Postmenopausal Breast Cancer Survivors at Risk for Osteoporosis: Physical Activity, Vigor, and Vitality

Gloria Jean Gross, RN, PhD, Carol D. Ott, RN, PhD, OCN®,
Ada M. Lindsey, RN, PhD, FAAN, Janice J. Twiss, RN, PhD, APRN,
and Nancy Waltman, RN, PhD, APRN

Purpose/Objectives: To test a multicomponent intervention to prevent and treat osteoporosis in breast cancer survivors.

Design: Descriptive, correlational.

Setting: Midwestern urban and rural sites.

Sample: 27 postmenopausal breast cancer survivors between the ages of 42–65 who had completed treatment, except for tamoxifen, and were not candidates for hormone replacement therapy.

Methods: Bone mineral density (BMD) of the hip, spine, and forearm was measured using dual-energy x-ray absorptiometry. Physical activity was recorded using the Seven-Day Physical Activity Recall–Adapted, which classifies activities as light, moderate, hard, or very hard. Vigor was measured with the eight-item subscale of the Profile of Mood State based on the previous week. Vitality was measured using the four-question subscale of the Medical Outcomes Study 36-Item Short Form Health Survey.

Main Research Variables: Physical activity, vigor, vitality, and BMD.

Findings: More than half reported no very hard physical activity, and 37% reported no hard activity. The association of vigor with total metabolic equivalents for combined moderate, hard, and very hard activities was significant ($r = 0.536$, $p = 0.007$), as were the hours spent in the combined moderate to very hard activities. No relationship was found between vigor, vitality, or any level of activity and BMD.

Conclusions: Survivors reported high levels of perceived vigor and vitality but spent more time engaged in light versus hard or very hard activities. Positive correlations between higher levels of vitality and vigor with metabolic equivalents support the idea that activity promotes perceptions of energy and positive feelings.

Implications for Nursing: Breast cancer survivors are at risk for osteoporosis. Nurses should be aware of increased risk, recommend screening for bone health, and encourage physical activity.

Key Points . . .

➤ Women who have undergone treatment for breast cancer are at higher risk for osteoporosis because of loss of ovarian function.

➤ A low level of physical activity is an additional risk factor for osteoporosis; increasing physical activity, particularly weight bearing, is a strategy for maintaining bone health.

➤ A positive correlation existed between higher levels of physical activity and energy expended and higher levels of vigor and vitality in this group of breast cancer survivors.

of height and change in body stature, and increasing loss of mobility with resultant social isolation.

Women who are diagnosed with breast cancer often are treated with adjuvant chemotherapy, and the improved treatment protocols have resulted in an increasing number of women who survive the disease. However, the medications that are used to achieve this positive outcome often result in early menopause, with more than 50% of women younger than 50 experiencing ovarian failure (Ali & Twibell, 1994; Cobleigh et al., 1994; Mahon, 1998). Loss of ovarian function produces a rapid increase in bone remodeling with a consequent loss of skeletal mass. This is true whether the loss is the result of natural, age-related decline in ovarian production of estrogen or iatrogenic causes (e.g., oophorectomy, chemotherapeutic agents).

Treatment and prevention of osteoporosis have been studied by many investigators. They have examined hormone replacement therapy (HRT) with estrogen or estrogen plus progestin, the bisphosphonates including alendronate, calcium with and without vitamin D, calcitonin, selective estrogen

Gloria Jean Gross, RN, PhD, is an associate professor, Carol D. Ott, RN, PhD, OCN®, is an assistant professor, Ada M. Lindsey, RN, PhD, FAAN, is a professor, Janice J. Twiss, RN, PhD, APRN, is an associate professor, and Nancy Waltman, RN, PhD, APRN, is an associate professor, all in the School of Nursing at the University of Nebraska Medical Center in Scottsbluff.

Osteoporosis is a major cause of morbidity and mortality for postmenopausal women, with an estimated 40% expected to suffer a fragility fracture in their lifetimes if osteoporosis is untreated (Lindsay, 1993; Scheiber & Torregrosa, 1998). Fractures occur most commonly in the vertebral column, hip, and wrist. Mortality three to four months after a hip fracture is 20% (Gibaldi, 1997). Women who have osteoporosis suffer from chronic pain, loss

receptor modulators, anabolic steroids, and parathyroid hormone (Brandi, 1993; Heaney, 1993; Kanis, 1993; Karpf et al., 1997; Lindsay, 1993; Papapoulos, 1993; Reginster, 1993). The consensus is that HRT is the most effective therapy to treat and prevent osteoporosis. Because more than 60% of women with breast cancer have tumors that are estrogen-receptor positive and estrogen may promote tumor growth, most are not thought to be candidates for HRT (Cobleigh et al., 1994; DeVita, Hellman, & Rosenberg, 1997). Headley, Theriault, LeBlanc, Vassilopoulou-Sellin, and Hortobagyi (1998) studied the bone mineral density (BMD) of patients with breast cancer treated with adjuvant chemotherapy. Sixteen of 27 patients became permanently amenorrheic following chemotherapy and had BMDs 14% lower than women who maintained ovarian function. These studies seem to indicate that breast cancer survivors are at a greater risk for osteoporosis and that, because they are not candidates for the best treatment and prevention with HRT, alternative therapies are indicated. The current study incorporates a multicomponent program to prevent and treat osteoporosis in breast cancer survivors.

The role of physical activity in bone health is known to be important, particularly during childhood. Ernst (1998) conducted a review of the relevant literature on the effects of physical activity on BMD in women with osteoporosis. The 21 studies had sample sizes ranging from 15–255 subjects and were conducted for as short as seven months to as long as four years. Despite the heterogeneity of the trials, Ernst concluded that regular physical activity can influence bone health by delaying or halting bone loss.

Physical activity was one of several variables examined for relationship to bone loss in 1,134 elderly women (Nguyen, Sambrook, & Eisman, 1998). Physical activity was assessed based on self-reported hours per day spent on several activities that were categorized into five levels of activity according to expected oxygen consumption. The products of hours per day multiplied by the weighting factor were summed to yield a daily physical activity index. A sedentary lifestyle was associated with a significant reduction in BMD, and no significant bone loss was demonstrated among the most active women. This effect was independent of age but dependent on baseline weight and weight change. Physical activity produced change in BMD only in women who lost or had stable weight.

Because of the recognized risk for osteoporosis in breast cancer survivors, the current study's researchers designed an 18-month, prospective pilot study to test the feasibility and effectiveness of a multicomponent intervention to prevent and treat osteoporosis in postmenopausal breast cancer survivors. Components of the intervention include alendronate, calcium, vitamin D, and strength or weight training with facilitative

strategies. Description of the intervention is reported elsewhere (Ott et al., 2001; Waltman et al., 2001). Nutritional intake, body size, bone health, and presence of osteoporosis were determined at study entry (Lindsey et al., 2002; Twiss et al., 2001). The primary purpose of this article is to describe the levels of physical activity, vigor, and vitality in relation to BMD at baseline for 27 breast cancer survivors at risk for osteoporosis. Figure 1 depicts the research model for the elements reported for this study.

Methods

The design for the 18-month pilot study was quasi-experimental. The study was approved by the scientific review committee of the cancer center and the institutional review board of the midwestern university academic health science center. For this report on physical activity, vigor, and vitality at baseline, findings are presented as descriptive and correlational.

Sample and Setting

Female breast cancer survivors were recruited from one urban and two rural sites in a midwestern state. Strategies for recruitment included presentations at breast cancer support groups, notices in hospital newsletters, referrals by oncologists, newspaper and radio advertisements, and personal contact. Inclusion criteria were female breast cancer survivors between the ages of 40–65 who were at least six months past completion of treatment (except for tamoxifen) for stage I or II breast cancer and had no recurrence, postmenopausal (six months since last menses), and not candidates for HRT. Each subject had to be able to read, speak, and understand English. Excluded were those who were current smokers; had a body mass index greater than 38; consumed on average more than two alcoholic drinks per day; currently were taking HRT, glucocorticoids, medications for gastrointestinal problems, or other medications affecting bone; or were in a physical activity program that included strength or weight training. Women in exercise programs that included strength or weight training were excluded because the training was an important component of the intervention and the investigators wanted to evaluate the effect over time of that component on BMD. After telephone interviews by the investigators to determine eligibility, the subjects met with investigators at the subjects' homes or other convenient locations (e.g., office, hospital, physical therapy department). The study was fully explained, informed consent was obtained, and baseline data were gathered. Thirty women—29 Caucasian and 1 Hispanic—met the inclusion criteria and completed baseline instruments. Only 27 subjects had complete data for physical activity, vigor, and vitality.
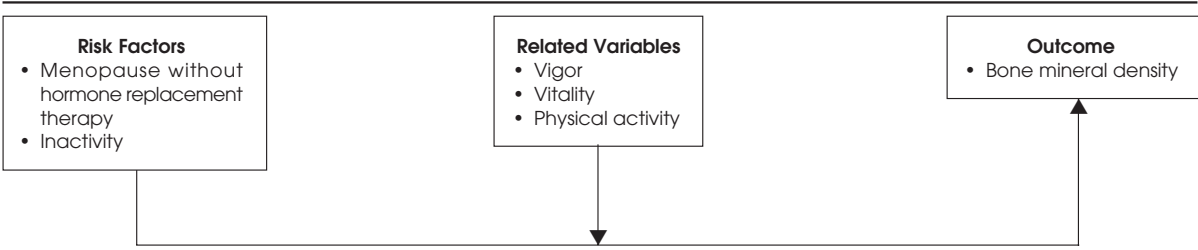

Figure 1. Prevention and Treatment of Osteoporosis in Breast Cancer Survivors' Physical Activity

Instruments

Demographic and antecedent variables profile: The profile is an investigator-designed instrument to elicit typical demographic information and data related to the cancer diagnosis and treatment, family history of osteoporosis, history of medications thought to influence bone health, and exposure to estrogen. Subjects completed the instrument as a self-report at the first session.

Seven-Day Physical Activity Recall–Adapted: Interviewers guided the subjects to complete a self-reported, seven-day recall of activities classified as light (consuming less than 2 metabolic equivalents [METs]), moderate (2–3.9 METs), hard (4–5.9 METs), or very hard (> 6 METs). MET is the energy expended while sitting quietly or the resting metabolic rate. An example of a light activity is watching television, moderate is shopping, hard is dancing, and very hard is moving heavy furniture. The number of minutes or hours spent in each activity is multiplied by the number of days per week the subjects engaged in the activity. The total time in minutes and hours are summed for each activity level, and the total is divided by seven to get the mean number of hours and minutes per day spent in each activity level. To derive the estimated METs for each level of activity, the mean time spent per day is multiplied by the level of activity factor; for example, for light activity, the factor used was 1.5; moderate activity was 3; hard activity was 5; and very hard activity was 6.5.

Sallis et al. (1985) conducted test-retest reliability (reproducibility) of the self-report measures of activity with a correlation of 0.83 and 0.91–0.98 for individual behavior items. Construct validity was established for interviews with lder adults by Hellman, Williams, and Thalken (1997). The mean number of hours and minutes spent in each activity level and the mean METs for each activity level were entered into the analysis for the current study.

Vigor subscale of Profile of Mood State (POMS): Vigor is measured on an eight-item subscale of POMS. Subjects responded to 65 adjectives describing how they felt over the previous week on a five-point ordinal scale of "not at all," "a little," "quite a bit," "moderately," and "extremely." These modifiers are weighted from 0–4 with a possible score of 32 representing the highest level of vigor. POMS has six factors: tension-anxiety, depression-dejection, anger-hostility, vigor-activity, fatigue-inertia, and confusion-bewilderment. Test-retest reliability for the vigor-activity subscale was 0.65 and internal consistency was 0.89 and 0.87 in two studies (Nowlis & Green, 1957; McNair, Lorr, & Droppleman, 1992). Both predictive and construct validity for POMS have been established in studies from a variety of fields (McNair et al.). The mean scores on the vigor subscale were entered into the analysis for this study.

Vitality subscale of Medical Outcomes Study 36-Item Short Form Health Survey (MOS SF-36): MOS SF-36 asks respondents for self-reports of feelings and actions over the previous month. The instrument contains eight subscales on physical functioning, social functioning, role limitations for physical and emotional reasons, mental health, pain, general health perception, and energy and fatigue. The energy and fatigue subscale measures vitality. The vitality subscale has four questions on energy, being tired, or being "full of pep." Reliability and validity of the total instrument have been established (McHorney, Ware, Lu, & Sherbourne, 1994; McHorney, Ware, & Raczek, 1993; Ware & Sherbourne, 1992; Ware,

Snow, Kosinski, & Gandek, 1993). For this report, the mean subscale scores for vitality were entered for analysis.

Dual-energy x-ray absorbtiometry (DEXA): Because BMD is an end point of the study, each subject had a baseline DEXA using a Hologic QDR® 1000 densitometer (Hologic Inc., Bedford, MA) at one site, a Hologic QDR 2000 densitometer at another site, and a Lunar DPX-IQ™ (Lunar Corp., Madison, WI) densitometer at the third site. BMD was measured for the lumbar spine, hip, and distal forearm. All BMDs were read by one research radiologist to maintain consistency. Daily calibration was performed on each machine using a standard phantom, with a maintenance of a 95% confidence interval. Lunar DPX-IQ has a coefficient of variation from 0.24–0.66, and the Hologic QDR has a coefficient of variation from 0.27–0.33. Studies of DEXA have documented accuracies from 90%–99% and precisions from 98%–99% for measurements of the hip, spine, and forearm (Jergas & Genant, 1993). DEXA results are given in gm/cm^2 and in T-scores comparing subjects' BMD to those of normal young adults. For this analysis, T-scores and gm/cm^2 were entered for analysis.

Data Analysis

Baseline data on demographics, physical activity level, vigor, vitality, and BMD were analyzed using SPSS® 9.0 (SPSS Inc., Chicago, IL) software. Results are reported as descriptive data, correlations, and comparisons. An alpha level of greater than or equal to 0.05 was established for all statistical tests.

Results

The baseline characteristics of the 27 women are shown in Table 1. The mean age was 53.3 with a range from 42–65 years. Fifty-six percent had stage II cancer at diagnosis. A wide range of time since diagnosis (14–168 months) was found, with a mean of approximately 60 months (5 years). Fifteen (56%)

Table 1. Baseline Characteristics of Intervention Subjects

Characteristic	Range	$\bar{x}$
Age in years	42–65	53.3
Months since diagnosis	14–168	59.85
Months since treatment completed	11–166	53

Characteristic	n	%
Race		
Caucasian	26	96
Hispanic	1	4
Cancer stage at diagnosis		
Stage I	12	44
Stage II	15	56
Time since menopause or last use of HRT		
Five years or less	17	63
More than five years	10	37
Family history of osteoporosis		
Yes	12	44
No	15	56
Tamoxifen use		
Yes	15	56
No	12	44

N = 27

HRT—hormone replacement therapy

had been tamoxifen users, with 11 remaining on the drug at entry into the study. Results for physical activity, vigor, and vitality are reported for the women (N = 27) who completed all instruments at baseline and for BMD.

Physical Activity

Fourteen (52%) women recorded no very hard activity, and 10 (37%) recorded no hard activity. Ten (37%) subjects reported less than two hours per day of moderate activity, although five (18.5%) reported more than five hours per day. The range of calculated total METs used by the 27 women for whom physical activity data were available ranged from 15–54.91 METs per day for the prior seven days. The average number of METs expended per day was 35.15. Eighteen (69%) women reported sleeping less than eight hours per night. Physical activity data are shown in Table 2.

When physical activity was examined for correlations with other variables, significant positive relationships existed for total METs expended per day in activities above the light level, with scores on the SF-36 for vitality (r = 0.581, p = 0.004) and on the POMS subscale for vigor (r = 0.536, p = 0.007). Correlations of various levels of physical activity with vigor, vitality, and BMD are shown in Table 3. No significant correlation existed between any level of activity and baseline BMD.

Vigor

Scores for the eight-item vigor-activity subscale ranged from 4–27, with higher scores indicating increased vigor. The mean score was 20.07 out of a possible 32. The vigor subscale scores increased with age (r = 0.508, p = 0.007). The association of vigor with total METs for combined moderate, hard, and very hard activities was significant (r = 0.536, p = 0.007), as were the hours spent in the combined moderate to very hard activities (see Table 3). No relationship existed between vigor scores and DEXA BMD values.

Vitality

Raw scores for vitality ranged from 6–28 ($\overline{X}$ = 15.8), and percent scores ranged from 10%–85%. Vitality was correlated with mean hours per day spent in combined activities above the light level (see Table 3). Besides the correlation noted previously with vitality and METs from hours spent in moderate, hard, and very hard activity, the other relationships revealed negative associations of vitality with number of months since diagnosis of breast cancer (r = –0.438, p = 0.022) and vitality with months since treatment was completed (r = –0.438, p = 0.006). Level of perceived vitality was not correlated significantly with age (r = 0.150, p = 0.456). No relationship existed between level of vitality and baseline DEXA, and no correlation was found between vigor and vitality scores (r = 0.273, p = 0.168).

Bone Mineral Density

Three subjects had osteoporosis at one or more sites (i.e., wrist, spine, hip), 18 were osteopenic, and six had normal BMDs. Correlations between baseline levels of activity, vigor, and vitality with BMD at any of the sites were not statistically significant. The association of other risk factors for osteoporosis in this sample has been reported elsewhere (Lindsey et al., 2002; Twiss et al., 2001).

Discussion

Women who have undergone treatment for breast cancer are at higher risk of osteoporosis because of loss of ovarian function. Most of this group experienced decreased BMD or became osteoporotic. This is a finding in congruence with that of Headley et al. (1998). A low level of physical activity is an additional risk factor for osteoporosis in women who are at risk for poor bone health. This group of postmenopausal breast cancer survivors was mostly sedentary at baseline. Increasing physical activity, especially weight bearing, is a strategy for maintaining bone health and preventing debilitating falls and fractures. At baseline, no relationship between levels of physical activity and BMD was evident.

The positive correlations between METs expended per day and mean number of hours spent in activity above the light levels with higher levels of vitality and vigor would support the idea that activity promotes feelings of vitality. If so, then having higher levels of perceived energy (i.e., vigor and vital-

Table 2. Physical Activity Levels of Breast Cancer Survivors

Activity Level	N	Minimum	Maximum	$\overline{X}$	SD
Total hours per week sleeping	27	38.50	61.50	50.79	6.26
Average hours per day sleeping	27	5.50	8.79	7.26	0.89
Metabolic equivalents (METs) per day sleeping	27	5.50	8.79	7.26	0.89
Total hours per week of light activity	27	21.00	112.00	58.75	23.00
Average hours per day of light activity	27	3.00	16.00	8.45	3.27
METs per day of light activity	27	4.50	24.00	12.30	4.92
Total hours per week of moderate activity	26	5.00	48.00	23.29	14.38
Average hours per day of moderate activity	26	0.71	6.86	3.32	2.06
METs per day of moderate activity	26	2.13	20.58	9.98	6.17
Total hours per week of hard activity	27	–	28.50	6.20	8.22
Average hours per day of hard activity	27	–	4.07	0.89	1.17
METs per day of hard activity	26	–	20.30	4.38	5.97
Total hours per week of very hard activity	27	–	7.35	1.19	2.18
Average hours per day of very hard activity	27	–	1.05	0.17	3.31
METs per day of very hard activity	27	–	6.83	1.12	2.03
Total METs per day of all activity	26	15.06	54.91	35.41	8.85
Partial METs per day of moderate, hard, or very hard activity	26	2.13	38.95	15.53	7.92
Hours per day of moderate, hard, or very hard activity	25	0.71	7.64	4.09	1.96

Table 3. Relationships Between Physical Activity, Vigor, Vitality, and Bone Mineral Density

Level of Physical Activity (mean hours per day)	Vigor	Vitality	Bone Mineral Density of Hip
Light activity	r = 0.189 p = 0.325	r = 0.117 p = 0.546	r = –0.301 p = 0.144
Moderate activity	r = 0.028 p = 0.884	r = 0.087 p = 0.655	r = –0.111 p = 0.606
Hard activity	r = 0.263 p = 0.167	r = 0.022 p = 0.912	r = 0.103 p = 0.625
Moderate, hard, and very hard activity	r = 0.536 p = 0.007	r = 0.581 p = 0.004	r = 0.048 p = 0.828
Vitality	r = 0.273 p = 0.168	– –	r = 0.045 p = 0.828
Vigor	– –	r = 0.273 p = 0.168	r = 0.273 p = 0.168

ity) may promote adherence to exercise programs, such as the strength- or weight-training component of the intervention (Ott et al., 2001). Even though as a group the women reported relatively high levels of vigor and vitality on the two subscales, the results of increased physical activity through strength or weight training in this ongoing longitudinal study may provide information about whether increasing levels of vigor and vitality and BMD may result from a change in physical activity. Scores on the separate instruments for vitality and vigor were not correlated. This suggests that perhaps the two instruments are measuring different dimensions or concepts.

Limitations

The sample size was small but acceptable for a pilot study to test feasibility. Random selection did not occur, with women self-selecting to enroll in the study. The women represented a wide range of time since treatment, which may affect activity level and perceived vigor and vitality.

The Seven-Day Physical Activity Recall–Adapted instrument uses self-report for recall of the previous seven-day period. Four of the first subjects had difficulty interpreting how to report on this instrument; subsequently, the investigators assisted subjects while they completed the questionnaire to ensure that they recorded all activities, including sleep. This may have affected the overall results.

Implications for further research include using a larger sample with random assignment to a treatment or comparison group. The Seven-Day Physical Activity Recall–Adapted instrument should have explicit printed instructions to ensure inclusion of all activities to total 24 hours each day.

Because women with breast cancer are at increased risk for osteoporosis, nurses and other healthcare providers who work with them can promote good bone health by being aware of the greater risk for osteoporosis and encouraging early assessment of BMD. Education for survivors must incorporate information about prevention of osteoporosis by increasing physical activity.

Author Contact: Gloria Jean Gross, RN, PhD, can be reached at ggross@unmc.edu, with copy to editor at rose_mary@earthlink.net.

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For more information . . .

➤ National Alliance of Breast Cancer Organizations
www.nabco.org

➤ Breast Cancer Information Center
www.feminist.org/other/bc/bchome.html

➤ Breast Cancer Research
www.breast-cancer-research.com

These Web sites are provided for information only. The hosts are responsible for their own content and availability. Links can be found using ONS Online at www.ons.org.