Journal of Epidemiology* 1995; 141(10):907-15.

70. Vihko VJ, Apter DL, Pukkala EI, Oinonen MT, Hakulinen TR & Vihko RK. Risk of breast cancer among female teachers of physical education and languages. *Acta Oncologica* 1992;31(2):201-4.

71. Ware JE, Kosinski M, Keller S. SF-36 Physical an Mental Health Summary Scales: A User's Manual. Boston, MA: The Health Institute, 1994.

72. Welsch CW. Interrelationship between dietary lipids and calories and experimental gland tumorogenesis. *Cancer Supplement* 1994;74:1055-62.

73. Willett WC & Hunter D. Prospective studies of diet and breast cancer. *Cancer Supplement* 1994;74(3):1085-9.

74. Winningham ML. Effects of a bicycle ergometry program on functional capacity and feelings of control with breast cancer [Dissertation]. The Ohio State University, Columbus, OH, 1983.

75. Winningham ML & MacVicar MG. The effect of aerobic exercise on patient reportsof nausea. *Oncology Nursing Forum* 1988;15(4):447-50.

76. Winningham ML, MacVicar MG, Bondoc M, Anderson JI & Minton JP. Effect of aerobic exercise on body weight and composition in patients with breast cancer on adjuvant chemotherapy. *Oncology Nursing Forum* 1989;16:683-9.

77. World Health Organization. HED/HEP Health education and health promotion in developing countries 930506 (to be published).

ARTICLE

Effects of a 12-week walking program on cardiovascular fitness and quality of life in breast cancer patients receiving adjuvant chemotherapy.

By

Liisa Vexler

School of Human Kinetics

Faculty of Health Sciences

University of Ottawa

Ottawa, Ontario K1N 6N5

ABSTRACT

BACKGROUND. Decline in functional capacity, change in body composition, and a reduction of quality of life (QOL) are frequent problems of cancer patients undergoing adjuvant chemotherapy for breast cancer. Previous studies have shown that aerobic activity such as a walking program help to maintain cardiovascular fitness, body composition, and QOL in breast cancer patients undergoing adjuvant therapy. This study attempted to verify this information with a randomized experimental design.

METHODS. Twenty women with histologically proven stage I-II breast cancer were randomized into either an experimental or control group. The patients began the program the same week that they began their chemotherapy treatments. Ten patients participated in a supervised walking program at the Ottawa Regional Cancer Centre which consisted of walking around a track for a minimum of twenty minutes three times per week, and on their own at home a minimum of two times per week. Ten patients who did not take part in the walking program served as a control group. Cardiovascular fitness (as measured by a modified CAFT), body composition, and quality of life (QOL) were compared at the time of entry into the study and 12 weeks later.

FINDINGS. The results of the present study suggest that a 12-week walking program, in this sample of stage I-II breast cancer patients undergoing adjuvant chemotherapy, does not affect cardiovascular fitness levels or body composition. QOL was not significantly affected by the intervention. These findings would most certainly have been affected by the fact that 50% of the usual care group became physically active.

CONTRIBUTIONS OF COLLABORATORS

This work could not have been completed without the help of the Cancer Rehabilitation Research Team at the Ottawa Regional Cancer Centre – General Division. Thank you to the following individuals for their contributions:

Dr. Maurice Jette - thesis advisor

Dr. Roanne Segal – primary researcher

Darren Johnson & Julie Smith – ORCC Rehabiliation Program; test/program administrators

INTRODUCTION

Stage I-II breast cancer patients and their physicians must decide on a course of treatment following surgery. Node negative patients have a relatively low rate of developing distant metastases. However, depending on various prognostic factors, the recurrence rate can change from less than 10% to more than 45% over a span of 20 years (Fisher et al., 1989). In patients with node involvement, the probability of developing distant metastases may be greater than 45% at 5 years. However, this risk can be reduced by 20-30% with a standard course of adjuvant therapy (McGuire et al., 1990). This often results in prolonged treatment periods that extend over many months.

Furthermore, adjuvant chemotherapy often causes symptoms such as nausea, vomiting, poor appetite, and fatigue. Patients and their physicians observe a decline in the patient's functional capacity during the span of the treatment. Many women fear overexertion and are uncertain of what they are capable of doing. During this period, patients often become very inactive, and some even bedridden. Evidence has suggested that in addition to a decline in functional status, newly diagnosed Stage I-II patients receiving adjuvant therapy had a decline in quality of life during the initial phase of treatment (Hughes, 1993; Hurny et al., 1992).

In both healthy and clinical populations, physical activity has been shown to improve quality of life. This has been studied extensively in cardiac patients and patients with chronic obstructive pulmonary disease. Both have shown marked improvements in psychological, functional, and physiological measures with regular physical activity (American Association of Cardiovascular and Pulmonary Rehabilitation, 1991; O'Connor et al., 1989; Oldridge et al., 1991; Pashkow, 1993).

Prior to therapy, the initial exercise capacity of a breast cancer patient is somewhat low. Patients are usually directed to "engage in light physical activity" during the treatment period, although no formal direction or specific exercise prescription is given. The ensuing low level of activity contributes to their debilitation through muscle atrophy, weight gain, or diminution of range of motion and a general reduction in cardiovascular function. Fatigue is also compounded, the consequences of which may prolong the post-treatment recovery period.

Studies indicate that moderate exercise improves functional capacity, and body composition in breast cancer patients (Friedenreich & Courneya, 1996; MacVicar & Winningham, 1985; MacVicar et al., 1989; Mock et al., 1994; 1997; Nieman et al., 1995). There is also evidence indicating that mood, frequency of nausea, fatigue, and self-esteem, all components of quality of life, are improved through regular physical activity in this group of patients (Friedenreich & Courneya, 1996; MacVicar & Winningham, 1985; Mock, 1994; 1997; Nelson, 1991; Peters et al., 1994; Schwarz, 1998; Winningham, 1983; Winningham & MacVicar, 1988).

Until now, there have been no randomized exercise control trials involving breast cancer patients undergoing adjuvant chemotherapy. The purpose of this study was to determine the effects of a 12-week walking program in breast cancer patients undergoing adjuvant chemotherapy, on measures of cardiorespiratory fitness and body composition. A second objective was the assessment of the effects of this exercise program on quality of life (QOL) variables in these patients.

METHODOLOGY

Experimental Design

This study used a randomized pretest – posttest control group design.

Subjects

- Twenty women with histologically proven stage I-II breast cancer participated in this study of randomized control trial design at the Ottawa Regional Cancer Centre—General Division. None had had cardiorespiratory problems or met any of the following exclusion criteria:
- subject had received previous chemotherapy or hormonal therapy
- subject was being considered for adjuvant therapy other than that described above, or for dose-intensive regimes
- subject had a previous malignancy (other than basal or squamous cell skin cancer)
- subject had active cardiac disease
- subject had uncontrolled hypertension
- subject had uncontrolled diabetes mellitus
- subject had severe osteoporosis
- subject had psychiatric or addictive disorders which precluded them from following a program of prescribed physical activity or from providing informed consent
- subject had uncontrolled medical illness or contraindication to moderate physical activity

The subjects were randomized into an experimental group (n = 10) which would take part in the supervised walking program, and a control group (n = 10) who would receive the usual care from their oncologist.

The groups demonstrated no significant differences in terms of anthropometric data. There were also no apparent differences in employment situation, level of education, or marital status at the onset of the study. The supervised (experimental) group had a mean age of 48.1(±7.3) years, and the usual care (control) group had a mean age of 47.6 (±5.2) years. The average height in the supervised group was 165.8 (±3.8) cm and that of the usual care group was 161.3 (±8.4) cm. In the experimental group, 4 women were currently working, 3 were on disability, and 3 were unemployed. Of the control group, 5 were currently working, 3 were on disability, and 2 were unemployed. With respect to level of education, the experimental group consisted of 3 subjects who had completed high school, 2 who had completed college, 3 who had completed university, and 2 who had done post-graduate work. The control group had 1 subject who had completed primary school, 4 who had completed high school, 2 who had completed university, and 3 who had done post-graduate work. Seven women in the experimental group were married, 2 were single, and 1 was divorced. The control group consisted of 8 married women, 1 single woman, and 1 divorced woman. Of the control group, only 1 woman indicated participation in regular physical activity, whereas in the experimental group, 7 reported that they were regular participants.

Apparatus and Questionnaires

Heart rate at rest and between exercise stages was measured by auscultation with a stethoscope, and blood pressure was measured using an Almedic sphygmomanometer and stethoscope. Double 20.3 cm steps, a Canadian Aerobic Fitness Test (CAFT) cassette tape, as well as a cassette player were used for the modified CAFT. Grip strength was measured using a Stoelting dynamometer. Skin fold measurements were

taken using a Harpenden skin fold caliper. During the walking program, each subject in the supervised group was given a Polar heart rate monitor to keep for the duration of the study.

Subjects completed a total of four questionnaires: The first pertained to demographic data and lifestyle information, while the next three assessed quality of life. They were the Functional Assessment of Cancer Therapy—breast (FACT-B), MOS 36-Item Short Form Health Survey (SF-36), and the State Trait Anxiety Inventory (STAI).

The demographics and lifestyle questionnaire (Appendix A) was designed to reveal facts about the patient's age, level of education, employment situation, general physical activity history, marital status, and tobacco usage.

The FACT scales (Appendix B/C) are self-report measures of quality of life in people with cancer and HIV. The FACT-B is a disease specific extension of the general FACT-G (general) scale, and includes items which are relevant to breast cancer. There are six subscales within the questionnaire which deal with physical well-being, social/family well-being, relationship with doctor, emotional well-being, functional well-being, and additional concerns specific to breast cancer. There are 29 Likert-type items which comprise 5 subscales in the FACT-G. The FACT-B extension consists of 9 disease-specific items. The FACT manual (Cella, 1994), includes a scoring guide which identifies those items which must be reversed before being added to obtain subscale totals. Items are reversed by subtracting the given value from "4". After these items are reversed, all subscale items are summed to a total, which becomes the score for that subscale. If there are missing items, the subscale scores can be prorated based on a

formula given in the scoring guide. Finally, the total score for the FACT scale is the sum of the subscale scores.

This questionnaire was developed and validated in 4 phases. The items were first generated and then reduced. Next, the scales were constructed and finally the psychometric properties were evaluated. These steps are elaborated upon in the FACT manual (Cella, 1994).

The SF-36 questionnaire (Appendix D/E) has thirty-six items that are broken down into eight concepts, physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health. From these eight concepts, an aggregate physical score and an aggregate mental score are obtained based on the General Scoring Information given in the SF-36 Health Survey Manual (Ware & Sherbourne, 1992). Each raw score is transformed based on a formula given in the above-named manual. The functioning scales are scored so that the higher the score, the better the functioning. For example, the pain scale is scored so that the higher the score, the greater the freedom from pain.

The State-Trait Anxiety Inventory self-evaluation questionnaire (Spielberger, 1983) (Appendix F) is used extensively in research and clinical practice. It is comprised of separate self-report scales for measuring state and trait anxiety. The S (state) - anxiety scale consists of 20 statements used to evaluate feelings of apprehension, tension, nervousness, and worry. It may also be used to evaluate how a person felt at a particular time in the recent past, or how they anticipate they will feel at a specific time in the future, or in a hypothetical situation. The T (trait) - anxiety scale consists of 20 statements used to assess how people generally feel. This scale is used to diagnose

clinical anxiety in medical, surgical, psychosomatic, and psychiatric patients. Neurotic and depressed patients generally score high on this scale. Individual STAI items were required to meet validity criteria at each stage of the development process in order to be retained. The complex test construction and validation processes are described in Spielberger (1966) and Spielberger et al. (1970).

The two scales are printed on opposite sides of a single-page test form. These questionnaires were scored according to the scoring keys provided in the Manual for the State-Trait Anxiety Inventory (STAI) (Spielberger, 1983).

Procedures

Introductory Session and Pre-test

Prior to the initiation of chemotherapy, patients meeting subject criteria were referred and evaluated by the project oncologist for performance status, weight loss, usual weight, and concurrent medical problems. They were then referred to an exercise specialist who administered the study questionnaires. Upon completion of the questionnaires, anthropometric data was obtained from the patient's non-surgical side. Height, weight, waist and hip girth, and 4 sites of skinfolds were measured (biceps, triceps, subscapular, and supra-iliac as described in The Canadian Aerobic Fitness Test (CAFT) Operations Manual) by the test administrator (Jette et al., 1991). These data are shown in Table 3. Every effort was made to ensure consistency of measurement.

Following these measurements and a five-minute seated rest, resting heart rate and blood pressure were taken prior to the initiation of the modified CAFT (Jetté et al., 1991).

The modified CAFT consists of a stepping sequence performed on double 20.3 cm steps to a six beat musical rhythm. The stepping cadences for the five stages are 66, 84, 102, 114, and 120 beats per minute. All subjects attempted to progress through the five stages beginning at stage 1. The test was stopped when one of the following occurred:

- they successfully completed all 5 stages without exceeding ceiling heart rate values (see Table 1);
- they exceeded the predetermined ceiling heart rate following one of the stages;
- the subject or administrator decided not to proceed further with the test.

Following the pre-test heart rate and blood pressure measurements, the test administrator demonstrated the stepping sequence allowing the subject to practice the sequence. Once they were comfortable with this sequence, the subject began performing stage 1 of the CAFT. The participant was reminded that they were free to stop stepping at any time if any discomfort was experienced. As well, the administrator was instructed to discontinue the test if the subject complained of dizziness, chest pain, extreme leg pain, showed signs of facial pallor, or displayed any other signs of unusual discomfort during the test.

Each stepping stage was three minutes in length and was followed by a one minute standing rest, during which heart rate and blood pressure were measured by the test administrator. If the subject's post stage heart rate was below the ceiling value, the subject proceeded to the next stage. Following the final stage, the subject was asked to be seated for three minutes during which heart rate and blood pressure were monitored to assure that they returned to normal post exercise values. The maximum number of stages

that any subject was allowed to complete was 5. The amount of time to administer the test did not exceed 30 minutes. The CAFT was used to determine a predicted VO_2 max, and to compare the number of stages completed before and after treatment (Jetté et al., 1976).

Maximum voluntary contraction (MVC) was then measured. Subjects, using their dominant hand, and placing their arm unsupported at their side, were asked to perform three trials on a Stoelting hand dynamometer. The instrument is gripped firmly, held away from the body, and squeezed vigorously. The average of the two best trials was recorded as her MVC.

Following this baseline testing, the patients were randomized into either the control or experimental group by means of a random number generator.

Intervention

Those in the experimental group took part in a 12-week walking program. They received information from their evaluation and were prescribed a progressive walking program at an intensity of 45-65% of heart rate reserve based on the results of the modified CAFT test.

Participants in the experimental group performed their exercise prescription during a supervised group session on the track at the Ottawa Regional Cancer Centre three times per week, and were requested to exercise at least two other days per week on their own. The subjects were asked to complete an exercise log to ensure that they were complying with the program, and calls were made monthly to the patient's home as follow-up. The duration of each exercise session was approximately 40 minutes. It

consisted of a 5 to 10 minute walking warm-up followed by some static stretches for all the major muscle groups. The aerobic portion consisted of a minimum of 20 minutes of walking at the prescribed heart rate monitored on a Polar heart rate monitor. This was followed by a cool- down period involving stretching and some optional abdominal exercises. The subjects were free to converse with other group members who were undergoing or who had undergone similar treatment.

Participants in the control group received the usual advice from their Cancer Centre physician with regards to exercise.

Post-Test

Following the 12 weeks, experimental and control subjects returned for follow-up evaluations. Again, the project oncologist assessed them. Following this examination, they repeated the psychological questionnaires, anthropometric measurements, maximum voluntary contraction (MVC) measurement, and modified CAFT as they were performed during the baseline evaluation.

Statistical Analysis

A multivariate analysis of variance, as well as a multivariate analysis of covariance were performed on three dependent variables associated with anthropometric characteristics of subjects: weight, waist-to-hip ratio (WHR), and sum-of-skinfolds (SOS). The independent variable was group (supervised or usual care). Covariates were the pre-test scores for each of the dependent variables. The original sample of 20 was reduced to 18 because of missing data. SAS GLM was used for analysis.

A multivariate analysis of variance and a multivariate analysis of covariance were performed on six dependent variables associated with quality of life scores of subjects: FACT-G, FACT-B, State Anxiety, Trait Anxiety, SF-36 Physical, and SF-36 Mental. The independent variable was group (supervised or usual care). Covariates were the pre-test scores for each of the dependent variables.

A multivariate analysis of variance and a multivariate analysis of covariance were performed on eight dependent variables associated with cardiovascular fitness and strength of subjects: predicted VO_2max, number of stages completed, resting heart rate, resting systolic blood pressure (SBP), resting diastolic blood pressure (DBP), the change in SBP from rest to last stage completed, the change in DBP from rest to last stage completed, and maximum voluntary contraction (MVC). The independent variable was group (supervised or usual care). Covariates were the pre-test scores for each of the dependent variables.

RESULTS

Results of this study indicated that there were no significant differences between the groups prior to the intervention with regards to the following variables: age, height, weight, waist-to-hip ratio (WHR), sum of skinfolds (SOS), systolic blood pressure (SBP), diastolic blood pressure (DBP), resting heart rate (HR), systolic blood pressure response to exercise (last stage SBP - resting SBP), diastolic blood pressure response to exercise (last stage DBP - resting DBP), stages of the modified CAFT completed, predicted VO_2max, and maximum voluntary contraction (MVC). Cardiovascular and strength variables are presented in Table 2, while group and sample means for physical characteristic variables are presented in Table 3. There were no significant differences between the groups prior to the intervention in any of the QOL variables. Mean quality of life scores for each of the groups are presented in Table 4.

Cardiovascular fitness & Strength Characteristics (Table 2)

There was no significant difference between the groups in terms of change in predicted VO_2 max at the completion of the intervention when the means were adjusted for pre-test values. There was a non-significant decrease in mean resting SBP from pre-test to post-test of -10.4 mmHg for the supervised group and -0.2 mmHg for the usual care group. Although not significant, resting DBP from pre-test to post-test did decline by 7.6 mmHg in the supervised group. Change in SBP from rest to exercise, and change in DBP from rest to exercise were not significantly different when the values were adjusted for pre-test using MANCOVA. However, these variables were both significantly different between the supervised and usual care groups when a MANOVA was used, ($F=9.62$, $p=0.007$ and $F=17.3$, $p=0.0007$ respectively) (see table 2). MVC pre-

test to post-test was not significantly different between the groups. The means and standard deviations are shown in Table 2. When the eight variables were jointly considered using MANCOVA there was no statistical significance; however, using MANOVA, there was a statistically significant difference ($F=6.83$, $p=0.005$), as a result of the univariate F-statistics of the change in systolic and diastolic blood pressure from rest to exercise.

Body Composition (Table 3)

The mean change in body weight following the intervention program was similar between groups with the usual care group gaining an average of 0.1 kg (± 2.8) and the supervised group losing an average of 0.1 kg (± 4.1). The waist-to-hip and sum of skinfolds variables were not significantly different between groups following the intervention program.

Quality of Life (Table 4)

The FACT-G and FACT-B, state anxiety, and trait anxiety, and SF-36 aggregate physical and emotional scores, did not reveal any significant differences in QOL from the initial visit to the post-test.

DISCUSSION

A decline in functional capacity is often observed in patients undergoing surgery and then adjuvant chemotherapy for breast cancer. This reduced level of fitness, coupled with fatigue often leads to fear of overexertion, which in turn creates a decrease in level of physical activity to the point that many patients become inactive. (Friedenreich & Courneya, 1996) Previous non-randomized studies have shown that moderate exercise

in stage I-II breast cancer patients not undergoing adjuvant chemotherapy increases cardiovascular fitness (Friedenreich & Courneya, 1996; MacVicar et al., 1989; Mock et al., 1994; Nieman et al., 1995). In particular, the review of literature by Friedenreich and Courneya on the association of exercise and rehabilitation among cancer patients concludes that exercise programs appear to improve breast cancer patients' physiologic and psychological well-being. However, these findings were not observed in the present study in which the patients were randomized to a supervised exercise program and to a usual care group. The supervised walking group showed no significant improvement in the cardiovascular fitness, body composition, and quality of life variables employed in this study over the usual care group when evaluated using a MANCOVA which adjusts the variables for the pre-test scores. However, with a MANOVA, which does not take pre-test scores into account, there was a significant difference between groups with respect to the change in SBP and change in DBP from rest to exercise. It would seem that the usual care group had a greater systolic response to exercise and a slight reduction in diastolic blood pressure in response to exercise. This may indicate an improvement in vasomotor responsiveness in the experimental group. The vasculature of the skeletal muscle may be better adapted to exercise in the supervised group as a result of their regular physical activity. In addition, resting SBP and DBP were reduced in the supervised group by 10.4 mmHg and 7.6 mmHg, respectively. Although statistically non-significant, it remains a considerable reduction. The data was examined for outliers, but none were found. Since neither group experienced any significant weight loss, nor were they being administered differing chemotherapy regimens, the reason for this reduction in the blood pressure of the exercise group remains unexplained.

A reduction in body fat and an increased lean body mass was found in a similar group of patients who performed moderate exercise on a cycle ergometer over the course of 12 weeks (MacVicar & Winningham, 1985). The results of the present investigation, however, did not show any significant changes in body composition between the supervised group and the usual care group. Both groups remained within 1 kg of their weight at the time of the pre-test. As well, as can be seen in Table 3, both the waist-to-hip ratio and the sum of skinfolds changed minimally in both groups. These results indicate that the walking program, which the supervised group followed, had no effect on measures of body composition.

In the supervised group, 4 women gained more than 1 kg, while 6 women lost more than 1 kg. In the usual care group, 4 women gained more than 1 kg, while 4 stayed within 1 kg of their starting weight and 2 lost more than 1 kg. The absence of a significant change in body composition can perhaps be attributed to the limited amount of energy expenditure by the subjects. Twenty minutes of brisk walking three times per week for a total of 12 weeks for the average 70 kg healthy woman would lead to an energy expenditure of approximately 4680 kilocalories or 0.61 kg.

Evidence has indicated that newly diagnosed Stage I-II breast cancer patients receiving adjuvant chemotherapy experience a decline in quality of life, especially during the initial phases of treatment (Hughes, 1993; Hurny et al., 1992). Some studies have shown that a moderate exercise training program can improve some parameters of quality of life in stage I-II breast cancer patients (Friedenreich & Courneya, 1996; Mock et al., 1994; MacVicar & Winningham, 1985). More specifically, using a similar exercise program, Mock et al. (1997) studied a group of patients (N = 46) with a similar disease

stage to the above studies who were undergoing radiation therapy. In their investigation in which the subjects were randomized, the two groups revealed significant differences between groups with respect to symptom experience and fatigue, both components of quality of life. The results of the present research study, however, revealed no significant differences in quality of life variables between the supervised and usual care groups based on the FACT, the SF-36, and the STAI questionnaires, thus being in opposition to the above mentioned research.

Conversely, a randomized control trial of a group of stage II-IV breast cancer patients stratified by age and functional capacity evaluated a moderate exercise training program's effect on frequency of nausea and frequency of symptoms as reported by the subjects. During the course of the 10-12 week intervention, the exercisers had increased symptoms as compared to the placebo group and the controls, although they did experience less nausea than their counterparts (Winningham & MacVicar, 1988).

The discrepancies between previous research and the results of this study could be partially be explained by the short duration of this study. Furthermore, upon questioning the subjects at their post-test, it was revealed that five of the ten members of the usual care group had become physically active since entering the study. Although members of the research team did not give them any direct instruction with respect to exercise, it is quite possible that their oncologist may have recommended some form of physical activity. In addition, patients may have somehow assumed that physical activity must be beneficial to breast cancer patients since it was worthy of a clinical trial, and that other breast cancer patients were participating in a supervised exercise program. Moreover, the pre-test for both the supervised group and the usual care group was held in the fitness

centre at the Ottawa Regional Cancer Centre where observation of other cancer patients in the midst of exercise may have provoked some personal interest in the study participants. In addition, it is quite possible that the actual testing methods used during the baseline visit may have indicated to the usual care subjects that perhaps regular exercise and an improved fitness level might be beneficial to their overall well-being. In order to have more accurately analyzed the physical activity levels of the usual care group based on more than direct and indirect observation, a retrospective physical activity questionnaire at the time of the post-test would have been useful.

The fact that half the usual care group began participating in physical activity most certainly had a strong impact on the results of this study. The number of participants in physical activity cannot be considered significantly different between groups. It would therefore seem that the only difference remaining between the groups with respect to independent variables would be participation in a supervised group program.

The fact that the physical activity history of the participants was different between groups may have also impacted the results. Seven of the ten members of the supervised group were exercisers prior to the study, while only one member of the usual care group participated in regular exercise. This means that 70% of the supervised group was basically maintaining, or may even have been reducing their level of physical activity, whereas this was the case for only 10% of the usual care group. To control for this in future research, prior regular physical activity might be considered a criterion in stratifying the subjects.

Half the usual care group began to experience the initial benefits of exercise, while the majority of the supervised group were either maintaining their prior level of activity, or re-adopting a habit they had held in the past. This is sure to have been an impact on the results of this study, as adding a new healthy activity to one's life has both psychological and physiological effects.

A longer intervention might also have provided stronger data in support of the literature. Mock et al. (1994) found that the exercise group had improved quality of life as compared to the non-exercise groups after 4 - 6 months; however, at mid-test (2-3 months), the controls actually scored higher than the exercisers on one parameter of QOL, psychosocial adjustment to illness. At the same point, the controls had fewer symptoms than the exercisers based on a brief symptom inventory that was completed by the subjects. Had the present study been longer, this change in certain parameters of quality of life may have also taken place. A longer study would also be supported by the fact that the American College of Sports Medicine (1990) suggests that 15 to 20 weeks of exercise may be the minimum amount of time needed for realization of physical fitness improvements in a normal population. As of yet, no evidence exists to suggest how long it takes for improvements in psychological variables in breast cancer patients.

Sample size may have also influenced the outcomes of this study, as the small number of subjects may have contributed to a loss of statistical power. There were also unusually large standard deviations in both groups for many of the variables (as can be seen in Tables 2, 3, and 4). These statistical considerations could also explain the non-significant result in systolic and diastolic blood pressure of the exercise group.

A placebo group may have helped to separate exercise effects from any placebo effects such as attention, involvement, and expectation. One possibility for this might be using what Friedenreich and Courneya (1996) call "minimal exercise" for the placebo group where a light stretching program could be employed.

Since no other study has looked specifically at patients undergoing adjuvant chemotherapy, the physiological and psychological effects of this type of treatment should perhaps be considered especially in terms of timing of training. It is quite possible that the stress of a new exercise program at the same time as the stress of beginning chemotherapeutic treatment may be too demanding for the patient, both physiologically and psychologically, at least at the onset of the therapy. It would also be interesting to study a similar group of patients who participate in fitness training prior to the initiation of chemotherapy, as well as through the course of the treatment. This pre-conditioning might eliminate the double exposure to stress that was incurred at the beginning of this research study. Future research into the effects of the double stress on patients simultaneously beginning a treatment program of adjuvant chemotherapy and a physical exercise program would be of interest.

Another interesting area of future research might be pre-conditioning of patients prior to adjuvant chemotherapy. It would be valuable to know whether those patients who maintain a certain level of physical activity, are able to tolerate the trauma of adjuvant chemotherapy for breast cancer with greater ease than those who are inactive/sedentary.

As half the usual care group began to exercise, it would be imprudent to say that a 12-week walking program has no significant impact on cardiovascular fitness, body

composition and quality of life in breast cancer patients undergoing adjuvant chemotherapy. However, in this study the supervised exercise group and the usual care group had no significant differences with respect to these variables.

CONCLUSION

The results of this study indicate that stage I-II breast cancer patients undergoing adjuvant chemotherapy for breast cancer did not demonstrate an improvement in cardiovascular fitness, body composition, or quality of life over the period of a 12-week supervised walking program. These results do not support previous studies that showed that exercise in breast cancer patients improved some parameters of quality of life and physical fitness. However, the fact that subjects in the usual care group may have begun an exercise program could most certainly have affected the results. A larger sample size might elicit different results, as might a longer intervention. Controlling for physical activity history, as well as current participation in physical activity in the usual care group might also have lent strength to the study, while a placebo group might also help to more accurately demonstrate the effects of this type of exercise program.

Exercise is an inexpensive, current, and auspicious mode for the rehabilitation of breast cancer patients, and continues to be well worthy of further research.

REFERENCES

1. American Association of Cardiovascular and Pulmonary Rehabilitation: Guidelines for Cardiac Rehabilitation Programs. Champaign, IL: Human Kinetics, 1991.
2. American College of Sports Medicine. The recommended quality and quantity of exercise for developing and maintaining cardiorespiratory and muscular fitness in healthy adults. *Med Sci Sports Exer* 1990;22:265-74.
3. Cella DF. F.A.C.T. Manual (Version 3). Chicago: Rush-Presbyterian-St. Luke's Medical Center: 1994.
4. Department of Health and Human Services. Physical activity and health: A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.
5. Fisher B, Redmond C, Wickerham L, Wolmark N, Bowman D, Couture J, Dimitro NV, Margolese R, Legault-Poisson S & Robidoux A. Systemic therapy in patients with node negative breast cancer: a commentary based on two NSABP clinical trials. *Annals of Internal Medicine* 1989;111:703-712.
6. Friedenreich CM & Courneya KS. Exercise as rehabilitation for cancer patients. *Clinical Journal of Sport Medicine* 1996;6:237-244.
7. Hughes KK. Psychosocial and functional status of breast cancer patients. The influence of diagnosis and treatment choice. [Review] *Cancer Nurse* 1993;16(3):222-29.

8. Hurny C, Bernhard J, Gelber RD, Coates A, Castiglione M, Isley M, Dreher D, Peterson H, Goldhirsch A & Senn HJ. Quality of life measures for patients receiving adjuvant therapy for breast cancer: an international trial. The International Breast Cancer Study Group. *European Journal of Cancer* 1992;28(1):118-24.
9. Jetté M, Campbell J, Mongeon J & Routhier R. The Canadian Home Fitness Test as a predictor for aerobic capacity. *Canadian Medical Association Journal* 1976;114(8):680-2.
10. Jetté M, Landry F, Sidney K. Blood pressure response to the Canadian Aerobic Fitness Test. *Canadian Journal of Public Health* 1991;82(4):267-76.
11. MacVicar M & Winningham ML. Response of cancer patients on chemotherapy to a supervised exercise program, abstracted. *Medicine and Science in Sports & Exercise* 1985;17:292.
12. MacVicar M, Winningham ML & Nickel J. Effects of aerobic interval training on cancer patients' functional capacity. *Nursing Research* 1989;38:348-51.
13. McGuire WL, Tandon AK, Allred DC, Chamness GC & Clark GM. How to use prognostic factors in axillary node-negative breast cancer patients. *Journal of the National Cancer Institute* 1990;82:1006-15.
14. Mock V, Burke MB, Sheehan P,Creaton EM, Winningham ML, McKenney-Tedder S, Schwager LP & Liebman M. A nursing rehabilitation program for women with breast cancer receiving adjuvant chemotherapy. *Oncology Nursing Forum* 1994;21:899-907.

15. Mock V, Dow KH, Meares CJ, Grimm PM, Dienemann JA, Haisfield-Wolfe ME, Quitasol PW, Mitchell S & Mock V. Effects of exercise on fatigue, physical functioning, and emotional distress during radiation therapy for breast cancer. 1997;24:991-1000.

16. Nelson JP. Perceived health, self-esteem, health habits, and perceived benefits and barriers to exercise in women who have and have not experienced stage I breast cancer. *Oncology Nursing Forum* 1991;18:1191-7.

17. Nieman DC, Cook VD, Henson DA, Suttles J, Rejeski WJ, Ribisl PM, Fagoaga OR & Nehlsen-Cannarella SL. Moderate exercise training and natural killer cell cytotoxic activity in breast cancer patients. *International Journal of Sports Medicine* 1995;16(5):334-7.

18. O'Connor G, Buring J, Yusuf S, Goldhaber SZ, Olmstead EM, Paffenbarger RS Jr. & Hennekens CH. An overview of randomized trials of rehabilitation with exercise after myocardial infarction. *Circulation* 1989;80(2):234-44.

19. Oldridge N, Guyatt G, Jones N, Crowe J, Singer J, Feeny D, McKelvie R, Runions J, Streiner D & Torrance G. Effects on quality of life with comprehensive rehabilitation after acute myocardial infarction. *The American Journal of Cardiology* 1991;67:1084-89.

20. Pashkow F. Issues in contemporary cardiac rehabilitation: A historical perspective. *Journal of the American College of Cardiology* 1993;21(3):822-34.

21. Peters C, Lotzerich H, Niemeier B, Schule K & Uhlenbruck G. Influence of a moderate exercise training on natural killer cell cytotoxicity and personality traits in cancer patients. *Anticancer Research* 1994;14:1033-36.

22. Selye H. The role of stress in the production and prevention of experimental cardiopathies. In W. Raab (Ed.), Prevention of Ischemic Heart Disease: Principles and Practice. Springfield, IL: Charles C. Thomas, Publisher: 1966.

23. Spielberger CD. State-Trait Anxiety Inventory (Form Y). PaloAlto: Consulting Psychologists Press, Inc:1983.

24. Uhlenbruck G & Order U. Can endurance sports stimulate immune mechanisms against cancer and metastasis? *International Journal of Sports Medicine* 1991;12(suppl 1):s63-8.

25. Ware JE & Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36). I. Conceptual framework and item selection. *Medical Care* 1992;30:473-483.

26. Winningham ML. Effects of a bicycle ergometry program on functional capacity and feelings of control with breast cancer [Dissertation]. The Ohio State University, Columbus, OH, 1983.

27. Winningham ML & MacVicar MG. The effect of aerobic exercise on patient reportsof nausea. *Oncology Nursing Forum* 1988;15(4):447-50.

28. Winningham ML, MacVicar MG, Bondoc M, Anderson JI & Minton JP. Effect of aerobic exercise on body weight and composition in patients with breast cancer on adjuvant chemotherapy. *Oncology Nursing Forum* 1989;16:683-9.

TABLES

Table 1- Ceiling Heart Rates (beats per 10 sec) for Progressive Step Test for Females by Age Group

Females				
20-29	nr*	nr	Nr	30
30-39	Nr	nr	Nr	29
40-49	Nr	nr	28	29
50-59	Nr	24	26	27

*nr = No restriction, subjects allowed to progress to next stage

Table 2
Pre-test and Post-test Cardiovascular Fitness & Strength Characteristics of Subjects.

				MANCOVA			MANOVA	
Variable	**Group**	**Pre-test M/SD**	**Post-test M/SD**	**Least Squares Mean**	**Univariate F-Statistic**	**F: Num DF/ Den DF; Pr < F**	**Uni-variate F-statistic**	**F(p)**
Predicted VO_2max ($ml \cdot kg \cdot min^{-1}$)	S UC	27.5/6.3 25.9/5.3	25.8/5.5 27.0/4.0	27.1 25.4	17.79	0.231: 8/1; 0.929	0.36	6.83 (0.005)
Stages completed	S UC	3.8/1.1 3.2/1.2	3.3/1.1 3.1/1.4	2.9 3.6	5.11		1.27	
Resting HR (BPM)	S UC	71.4/7.7 71.8/9.9	70.5/5.2 73.6/8.6	72.5 70.9	1.87		1.46	
SBP (rest)	S UC	120.4/ 13.3 125.2/ 18.0	110.0/ 12.4 125.0/ 16.5	125.0 107.0	2.53		3.7	
DBP (rest)	S UC	80.0 / 9.1 76.0 / 10.0	72.4 / 9.6 75.4 / 10.4	76.0 72.2	2.20		0.02	
ΔSBP (last stage- rest)	S UC	37.4 / 23.1 39.8 / 18.9	39.6 / 28.5 29.1 / 25.4	21.4 37.9	5.52		9.62	
ΔDBP (last stage- rest)	S UC	5.6 / 8.5 3.2 / 5.4	7.4 / 7.3 2.7 / 8.1	7.4 -0.5	7.49		17.3	
MVC (kg)	S UC	31.0 / 4.1 28.0 / 4.1	30.9 / 4.1 27.6 / 4.8	27.4 30.3	3.51		3.74	

HR= heart rate; BPM = beats per minute; SBP = systolic blood pressure; DBP = diastolic blood pressure; MVC = maximum voluntary contraction

Table 3
Pre-test and Post-test Anthropometric Characteristics of Subjects.

					MANCOVA		MANOVA	
Variable	**Group**	**Pre-test M/SD**	**Post-test M/SD**	**Least Squares Means**	**Univariate F-statistics**	**F: Num DF/ Den DF; Pr > F**	**Univariate F-statistic**	**F(p)**
Weight (kg)	S UC	77.3 / 23.7 70.1 / 17.5	77.2 / 22.8 71.1 / 16.5	73.9 74.2	142.45	0.509: 3 / 11; 0.684	0.34	0.12 (0.95)
WHR	S UC	0.79 / 0.07 0.80 / 0.08	0.79 / 0.06 0.81 / 0.08	0.80 0.80	16.63		0.08	
SOS (mm)	S UC	77.6 / 40.7 75.1 / 26.4	80.5 / 42.3 78.7 / 3.2	81.1 74.6	16.69		0.04	

WHR = Waist-to-hip ratio
SOS = sum of skinfolds

Table 4
Pre-test and Post-test Quality of Life Scores of Subjects.

			MANCOVA		MANOVA	
Variable	**Group**	**Least Squares Mean**	**Univariate F-statistics**	**F: Num DF/ Den DF; Pr < F**	**Univariate F-statistics**	**F(p)**
FACT – G	S UC	93 95.5	3.86	2.646: 6/5; 0.153	0.14	0.91 (0.52)
FACT - B	S UC	24.6 27.2	0.56		0.01	
State Anxiety	S UC	35.9 28.3	7.20		0.06	
Trait Anxiety	S UC	34.3 33.0	6.51		0.11	
SF - 36 Physical	S UC	21.3 23.7	1.76		0.15	
SF-36 Emotional	S UC	17.7 17.9	11.67		2.25	

GENERAL DISCUSSION

A decline in functional capacity is often observed in patients undergoing surgery and then adjuvant chemotherapy for breast cancer. This reduced level of fitness, coupled with fatigue often leads to fear of overexertion, which in turn creates a decrease in level of physical activity to the point that many patients become inactive. Previous non-randomized studies have shown that moderate exercise in stage I-II breast cancer patients not undergoing adjuvant chemotherapy increases cardiovascular fitness (Friedenreich & Courneya, 1996; MacVicar et al., 1989; Mock et al., 1994; Nieman et al., 1995). In particular, the review of literature by Friedenreich and Courneya on the association of exercise and rehabilitation among cancer patients concludes that exercise programs appear to improve breast cancer patients' physiologic and psychological well-being. However, these findings were not observed in the present study in which the patients were randomized to a supervised exercise program and to a usual care group. The supervised walking group showed no significant improvement in the cardiovascular fitness, body composition, and quality of life variables employed in this study over the usual care group. However, resting SBP and DBP were reduced in the supervised group by 10.4 mmHg and 7.6 mmHg respectively. Although statistically non-significant, it remains a considerable reduction. The data were examined for outliers, but none were found. Since neither group experienced any significant weight loss, nor were they being administered differing chemotherapy regimens, the reason for this reduction in the blood pressure of the exercise group remains unexplained.

A reduction in body fat and an increased lean body mass were found in a similar group of patients who performed moderate exercise on a cycle ergometer over the course

of 12 weeks (MacVicar & Winningham, 1985). The results of the present investigation, however, did not show any significant changes in body composition between the supervised group and the usual care group. Both groups remained within 1 kg of their weight at the time of the pre-test. As well, as can be seen in Table 3, both the waist-to-hip ratio and the sum of skinfolds changed minimally in both groups. These results indicate that the walking program, which the supervised group followed, had no effect on measures of body composition.

In the supervised group, 4 women gained more than 1 kg, while 6 women lost more than 1 kg. In the usual care group, 4 women gained more than 1 kg, while 4 stayed within 1 kg of their starting weight and 2 lost more than 1 kg. The absence of a significant change in body composition can perhaps be attributed to the limited amount of energy expenditure by the subjects. Twenty minutes of brisk walking three times per week for a total of 12 weeks for the average 70 kg healthy woman would lead to an energy expenditure of approximately 4680 kilocalories or 0.61 kg.

Evidence has indicated that newly diagnosed Stage I-II breast cancer patients receiving adjuvant chemotherapy experience a decline in quality of life, especially during the initial phases of treatment (Hughes, 1993; Hurny et al., 1992). Some studies have shown that a moderate exercise training program can improve some parameters of quality of life in stage I-II breast cancer patients (Friedenreich & Courneya, 1996; Mock et al., 1994; MacVicar & Winningham, 1985). More specifically, using a similar exercise program, Mock et al. (1997) studied a group of patients (N = 46) with a similar disease stage to the above studies who were undergoing radiation therapy. In their investigation in which the subjects were randomized, the two groups revealed significant differences

between groups with respect to symptom experience and fatigue, both components of quality of life. The results of the present research study, however, revealed no significant differences in quality of life variables between the supervised and usual care groups based on the FACT, the SF-36, and the STAI questionnaires, thus being in opposition to the above mentioned research.

Conversely, a randomized control trial of a group of stage II-IV breast cancer patients stratified by age and functional capacity evaluated a moderate exercise training program's effect on frequency of nausea and frequency of symptoms as reported by the subjects. During the course of the 10-12 week intervention, the exercisers had increased symptoms as compared to the placebo group and the controls, although they did experience less nausea than their counterparts (Winningham & MacVicar, 1988).

The discrepancies between previous research and the results of this study could be partially be explained by the short duration of this study. Furthermore, upon questioning the subjects at their post-test, it was revealed that five of the ten members of the usual care group had become physically active since entering the study. Although members of the research team did not give them any direct instruction with respect to exercise, it is quite possible that their oncologist may have recommended some form of physical activity. In addition, patients may have somehow assumed that physical activity must be beneficial to breast cancer patients since it was worthy of a clinical trial, and that other breast cancer patients were participating in a supervised exercise program. Moreover, the pre-test for both the supervised group and the usual care group was held in the fitness centre at the Ottawa Regional Cancer Centre where observation of other cancer patients in the midst of exercise may have provoked some personal interest in the study

participants. In addition, it is quite possible that the actual testing methods used during the baseline visit may have indicated to the usual care subjects that perhaps regular exercise and an improved fitness level might be beneficial to their overall well-being. In order to have more accurately analyzed the physical activity levels of the usual care group based on more than direct and indirect observation, a retrospective physical activity questionnaire at the time of the post-test would have been useful.

The fact that half the usual care group began participating in physical activity most certainly had a strong impact on the results of this study. The number of participants in physical activity cannot be considered significantly different between groups. It would, therefore, seem that the only difference remaining between the groups with respect to independent variables would be participation in a supervised group program.

In order to avoid this problem in future research, it would be ideal to have a large enough number of participants in the study to be able to drop those in the usual care group who begin exercise programs.

The fact that the physical activity history of the participants was different between groups may have also impacted the results. Seven of the ten members of the supervised group were exercisers prior to the study, while only one member of the usual care group participated in regular exercise. This means that 70% of the supervised group was basically maintaining, or may even have been reducing their level of physical activity, whereas this was the case for only 10% of the usual care group. To control for this in future research, prior regular physical activity might be considered a criterion in stratifying the subjects.

Half the usual care group began to experience the initial benefits of exercise, while the majority of the supervised group were either maintaining their prior level of activity, or re-adopting a habit they had held in the past. This is sure to have been an impact on the results of this study, as adding a new healthy activity to one's life has both psychological and physiological effects.

A longer intervention might also have provided stronger data in support of the literature. Mock et al. (1994) found that the exercise group had improved quality of life as compared to the non-exercise groups after 4 - 6 months; however, at mid-test (2-3 months), the controls actually scored higher than the exercisers on one parameter of QOL, psychosocial adjustment to illness. At the same point, the controls had fewer symptoms than the exercisers based on a brief symptom inventory that was completed by the subjects. Had the present study been longer, this change in certain parameters of quality of life may have also taken place. A longer study would also be supported by the fact that the American College of Sports Medicine (1990) suggests that 15 to 20 weeks of exercise may be the minimum amount of time needed for realization of physical fitness improvements in a normal population. As of yet, no evidence exists to suggest how long it takes for improvements in psychological variables in breast cancer patients.

Sample size may have also influenced the outcomes of this study, as the small number of subjects may have contributed to a loss of statistical power. There were also unusually large standard deviations in both groups for many of the variables (as can be seen in Tables 2, 3, and 4). This statistical consideration could also explain the non-significant result in systolic and diastolic blood pressure at rest of the exercise group. A placebo group may have helped to separate exercise effects from any placebo effects such

as attention, involvement, and expectation. One possibility for this might be using what Friedenreich and Courneya (1996) call "minimal exercise" for the placebo group where a light stretching program could be employed.

Since no other study has looked specifically at patients undergoing adjuvant chemotherapy, the physiological and psychological effects of this type of treatment should perhaps be considered especially in terms of timing of training. It is quite possible that the stress of a new exercise program at the same time as the stress of beginning chemotherapeutic treatment may be too demanding for the patient, both physiologically and psychologically, at least at the onset of the therapy. It would also be interesting to study a similar group of patients who participate in fitness training prior to the initiation of chemotherapy, as well as through the course of the treatment. This pre-conditioning might eliminate the double exposure to stress that was incurred at the beginning of this research study. Future research into the effects of the double stress on patients simultaneously beginning a treatment program of adjuvant chemotherapy and a physical exercise program would be of interest.

Another interesting area of future research might be pre-conditioning of patients prior to adjuvant chemotherapy. It would be valuable to know whether those patients who maintain a certain level of physical activity, are able to tolerate the trauma of adjuvant chemotherapy for breast cancer with greater ease than those who are inactive/sedentary.

As half the usual care group began to exercise, it would be imprudent to say that a 12-week walking program has no significant impact on cardiovascular fitness, body composition and quality of life in breast cancer patients undergoing adjuvant

chemotherapy. However, in this study the supervised exercise group and the usual care group had no significant differences with respect to these variables.

CONCLUSION

The results of this study indicate that stage I-II breast cancer patients undergoing adjuvant chemotherapy for breast cancer did not demonstrate an improvement in cardiovascular fitness, body composition, or quality of life over the period of a 12-week supervised walking program. These results do not support previous studies that showed that exercise in breast cancer patients improved some parameters of quality of life and physical fitness. However, the fact that subjects in the usual care group may have begun an exercise program could most certainly have affected the results. A larger sample size might elicit different results, as might a longer intervention. Controlling for physical activity history, as well as limiting in some way the participation of the usual care group in physical activity might also have lent strength to the study, while a placebo group might help to more accurately demonstrate the effects of this type of exercise program.

Exercise is an inexpensive, current, and auspicious mode for the rehabilitation of breast cancer patients, and continues to be well worthy of further research.

CONTRIBUTIONS OF COLLABORATORS

This work could not have been completed without the help of the Cancer Rehabilitation Research Team at the Ottawa Regional Cancer Centre – General Division.

Thank you to the following individuals for their contributions:

Dr. Maurice Jette - thesis advisor

Dr. Roanne Segal – primary researcher

Darren Johnson & Julie Smith – ORCC Rehabiliation Program; test/program administrators

APPENDIX: A

PARTICIPANT AND DATA QUESTIONNAIRES

Exercise and Breast Cancer Study
Participant Questionnaire

ORCC Id No. _____ Date: _____
Participant Number: _____

A. DEMOGRAPHICS

1. Age

Date of Birth ____/____/____ Age____yrs
Y M D

2. Education

Check off the highest level of education completed:

i) Primary school _____
ii) High school _____
iii) College _____
iv) University _____
v) Post Graduate _____

3. Employment

What is your present employment status?

i) Currently working _____
ii) Unemployed _____
iii) Disability leave _____
iv) Retired _____

What is your present or most recent occupation?_____
_____

4. Marital Status

i) Single _____
ii) Married _____
iii) Divorced _____
iv) Separated _____
v) Widowed _____

5. In what language would you like to receive the educational material for this program?

English French

B. PHYSICAL ACTIVITY

1. Do you take part in REGULAR physical activity? Yes No

If yes, please list the activity(ies), amount weekly, duration per session, and intensity.

Amount Weekly: Refers to the number of times you participate per week.

Duration: Refers to the number of minutes per session.

Intensity: Light = Slight change above normal state.
Moderate = Perspiration and breathing above normal.
Heavy = Heavy perspiration and heavy breathing.

ACTIVITY	AMT./WEEK	DURATION	INTENSITY

C. SMOKING HISTORY

Please circle the MOST appropriate response:

Smoker Ex-Smoker Non-Smoker

If a smoker or ex-smoker please enter the number of years:

an Ex-Smoker_____ a Smoker____

APPENDIX: B/C

FUNCTIONAL ASSESSMENT OF CANCER THERAPY SCALE

FACT-B

FACT-B (Version 3)

Below is a list of statements that other people with your illness have said are important. **By circling one number per line, please indicate how true each statement has been for you <u>during the past 7 days</u>.**

PHYSICAL WELL-BEING

		not at all	a little bit	some-what	quite a bit	very much
1.	I have a lack of energy	0	1	2	3	4
2.	I have nausea	0	1	2	3	4
3.	Because of my physical condition, I have trouble meeting the needs of my family	0	1	2	3	4
4.	I have pain	0	1	2	3	4
5.	I am bothered by side effects of treatment	0	1	2	3	4
6.	I feel sick	0	1	2	3	4
7.	I am forced to spend time in bed	0	1	2	3	4

8. Looking at the above 7 questions, how much would you say your **PHYSICAL WELL-BEING** affects your quality of life? (circle one number)

0 1 2 3 4 5 6 7 8 9 10

Not at all **Very much so**

SOCIAL/FAMILY WELL-BEING

		not at all	a little bit	some-what	quite a bit	very much
9.	I feel distant from my friends	0	1	2	3	4
10.	I get emotional support from my family	0	1	2	3	4
11.	I get support from my friends and neighbors	0	1	2	3	4
12.	My family has accepted my illness	0	1	2	3	4
13.	Family communication about my illness is poor	0	1	2	3	4
14.	I feel close to my partner (or the person who is my main support)	0	1	2	3	4
15.	Have you been sexually active during the past year? No ___ Yes ___ If yes: I am satisfied with my sex life	0	1	2	3	4

16. Looking at the above 7 questions, how much would you say your **SOCIAL/FAMILY WELL-BEING** affects your quality of life? (circle one number)

0 1 2 3 4 5 6 7 8 9 10

Not at all **Very much so**

FACT-B (Version 3)

Please indicate how true each statement has been for you during the past 7 days.

RELATIONSHIP WITH DOCTOR

	not at all	a little bit	some-what	quite a bit	very much
17. I have confidence in my doctor(s).....	0	1	2	3	4
18. My doctor is available to answer my questions.....	0	1	2	3	4

19. Looking at the above 2 questions, how much would you say your **RELATIONSHIP WITH THE DOCTOR** affects your quality of life? (circle one number)

0 1 2 3 4 5 6 7 8 9 10

Not at all **Very much so**

EMOTIONAL WELL-BEING

	not at all	a little bit	some-what	quite a bit	very much
20. I feel sad.....	0	1	2	3	4
21. I am proud of how I'm coping with my illness.....	0	1	2	3	4
22. I am losing hope in the fight against my illness.....	0	1	2	3	4
23. I feel nervous.....	0	1	2	3	4
24. I worry about dying.....	0	1	2	3	4
25. I worry that my condition will get worse.....	0	1	2	3	4

26. Looking at the above 6 questions, how much would you say your **EMOTIONAL WELL-BEING** affects your quality of life? (circle one number)

0 1 2 3 4 5 6 7 8 9 10

Not at all **Very much so**

FUNCTIONAL WELL-BEING

	not at all	a little bit	some-what	quite a bit	very much
27. I am able to work (include work in home).....	0	1	2	3	4
28. My work (include work in home) is fulfilling.....	0	1	2	3	4
29. I am able to enjoy life.....	0	1	2	3	4
30. I have accepted my illness.....	0	1	2	3	4
31. I am sleeping well.....	0	1	2	3	4
32. I am enjoying the things I usually do for fun.....	0	1	2	3	4
33. I am content with the quality of my life right now.....	0	1	2	3	4

34. Looking at the above 7 questions, how much would you say your **FUNCTIONAL WELL-BEING** affects your quality of life? (circle one number)

0 1 2 3 4 5 6 7 8 9 10

Not at all **Very much so**

FACT - B (Version 3)

Please indicate how true each statement has been for you during the past 7 days.

ADDITIONAL CONCERNS	not at all	a little bit	some-what	quite a bit	very much
35. I have been short of breath	0	1	2	3	4
36. I am self-conscious about the way I dress	0	1	2	3	4
37. My arms are swollen or tender	0	1	2	3	4
38. I feel sexually attractive	0	1	2	3	4
39. I have been bothered by hair loss	0	1	2	3	4
40. I worry about the risk of cancer in other family members	0	1	2	3	4
41. I worry about the effect of stress on my illness	0	1	2	3	4
42. I am bothered by a change in weight	0	1	2	3	4
43. I am able to feel like a woman	0	1	2	3	4

44. Looking at the above 9 questions, how much would you say these **ADDITIONAL CONCERNS** affect your quality of life? (circle one number)

0 1 2 3 4 5 6 7 8 9 10

Not at all **Very much so**

FACT - B (3ème version)

Vous trouverez ci-dessous une liste d'affirmations que des personnes atteintes de la même maladie que vous ont déclaré être importantes. **En entourant un seul chiffre par ligne, veuillez indiquer dans quelle mesure chaque affirmation a été applicable à votre cas, au cours des 7 derniers jours.**

BIEN-ÊTRE PHYSIQUE

	pas du tout	un peu	moyen-nement	beau-coup	énor-mément
1. J'ai manqué d'énergie	0	1	2	3	4
2. J'ai eu des nausées	0	1	2	3	4
3. À cause de mon état physique, j'ai eu du mal à répondre aux besoins de ma famille	0	1	2	3	4
4. J'ai eu des douleurs	0	1	2	3	4
5. J'ai été gêné(e) par les effets indésirables du traitement	0	1	2	3	4
6. Je me suis senti(e) malade	0	1	2	3	4
7. J'ai été obligé(e) de rester alité(e)	0	1	2	3	4

8. En tenant compte des 7 propositions ci-dessus, dans quelle mesure pensez-vous que votre **BIEN-ÊTRE PHYSIQUE** a affecté votre qualité de vie? (encerclez un chiffre)

0 1 2 3 4 5 6 7 8 9 10

Pas du tout **Énormément**

BIEN-ÊTRE FAMILIAL/SOCIAL

	pas du tout	un peu	moyen-nement	beau-coup	énor-mément
9. Je me suis senti(e) distant(e) de mes amis	0	1	2	3	4
10. Je me suis senti(e) soutenu(e) moralement par ma famille	0	1	2	3	4
11. Je me suis senti(e) soutenu(e) par mes amis et mes voisins	0	1	2	3	4
12. Ma famille a accepté ma maladie	0	1	2	3	4
13. À propos de ma maladie, la communication dans ma famille a été très limitée	0	1	2	3	4
14. Je me suis senti(e) proche de mon (ma) partenaire (ou de la personne qui est mon principal soutien)	0	1	2	3	4
15. Avez-vous eu une vie sexuelle au cours de l'année passée? Non ___ Oui ___ Si oui: J'ai été satisfait(e) de ma vie sexuelle...	0	1	2	3	4

16. En tenant compte des 7 propositions ci-dessus, dans quelle mesure pensez-vous que votre **BIEN-ÊTRE FAMILIAL/SOCIAL** a affecté votre qualité de vie? (encerclez un chiffre)

0 1 2 3 4 5 6 7 8 9 10

Pas du tout **Énormément**

FACT - B (3ème version)

En entourant un seul chiffre par ligne, veuillez indiquer dans quelle mesure chaque affirmation a été applicable à votre cas, au cours des 7 derniers jours.

RAPPORTS AVEC LE MÉDECIN	pas du tout	un peu	moyen-nement	beau-coup	énor-mément
17. J'ai eu confiance en mon médecin.....	0	1	2	3	4
18. Mon médecin a été prêt à répondre aux questions que je lui ai posées.....	0	1	2	3	4

19. En tenant compte des 2 propositions ci-dessus, dans quelle mesure pensez-vous que vos **RELATIONS AVEC VOTRE(VOS) MÉDECIN(S)** ont affecté votre qualité de vie? (encerclez un chiffre)

0 1 2 3 4 5 6 7 8 9 10

Pas du tout **Énormément**

BIEN-ÊTRE ÉMOTIONNEL	pas du tout	un peu	moyen-nement	beau-coup	énor-mément
20. Je me suis senti(e) triste.....	0	1	2	3	4
21. Je me suis senti(e) fier(fière) de la façon dont je fais face à ma maladie.....	0	1	2	3	4
22. J'ai perdu l'espoir dans le combat contre ma maladie.....	0	1	2	3	4
23. Je me suis senti(e) nerveux (nerveuse).....	0	1	2	3	4
24. J'ai eu peur de mourir.....	0	1	2	3	4
25. J'ai eu peur que mon état s'aggrave.....	0	1	2	3	4

26. En tenant compte des 6 propositions ci-dessus, dans quelle mesure pensez-vous que votre **BIEN-ÊTRE ÉMOTIONNEL** a affecté votre qualité de vie? (encerclez un chiffre)

0 1 2 3 4 5 6 7 8 9 10

Pas du tout **Énormément**

BIEN-ÊTRE FONCTIONNEL	pas du tout	un peu	moyen-nement	beau-coup	énor-mément
27. Je me suis senti(e) capable de travailler, y compris les tâches domestique	0	1	2	3	4
28. Mon travail (y compris les tâches domestiques) a été tout à fait satisfaisant.....	0	1	2	3	4
29. Je peux profiter de la vie.....	0	1	2	3	4
30. J'ai accepté ma maladie.....	0	1	2	3	4
31. J'ai bien dormi.....	0	1	2	3	4
32. J'ai pu profiter des choses que je fais habituellement pour me distraire.....	0	1	2	3	4
33. J'ai été satisfait(e) de ma qualité de vie actuelle.....	0	1	2	3	4

34. En tenant compte des 7 propositions ci-dessus, dans quelle mesure pensez-vous que votre **BIEN-ÊTRE FONCTIONNEL** a affecté votre qualité de vie? (encerclez un chiffre)

0 1 2 3 4 5 6 7 8 9 10

Pas du tout **Énormément**

FACT - B (3ème version)

En entourant un seul chiffre par ligne, veuillez indiquer dans quelle mesure chaque affirmation a été applicable à votre cas, au cours des 7 derniers jours.

AUTRES SUJETS D'INQUIÉTUDE	pas du tout	un peu	moyen-nement	beau-coup	énor-mément
35. J'ai eu le souffle court	0	1	2	3	4
36. Je me suis sentie gênée pour trouver la manière de m'habiller	0	1	2	3	4
37. Mes bras ont été enflés ou sensibles	0	1	2	3	4
38. Je me suis sentie sexuellement attirante	0	1	2	3	4
39. J'ai été préoccupée par la perte de mes cheveux	0	1	2	3	4
40. Je me suis inquiétée des risques de cancer pour d'autres membres de ma famille	0	1	2	3	4
41. L'effet du stress sur ma maladie m'a inquiété	0	1	2	3	4
42. Les variations de mon poids m'ont préoccupée	0	1	2	3	4
43. Je me suis sentie femme à part entière	0	1	2	3	4

44. En tenant compte des 9 propositions ci-dessus, dans quelle mesure pensez-vous que ces **AUTRES SUJETS D'INQUIÉTUDE** ont affecté votre qualité de vie? (encerclez un chiffre)

0 1 2 3 4 5 6 7 8 9 10

Pas du tout **Énormément**

APPENDIX: D/E

MOS 36-ITEM SHORT FORM HEALTH SURVEY

(SF-36)

SF-36 HEALTH SURVEY

INSTRUCTIONS: This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.

Answer every question by marking the answer as indicated. If you are unsure about how to answer a question, please give the best answer you can.

1. In general, would you say your health is:

(circle one)

Excellent 1

Very good 2

Good 3

Fair 4

Poor 5

2. Compared to one week ago, how would you rate your health in general now?

(circle one)

Much better now than one week ago 1

Somewhat better now than one week ago 2

About the same as one week ago 3

Somewhat worse now than one week ago 4

Much worse now than one week ago 5

3. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

(circle one number on each line)

ACTIVITIES	Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
a. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	1	2	3
b. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	1	2	3
c. Lifting or carrying groceries	1	2	3
d. Climbing **several** flights of stairs	1	2	3
e. Climbing **one** flight of stairs	1	2	3
f. Bending, kneeling, or stooping	1	2	3
g. Walking **more than a kilometre**	1	2	3
h. Walking **several blocks**	1	2	3
i. Walking **one block**	1	2	3
j. Bathing or dressing yourself	1	2	3

4. During the past week, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

(circle one number on each line)

	YES	NO
a. Cut down on the **amount of time** you spent on work or other activities	1	2
b. **Accomplished less** than you would like	1	2
c. Were limited in the **kind** of work or other activities	1	2
d. Had **difficulty** performing the work or other activities (for example, it took extra effort)	1	2

5. During the past week, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

(circle one number on each line)

	YES	NO
a. Cut down the amount of time you spent on work or other activities	1	2
b. Accomplished less than you would like	1	2
c. Didn't do work or other activities as carefully as usual	1	2

6. During the past week, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

(circle one)

Not at all 1

Slightly 2

Moderately 3

Quite a bit 4

Extremely 5

7. How much bodily pain have you had during the past week?

(circle one)

None 1

Very mild 2

Mild 3

Moderate 4

Severe 5

Very severe 6

8. During the past week, how much did pain interfere with your normal work (including both work outside the home and housework)?

(circle one)

Not at all 1

A little bit 2

Moderately 3

Quite a bit 4

Extremely 5

9. These questions are about how you feel and how things have been with you during the past week. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past week -

(circle one number on each line)

	All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
a. Did you feel full of pep?	1	2	3	4	5	6
b. Have you been a very nervous person?	1	2	3	4	5	6
c. Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d. Have you felt calm and peaceful?	1	2	3	4	5	6
e. Did you have a lot of energy?	1	2	3	4	5	6
f. Have you felt downhearted and blue?	1	2	3	4	5	6
g. Did you feel worn out?	1	2	3	4	5	6
h. Have you been a happy person?	1	2	3	4	5	6
i. Did you feel tired?	1	2	3	4	5	6

10. During the past week, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

(circle one)

All of the time 1

Most of the time 2

Some of the time 3

A little of the time 4

None of the time 5

11. How TRUE or FALSE is each of the following statements for you?

(circle one number on each line)

	Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
a. I seem to get sick a little easier than other people	1	2	3	4	5
b. I am as healthy as anybody I know	1	2	3	4	5
c. I expect my health to get worse	1	2	3	4	5
d. My health is excellent	1	2	3	4	5

QUESTIONNAIRE SUR L'ÉTAT DE SANTÉ SF-36

DIRECTIVES: Les questions qui suivent portent sur votre santé, telle que vous la percevez. Vos réponses permettront de suivre l'évolution de votre état de santé et de savoir dans quelle mesure vous pouvez accomplir vos activités courantes.

Répondez à toutes les questions en suivant les indications qui vous sont données. En cas de doute, répondez de votre mieux.

1. En général, diriez-vous que votre santé est:

(encerclez une seule réponse)

Excellente 1

Très bonne 2

Bonne 3

Passable 4

Mauvaise 5

2. Par comparaison à l'an dernier, comment évaluez-vous, maintenant, votre santé générale?

(encerclez une seule réponse)

Bien meilleure maintenant que l'an dernier 1

Un peu meilleure maintenant que l'an dernier 2

À peu près la même que l'an dernier 3

Un peu moins bonne maintenant que l'an dernier 4

Bien moins bonne maintenant que l'an dernier 5

3. Les questions suivantes portent sur les activités que vous pourriez avoir à faire au cours d'une journée normale. Votre état de santé actuel vous limite-t-il dans ces activités? Si oui, dans quelle mesure?

(encerclez un seul chiffre par ligne)

ACTIVITÉS	Mon état de santé me limite beaucoup	Mon état de santé me limite un peu	Mon état de santé ne me limite pas du tout
a. Dans les activités exigeant un effort physique important comme courir, soulever des objets lourds, pratiquer des sports violents	1	2	3
b. Dans les activités modérées comme déplacer une table, passer l'aspirateur, jouer aux quilles ou au golf	1	2	3
c. Pour soulever ou transporter des sacs d'épicerie	1	2	3
d. Pour monter plusieurs étages à pied	1	2	3
e. Pour monter un seul étage à pied	1	2	3
f. Pour me pencher, me mettre à genoux ou m'accroupir	1	2	3
g. Pour faire plus d'un kilomètre à pied	1	2	3
h. Pour faire plusieurs coins de rue à pied	1	2	3
i. Pour marcher d'un coin de rue à l'autre	1	2	3
j. Pour prendre un bain ou m'habiller	1	2	3

4. Au cours des quatre dernières semaines, avez-vous eu l'une ou l'autre des difficultés suivantes au travail ou dans vos autres activités quotidiennes à cause de votre état de santé physique?

(encerclez un seul chiffre par ligne)

	OUI	NON
a. Avez-vous dû consacrer **moins de temps** à votre travail ou à d'autres activités?	1	2
b. **Avez-vous accompli moins** de choses que vous l'auriez voulu?	1	2
c. Avez-vous été limité(e) dans la **nature** de vos tâches ou de vos autres activités?	1	2
d. Avez-vous eu **de la difficulté** à accomplir votre travail ou vos autres activités (par exemple vous a-t-il fallu fournir un effort supplémentaire)?	1	2

5. Au cours des quatre dernières semaines, avez-vous eu l'une ou l'autre des difficultés suivantes au travail ou dans vos autres activités quotidiennes à cause de l'état de votre moral (comme le fait de vous sentir déprimé(e) ou anxieux(se))?

(encerclez un seul chiffre par ligne)

	OUI	NON
a. Avez-vous dû consacrer **moins de temps** à votre travail ou à d'autres activités?	1	2
b. Avez-vous **accompli moins** de choses que vous l'auriez voulu?	1	2
c. Avez-vous fait votre travail ou vos autres activités avec **moins de soin** qu'à l'habitude?	1	2

6. Au cours des quatre dernières semaines, dans quelle mesure votre état physique ou moral a-t-il nui à vos activités sociales habituelles (famille, amis, voisins ou autres groupes)?

(encerclez une seule réponse)

Pas du tout 1

Un peu 2

Moyennement 3

Beaucoup 4

Enormément 5

7. Au cours des quatre dernières semaines, avez-vous éprouvé des douleurs physiques?

(encerclez une seule réponse)

Aucune douleur 1

Douleurs très légères 2

Douleurs légères 3

Douleurs moyennes 4

Douleurs intenses 5

Douleurs très intenses 6

8. Au cours des quatre dernières semaines, dans quelle mesure la douleur a-t-elle nui à vos activités habituelles (au travail comme à la maison)?

(encerclez une seule réponse)

Pas du tout 1

Un peu 2

Moyennement 3

Beaucoup 4

Enormément 5

9. Ces questions portent sur les quatre dernières semaines. Pour chacune des questions suivantes, donnez la réponse qui s'approche le plus de la façon dont vous vous êtes senti(e).

Au cours des quatre dernières semaines, combien de fois:

(encerclez un seul chiffre par ligne)

	Tout le temps	La plupart du temps	Souvent	Quel-quefois	Rare-ment	Jamais
a. Vous êtes-vous senti(e) plein(e) d'entrain (de pep)?	1	2	3	4	5	6
b. Avez-vous été très nerveux(se)?	1	2	3	4	5	6
c. Vous êtes-vous senti(e) si déprimé(e) que rien ne pouvait vous remonter le moral?	1	2	3	4	5	6
d. Vous êtes-vous senti(e) calme et serein(e)?	1	2	3	4	5	6
e. Avez-vous eu beaucoup d'énergie?	1	2	3	4	5	6
f. Vous êtes-vous senti(e) triste et abattu(e)?	1	2	3	4	5	6
g. Vous êtes-vous senti(e) épuisé(e) et vidé(e)?	1	2	3	4	5	6
h. Vous êtes-vous senti(e) heureux(se)?	1	2	3	4	5	6
i. Vous êtes-vous senti(e) fatigué(e)?	1	2	3	4	5	6

10. Au cours des quatre dernières semaines, combien de fois votre état physique ou moral a-t-il nui à vos activités sociales (comme visiter des amis, des parents, etc.)?

(encerclez une seule réponse)

Tout le temps 1

La plupart du temps 2

Parfois 3

Rarement 4

Jamais 5

11. Dans quelle mesure chacun des énoncés suivants est-il VRAI ou FAUX dans votre cas?

(encerclez un seul chiffre par ligne)

	Tout à fait vrai	Plutôt vrai	Ne sais pas	Plutôt faux	Tout à fait faux
a. Il me semble que je tombe malade un peu plus facilement que les autres	1	2	3	4	5
b. Je suis en aussi bonne santé que les gens que je connais	1	2	3	4	5
c. Je m'attends à ce que ma santé se détériore	1	2	3	4	5
d. Ma santé est excellente	1	2	3	4	5

APPENDIX: F

STATE-TRAIT ANXIETY INVENTORY

(STAI)

SELF-EVALUATION QUESTIONNAIRE

Developed by Charles D. Spielberger
in collaboration with
R. L. Gorsuch, R. Lushene, P. R. Vagg, and G. A. Jacobs

STAI Form Y-1

Name _____ Date _____ S ____

Age _____ Sex: M ____ F ____ T ____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	①	②	③	④
2. I feel secure	①	②	③	④
3. I am tense	①	②	③	④
4. I feel strained	①	②	③	④
5. I feel at ease	①	②	③	④
6. I feel upset	①	②	③	④
7. I am presently worrying over possible misfortunes	①	②	③	④
8. I feel satisfied	①	②	③	④
9. I feel frightened	①	②	③	④
10. I feel comfortable	①	②	③	④
11. I feel self-confident	①	②	③	④
12. I feel nervous	①	②	③	④
13. I am jittery	①	②	③	④
14. I feel indecisive	①	②	③	④
15. I am relaxed	①	②	③	④
16. I feel content	①	②	③	④
17. I am worried	①	②	③	④
18. I feel confused	①	②	③	④
19. I feel steady	①	②	③	④
20. I feel pleasant	①	②	③	④

Consulting Psychologists Press, Inc.
3803 E. Bayshore Road • Palo Alto, CA 94303