PREVENTIVE MEDICINE 24, 528–534 (1995)

Health Promotion and Osteoporosis Prevention among Postmenopausal Women

NAGIA S. ALI, PH.D.,[1] AND RENEE K. TWIBELL, D.N.S.

Ball State University, School of Nursing, 2000 University Avenue, Muncie, Indiana 47306

Background. **Although there is a plethora of literature about osteoporosis, little is known about the attitudinal variables that may predict osteoporosis-preventive behaviors (OPBs) among postmenopausal women. This study examined the relationship between variables from the Health Promotion Model (HPM) and OPBs of calcium intake, exercise participation, and taking of estrogen/hormone replacement therapy (ERT/HRT).**

Methods. **One hundred women completed measures of benefits and barriers to calcium intake, exercise participation, ERT/HRT usage; self-efficacy; control of health; importance of health; and health status. Participants also reported their actual calcium intake, exercise participation, and use of ERT/HRT.**

Results. **Participants consumed an average of 1,243 mg of calcium from milk, yogurt, calcium-rich foods, and supplements; 81% participated in weight-bearing and resistant training exercise but on an irregular basis; and 31% were users of ERT/HRT at the time of data collection. There were significant relationships between some of the HPM variables and calcium intake and exercise participation. There was a significant difference between past and current users of ERT regarding benefits and barriers to taking hormones. Hormone users reported higher calcium intake and greater exercise participation than nonusers.**

Conclusion. **There is early evidence that variables of the HPM are associated with OPBs. After continued testing, intervention programs for osteoporosis prevention may use variables of the HPM as a theoretical base for behavior changes.** © 1995 Academic Press, Inc.

INTRODUCTION

Osteoporosis is a major health problem that results in approximately 1.5 million fractures annually (1). Osteoporosis can be prevented with adequate calcium intake, exercise activity, and hormone therapy usage (2–11).

Studies of bone mineral density (BMD) and calcium intake support the need for a liberal amount of calcium to maintain bone mass and reduce bone loss (12–15). Calcium supplements are popular because some women find dairy products unpalatable, inconvenient, hypercaloric, or they have lactose intolerance. Recent studies provide evidence that adequate calcium intake retards bone loss and prevents fractures (6, 7, 12–15). Similarly, studies of the beneficial effects of exercise have supported an association between increased BMD and weight-bearing and/or resistant training exercise (2, 8–10, 16–18). In addition to the beneficial effects of adequate calcium and physical activity on BMD, clinical trials have associated hormone usage with significant reduction in bone loss, increment in BMD, prevention of fractures, and coronary heart disease (6, 9, 10, 19–23). However, estrogen replacement therapy (ERT) remains controversial because of its association with increased risks of breast and uterine cancers (24). Other lifestyle behaviors, including cigarette smoking and alcohol abuse, affect BMD. Research studies have linked cigarette smoking and alcohol abuse to reduced BMD and increased hip fractures (9, 25, 26).

Theoretical Framework

Pender's Health Promotion Model (HPM) provides a framework for this study (27). The HPM describes concepts proposed to predict health promoting behaviors and consists of three components: cognitive/perceptual factors, modifying factors, and cues to action. The cognitive/perceptual factors are perceptions of benefits and barriers to performing a behavior, self-efficacy, control of health, health status, importance of health, and definition of health. Modifying variables are demographic, biologic, interpersonal, situational, and behavioral factors while cues to action are transient stimuli to behaviors (27). In this study, selected variables from the HPM were applied to osteoporosis prevention (Fig. 1). The researchers used the HPM rather than the Health Belief Model (28) because the behaviors of adequate calcium intake, exercise participation, and hormone usage for women who choose to take it are primarily health-promoting behaviors.

Many studies have used selected variables from the HPM to predict health-promoting behaviors; however,

[1] To whom reprint requests should be addressed.

0091-7435/95 $12.00

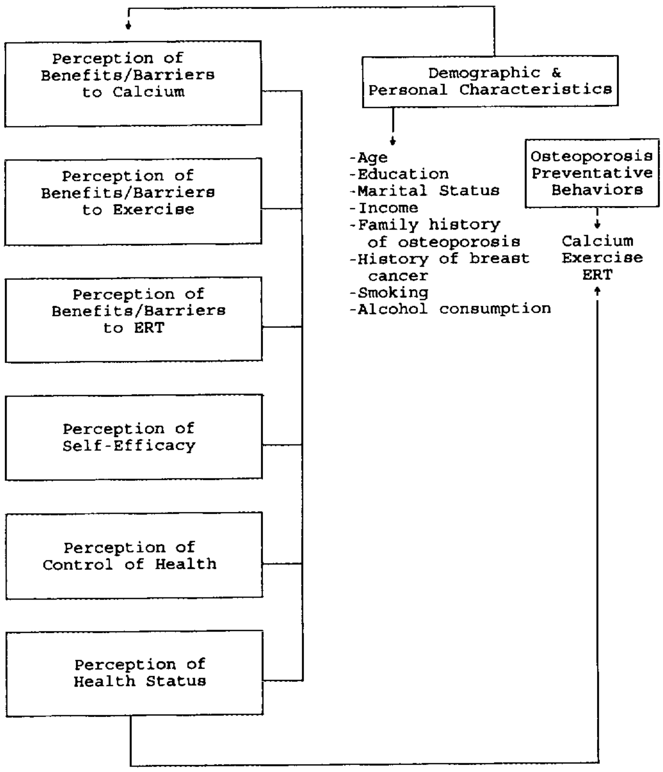

FIG. 1. Applied osteoporosis prevention model.

self-efficacy, control of health, health status, and benefits and barriers to specific behaviors were inconsistently predictive of behavior performance (29–34). No studies have examined the HPM model variables in a sample of postmenopausal women or adapted the model specifically for the prediction of osteoporosis-preventive behaviors (OPBs).

This study addressed four questions: (a) What are the subjects' OPBs of calcium intake, exercise participation, and taking of hormones? (b) What are the relationships between selected variables of the HPM and performance of OPBs? (c) Is there a significant difference between women who are currently taking hormones and women who took it in the past regarding the HPM variables? (d) Is there a significant difference between women who received hormones and those who did not regarding their calcium intake and exercise participation?

METHODS

Sample

The sample was obtained from attendants at three churches in a midwestern state. Approval to conduct the study was obtained from the investigators' university and the three churches. Criteria for inclusion were postmenopausal women of 50 years of age or greater. Postmenopausal condition was identified by two questions, "When was your last menstrual period?" and "Have you stopped getting your usual menstrual periods?" Women who reported a menstrual period in the previous 6 months were excluded from the study. Participants were paid gratuities. A total of 100 forms were distributed to three contact persons in the three churches, and all forms were returned and included in the study.

Instruments

Calcium intake. This variable was measured by a 24-h recall of dietary intake of milk, yogurt, and calcium-rich foods. A 24-h recall approach was selected to reduce errors related to the recall of information over a longer period of time by the elderly. Participants reported the number of 8-oz cups of milk and yogurt consumed, number of servings of calcium-rich foods, and type and amount of calcium supplements. Content validity of the calcium intake measure was supported through a review of the tool by experts in nutrition and measurement and through an earlier test of the tool (4). For each participant scores were calculated for calcium intake in milligrams from milk, yogurt, calcium-rich foods, calcium supplements, and total calcium intake.

Exercise participation. Subjects reported participation in walking, aerobics, weight-lifting, use of exercise machines, and other activities during an average week. Participants indicated how many minutes per day and how many days per week they performed each activity. In addition, they reported duration of engagement in regular exercise and reasons for exercising. Content validity of the exercise participation measure was supported by a review of the tool by content experts and an earlier test of the tool (4). A total exercise score expressed in minutes/week was computed.

Hormone usage. This variable was measured by a self-report of the pattern of hormone usage, if prescribed by a physician. Responses included current adherence to prescribed regimen, past usage, duration of past usage, regularity of use, and reasons for discontinuing use of the therapy, if applicable. Content validity of the tool was supported through a content review by experts in health care, gerontology, and measurement and in an earlier study (4).

Benefits and barriers to calcium intake. The instrument Calcium Benefits/Barriers Scale (5) consisted of 13 items to which subjects responded on a 5-point Likert scale. Eleven items addressed barriers and 2 items addressed benefits. Sample items included "I do not drink milk because I do not like its taste" and "I drink milk to keep my bones strong." The scale was developed from qualitative data and was reviewed for content validity by experts in nutrition and health promotion. Reliability was supported in three female samples (n = 190, n = 91, n = 100) and in 60 postmenopausal women. Cronbach's α reliabilities ranged from 0.66 to 0.81 for the barriers subscale and 0.58 to 0.70

for the shorter benefits subscale (4, 5). Items that lowered item-total correlations were deleted or revised during the testing of the instrument. Test–retest reliability over a 2-week period ($n = 32$) and among the previously mentioned 60 postmenopausal women ranged between 0.69 and 0.90 (5).

Benefits and barriers to exercise. The variable was measured by a modified form of the Exercise Benefits/Barriers Scale (35). The original instrument was tested with a sample ($n = 650$) of varying ages, with a mean age of 39 years. A 9-factor solution explained approximately 65% of the variance in perceived benefits and barriers to exercise participation. Cronbach's α's were 0.95 and 0.88 for the benefits and barriers subscales, respectively (35). The modified form had 12 items with a 4-point Likert response that were selected from the original tool and judged to be appropriate for an elderly sample. Nine items addressed barriers, while 3 items addressed benefits. Sample items included "I will live longer if I exercise" and "My spouse/significant other does not encourage exercising." Cronbach's α's for a sample of 100 elderly women and 60 postmenopausal women ranged from 0.79 to 0.87. One item that lowered item-total correlation in the benefit subscale was deleted in the present study.

Benefits and barriers to hormone usage. This variable was measured by the Hormone Benefits/Barriers scale (4). The instrument consisted of 7 items with a 5-point Likert response scale. Five items addressed benefits and 2 items addressed barriers. Sample items included "ERT will strengthen my bones" and "ERT may cause me to have breast cancer." The tool was developed from qualitative data derived through interviews with 25 postmenopausal women and was reviewed for content validity by four experts in health promotion and measurement. For samples of postmenopausal and elderly women ($n = 71$, $n = 100$, $n = 60$), Cronbach's α reliabilities ranged from 0.69 to 0.80 for the barriers subscale and 0.70 to 0.78 for the benefits subscale. Test–retest reliability coefficients over a 2-week period for 35 community-residing women and 60 postmenopausal women were 0.78 for the benefits subscale and 0.76 for the barriers subscale.

Self-efficacy. This variable was measured by the General Self-Efficacy subscale of the Self-Efficacy Scale (36). The tool measured individual's beliefs regarding their general abilities to perform life activities. The tool consisted of 17 items with a 5-point Likert format. Content, criterion, and construct validity have been reported elsewhere (36). Cronbach's α was 0.86 (36) and 0.89 for a sample of 60 postmenopausal women.

Control of health. This variable was measured by Wallston and Wallston's Multidimensional Health Locus of Control (MHLC) (37). The MHLC has 6 items in each of its three constructs: internal locus of control (IHLC), external powerful others locus of control (PHLC), and chance locus of control. Participants responded to a 6-point Likert scale. Concurrent and construct validity have been cited for the tool (37). In a previous study (37) and among 60 postmenopausal women, Cronbach's α and test–retest reliabilities for the three scales ranged from 0.66 to 0.83.

Health status. The Health Scale of the Multilevel Assessment Instrument (38) operationalized this variable. The tool consisted of 4 items to which participants responded on either a 3-point or 4-point scale. Criterion and construct validity have been reported for the tool (38). For a sample of elderly persons ($n = 590$), Cronbach's α was 0.76 and test–retest reliability coefficient over 3 weeks was 0.92 (38).

Importance of health. The Value Survey operationalized this variable (39). Participants ranked 10 values from least important to most important. The rank position assigned to health was the score for the variable. Test–retest reliability coefficient over a 2-week period for 60 postmenopausal women was 0.80.

Design

The design of this study was descriptive and correlational, using a questionnaire for data collection.

Statistical Analysis

Descriptive statistics were obtained on all variables. A correlation matrix was computed for the HPM variables and OPBs. Multiple regression analysis was employed to predict total calcium intake and exercise participation using the study variables. MANOVA analysis was used to examine the data for significant differences between ERT past and current takers regarding the HPM variables. A t test was used to examine for a significant difference between hormone users and nonusers regarding calcium intake and exercise participation.

RESULTS

Demographic and selected characteristics of participants are shown in Table 1. Age range for this sample was 50 to 88 years with a mean of 66.7. The majority of the sample was Caucasian (97%). Slightly less than half (43%) of the sample had high school diplomas and a similar percentage was married. Slightly over one-fourth (29%) of participants reported an annual income of up to $20,000. Very few women (6%) reported current cigarette smoking; however, 38% of participants were past smokers for an average duration of 12 years.

Question 1

What are the subjects' OPBs of calcium intake, exercise behaviors, and hormone usage? The mean daily

TABLE 1
Demographic and Personal Characteristics (n = 100)

Variables	Percentages
Education	
Middle school	12
High school	43
Some college	20
College degree	15
Graduate degree	10
Marital status	
Married	43
Widowed	42
Single	15
Annual household income	
<$10,000	10
$10,000–$20,000	29
$20,000–$30,000	20
$30,000–$50,000	20
>$50,000	21
Smoking behaviors	
Never smoked	56
Used to smoke but stopped	38
Current smokers	6
Packs of cigarettes smoked	
$<\frac{1}{2}$ pack	33
$\frac{1}{2}$–1 pack	38
1–2 packs	25
>2 packs	4
Alcohol consumption	
Cans of beer/week	
None	89
Up to 4 cans	11
Glasses of wine/week	
None	72
Up to 7 glasses	28
Liquor/week	
None	79
Up to 7 drinks	21

calcium intake from milk was 271.52 mg, 221.05 mg from yogurt, 424.88 mg from calcium-rich foods, 295.88 mg from calcium supplements, and 1,243.65 mg total. The majority of participants (89%) noted consistent consumption of the reported amount of milk throughout their lives; however, calcium supplements were ingested for a mean duration of 3 years with an intermittent pattern. Very few women (9%) reported that calcium supplements were prescribed by their physicians. When asked about the kind of calcium supplements they ingested, participants responded that they did not know or they mentioned a brand name.

Many (81%) participants reported performing weight-bearing and resistant training exercises with a mean of 154.29 min per week. Activities included walking, light aerobics, use of exercise machines, and others (dancing, household chores, tennis, and bowling). However, when women were asked about maintenance of exercise activities, 78% reported an irregular pattern. Participants' reasons for exercising included the benefits of exercise for heart function, blood pressure, diabetes mellitus, and psychosocial effects.

Although 42% of participants reported being prescribed hormone therapy, 31% reported current use. This indicates that 11% of participants who were prescribed the therapy either never took it or were past users. Sixty-eight percent of subjects reported never using ERT, which includes the previously mentioned 11%. Twenty-two percent of subjects reported past use of the therapy. Of the current users, 23% reported a regular pattern and 8% reported intermittent use. The mean duration of past use of ERT was 4.6 years. When women were asked to comment on their decisions to discontinue therapy, many concerns were revealed. The concerns included a physician's decision to discontinue therapy, presence of multiple side effects, lack of perceived need to continue the therapy for the rest of their lives, fear of breast cancer, financial reasons, and misconception about the actions of the therapy.

Question 2

What are the relationships between the predictor variables of the HPM and OPBs? Correlation coefficients between the HPM variables and OPBs appear in Table 2. Calcium intake from yogurt and from supplements was not significantly correlated with any variables. Calcium intake from milk was significantly and moderately correlated with benefits and barriers to calcium intake, indicating that women who perceived greater benefits and less barriers to calcium intake tended to consume a greater amount of milk.

TABLE 2
Correlation Matrix for HPM and OPBs Variables

	Selfeff	IHLC	CHLC	PHLC	PercHlth	ValuHlth	Milkben	Milkbar	Exben	Exbar	ERTben	ERTbar
Calcium from milk	0.10	0.14	0.05	0.14	0.18	0.03	0.52*	−0.48*	0.19	0.04	−0.05	−0.06
Calcium from foods	0.32*	0.25**	−0.17	−0.27**	0.21***	−0.07	0.11	−0.22***	0.08	−0.11	−0.03	−0.06
Total calcium	0.07	0.13	−0.12	−0.05	0.10	0.09	0.27**	−0.25**	0.13	−0.13	−0.04	−0.18
Exercise	0.25**	0.09	0.11	−0.13	0.25**	0.15	0.11	−0.12	0.26**	−0.21***	−0.04	−0.18

Note. HPM, Health Promotion Model; OPBs, osteoporosis preventive behaviors; Total calcium, calcium from milk, yogurt, foods, supplements; Selfeff, self-efficacy; IHLC, internal health locus of control; CHLC, chance health locus of control; PHLC, powerful others health locus of control; PercHlth, perception of health status; ValuHlth, perception of the importance of health; Milkben, perception of benefits of calcium; Milkbar, perception of barriers to calcium; Exben, perception of benefits of exercise; Exbar, perception of barriers to exercise; ERTben, perception of benefits to ERT; ERTbar, perception of barriers to ERT.

* $P < 0.001$.

** $P < 0.01$.

*** $P < 0.05$.

Intake of calcium-rich foods was significantly and low moderately correlated with self-efficacy, IHLC, PHLC, health status, and barriers to calcium intake. Women who consumed greater amount of calcium-rich foods perceived themselves as more self-efficacious, believed health was internally controlled or influenced by significant others, perceived better health status, and perceived fewer barriers to calcium intake. Total calcium intake was significantly and low moderately correlated with perceptions of greater benefits and less barriers to calcium intake.

Exercise behaviors were significantly and low to moderately correlated with self-efficacy, health status, and benefits and barriers to participation in exercise. Participants who reported greater exercise behaviors perceived themselves as more self-efficacious, perceived better health status, and greater benefits and less barriers to exercise participation. The variables of importance of health and chance health locus of control were not significantly correlated with any study variables. In a step-wise multiple regression to predict calcium intake and exercise participation, no variables entered the equation.

Question 3

Is there a significant difference between women who are currently taking ERT and women who took it in the past regarding the HPM variables? MANOVA analysis revealed that there was a significant difference in the multivariate test [F (12, 33) = 2.103, $P < 0.05$) for the HPM variables between women who were taking ERT at the time of data collection ($n = 31$) and women who took it in the past ($n = 22$). However, in the univariate F test, only perceived barriers to taking ERT were significant at the 0.05 level. Similarly, a MANOVA test between the two ERT groups regarding benefits and barriers to taking hormones showed a significant difference only in the multivariate test [F (2, 49) = 5.172, $P < 0.01$]. Table 3 reviews the means and standard deviations for perceived benefits and barriers to taking hormones among the two ERT groups.

Question 4

Is there a significant difference between women who took ERT and those who did not in their calcium intake and exercise participation? Although hormone users reported higher calcium intake and greater exercise participation than nonusers, the difference was not significant. The mean calcium intake for hormone users was 1388.48 mg and 1176.98 mg for nonusers. The mean exercise minutes/week for hormone users was 182.58 and 143.50 for nonusers.

TABLE 3

Means and Standard Deviations for Perceptions of ERT Benefits/Barriers for Current and Past Takers of ERT

ERT groups	Perceptions of benefits of ERT		Perceptions of barriers to ERT	
Current takers ($n = 31$)	$M = 19.60$	SD = 3.10	$M = 4.97$	SD = 1.85
Past takers ($n = 22$)	$M = 18.41$	SD = 3.19	$M = 6.41$	SD = 1.53

DISCUSSION

Three limitations of the study were noted. The small, convenient sample of churchgoing midwestern Caucasian women limits the generalizability of the findings to other women. The use of a 24-hr recall approach to compute calcium intake versus a longer duration was another potential limitation. In addition, the use of the General Self-Efficacy Scale to operationalize self-efficacy rather than the use of specific self-efficacy measures pertaining to OPBs is a possible limitation. The development of measures of self-efficacy regarding calcium intake, exercise participation, and ERT usage is necessary for further exploration.

This study described OPBs and examined the relationship between the behaviors and selected variables from the HPM. Prevention of osteoporosis is the key issue that should be stressed to younger women. Optimal calcium intake is most important from childhood until age 30 to achieve peak bone mass. Therefore, women in their teens, 20's, and 30's should consume at least 1,000 mg of calcium daily to obtain peak skeletal mass (13). Postmenopausal and elderly women need adequate calcium daily to compensate for inadequate intestinal absorption and rapid excretion of calcium through the kidneys. Postmenopausal women under age 65 need 1,000 to 1,500 mg and women over age 65 need 1,500 mg (1).

The mean calcium intake for women who reported taking ERT was higher than for women who did not. Possible explanations are that women who receive hormones have physicians who may have prescribed calcium supplements or instructed them about the need for adequate calcium intake or the women may have increased their own self-awareness of adequate calcium intake as a healthy behavior. Effective education about osteoporosis prevention needs to emphasize the required daily calcium amount for postmenopausal women, provide examples of the calcium content of calcium-rich foods, educate women about supplements, assess and address individual barriers, explain benefits, and use research findings to support information provided.

Although many (81%) participants performed exercise, a consistent pattern was not reported. Women who reported taking ERT had higher mean exercise participation than women who did not. This finding may indicate that women who took ERT were committed to multiple healthy behaviors or their physicians may have recommended exercise. Participants' reasons for performing exercise indicated that women were aware of the general benefits of exercise; however, the benefits of exercise in strengthening bones and preventing osteoporotic fractures were not clearly conceptualized by subjects. One possible reason is that participants were suffering from common conditions of aging, such as heart problems, elevated blood pressure, increased cholesterol level, and diabetes; therefore, benefits of exercise were perceived for their current conditions and not for prevention of osteoporosis. Another possible reason is that the media disseminate messages about the general benefits of exercise to every age group; however, when osteoporosis is addressed, more emphasis is on hormone treatment and calcium intake. Health education to promote strong bones needs to identify all postmenopausal women who are candidates to perform exercise, verify appropriateness of exercise options with the physician, assist women in choosing activities that can be incorporated into a daily lifestyle, and emphasize the importance of maintaining exercise activities, since BMD returns to baseline values when exercise is discontinued (17).

The research finding of a small number of participants using ERT is consistent with other research studies (4, 5, 10, 11, 20). Discontinuation of ERT was related to side effects of therapy, lack of understanding of the need to continue therapy over time, financial concerns, and lack of involvement in the decision-making process with care providers. Helping women become better decision makers regarding potential use of hormones should be based upon counseling them on choices available, which include use of ERT/hormone replacement therapy or nonuse of hormones but ensuring adequate calcium intake and regular exercise participation, risks associated with and without hormone use, immediate and long-term benefits of therapy, possible side effects, perceived personal risks and professionally assessed risks to osteoporosis development, and socioeconomic factors.

The significant relationships found in this study between calcium intake, exercise participation, and hormone usage and perceptions toward the behaviors is consistent with earlier studies of postmenopausal women (4, 5). Furthermore, the findings support results of other studies regarding relationships between health promoting behaviors and self-efficacy (30–33), internal locus of control (32), and health status (33). Given the accumulation of support for the relationships, education about OPBs needs to include an assessment of, and emphasis on, perceptions toward the targeted behaviors.

The moderate significant relationships between the HPM variables and OPBs suggest that future study may demonstrate prediction of the behaviors by the HPM variables. The small and homogenous sample, the many variables tested, the use of a 24-hr recall of calcium intake rather than a 7-day assessment, and the use of General Self-Efficacy Scale rather than specific self-efficacy tools may have contributed to only moderate significant correlation coefficients and lack of prediction.

Replication of the study will permit the inclusion of larger sample sizes, deletion of insignificant variables, refinement of instrumentation, and inclusion of other measures pertinent to osteoporosis, such as knowledge of OPBs and risk factors to osteoporosis development. As results provide additional support for the relationships between the HPM variables and OPBs, a base of theoretical knowledge and research findings can guide the design of educational interventions to support behavior changes.

REFERENCES

1. Star V, Hochberg M. Osteoporosis: treat current injury, retard future loss. Intern Med 1993;14:32–42.
2. Zhang J, Feldblum P, Fortney J. Moderate physical activity and bone density among perimenopausal women. Am J Public Health 1992;82:736–8.
3. Ali N. Teaching osteoporosis prevention. Adv Clin Care 1991;6: 32–3.
4. Ali N, Twibell R. Barriers to osteoporosis prevention in perimenopausal and elderly women. Geriatr Nurs 1994;15:201–6.
5. Ali N, Bennett S. Postmenopausal women: factors in osteoporosis preventive behaviors. J Gerontol Nurs 1992;18:23–32.
6. Aloia J, Vaswani A, Yeh J, Ross P, Flaster E, Dilmania F. Calcium supplementation with and without hormone replacement therapy to prevent postmenopausal bone loss. Ann Intern Med 1994;120:97–103.
7. Reid I, Ames R, Evans M, Gamble G, Sharpe S. Effect of calcium supplementation on bone mass in postmenopausal women. N Engl J Med 1993;328:460–4.
8. Campbell W. Can resistance training maintain physical function? Contemp Intern Med 1994;6:26–37.
9. Bauer D, Browner W, Cauley J, Orwall E, Scott J, Black D, Tao J, Cummings S. Factors associated with appendicular bone mass in older women. Ann Intern Med 1993;118:657–65.
10. Prince R, Smith M, Dick I, Price R, Webb P, Henderson K, Harris M. Prevention of postmenopausal osteoporosis: a comparative study of exercise, calcium supplementation, and hormone-replacement therapy. N Engl J Med 1991;325:1189–95.
11. Kadri A. Attitudes to HRT. Practitioner 1990;234:880–4.
12. Reid I, Ames R, Evans M, Gamble G, Sharpe S. Long-term effects of calcium supplementation on bone loss and fractures in postmenopausal women: a randomized controlled trial. Am J Med 1995;98:331–5.
13. Chapuy M, Arlot M, Duboeuf F, Brun J, Crouzet B, Arnaud S, Delmas P, Meunier P. Vitamin D3 and calcium to prevent hip fractures in elderly women. N Engl J Med 1992;327:1637–42.
14. Andon M, Smith K, Bracker M, Sartoris D, Saltman P, Strause L. Spinal Bone density and calcium intake in healthy postmenopausal women. Am J Clin Nutr 1991;54:927–9.
15. Dawson-Hughes B, Dallal G, Krall E, Sadowski L, Sahyoun N, Tannenbaum S. A controlled trial of the effect of calcium supplementation on bone density in postmenopausal women. N Engl J Med 1990;323:878–83.
16. Smith E, Gilligan C, McAdam M, Ensign C, Smith P. Deterring bone loss by exercise intervention in premenopausal and postmenopausal women. Calcif Tissue Int 1989;44:312–21.
17. Dalsky G, Stocke K, Ehsani A, Slatopolsky E, Lee W, Birge S. Weight-bearing exercise training and lumbar bone mineral con-

tent in postmenopausal women. Ann Intern Med 1988;108: 824–8.
18. Michel B, Bloch D, Fries J. Weight-bearing exercise, overexercise, and lumbar bone density over 50 years. Arch Intern Med 1989;149:2325–9.
19. Breslau N. Osteoporosis management. Semin Nephrol 1992;12: 116–26.
20. Felson D, Zhang Y, Hannah M, Kiel O, Wilson P, Anderson J. The effect of postmenopausal estrogen therapy on bone density in elderly women. N Engl J Med 1993;329:1141–6.
21. Cauley J, Seeley D, Ensrud K, Ettinger B, Black D, Cummings S. Estrogen replacement therapy and fractures in older women. Ann Intern Med 1995;122:9–16.
22. Nabulsi A, Folsom A, White A, Potsch W, Heiss G, Wu K, Szklo M. Association of hormone replacement therapy with various cardiovascular risk factors in postmenopausal women. N Engl J Med 1993;328:1069–75.
23. Stampfer M, Colditz G. Estrogen replacement therapy and coronary heart disease: a quantitative assessment of the epidemiologic evidence. Prev Med 1991;20:47–63.
24. Steinberg K, Thacker S, Smith S, Stroup D, Zack M, Flanders W, Berkelman R. A meta-analysis of the effect of estrogen replacement therapy on the risk of breast cancer. JAMA 1991;265: 1985–90.
25. Kiel D, Baron J, Anderson J, Hannan M, Felson D. Smoking eliminates the protective effect of oral estrogen on the risk for hip fractures among women. Ann Intern Med 1992;116:716–21.
26. Bikle D, Genant H, Cann C, Recker R, Halloran B, Strewler G. Bone disease in alcohol abuse. Ann Intern Med 1985;103:42–8.
27. Pender N. Health promotion in nursing practice, 2nd ed. Norwalk (CT): Appleton & Lange, 1987.
28. Becker H, Kabeck M, Rosenstock M, Ruth V. Some influences on public participation in a genetic screening program. J Community Health 1975;1:3–14.
29. Ahijevych K, Bernhard L. Health-promoting behaviors of African American women. Nurs Res 1994;43:86–9.
30. Stuifbergen A, Becker H. Predictor of health-promoting lifestyles in persons with disabilities. RINAH 1994;17:3–13.
31. Alexy B. Factors associated with participation or nonparticipation in a workplace wellness center. Res Nurs Health 1991;14: 33–40.
32. Duffy M. Determinants of health-promoting lifestyles in older persons. Image 1993;25:23–8.
33. Weitzel M. A test of the health promotion model with blue collar workers. Nurs Res 1989;38:99–104.
34. Kerr M, Richey D. Health promoting lifestyles of English-speaking and Spanish-speaking Mexican-American migrant farm workers. Public Health Nurs 1990;7:80–7.
35. Sechrist K, Walker S, Pender N. Development and psychometric evaluation of the exercise benefits/barriers scale. Res Nurs Health 1987;10:357–65.
36. Sherer M, Adams C. Construction and validation of the self-efficacy scale. Psychol Rep 1983;53:899–902.
37. Wallston K, Wallston B, Devillis R. Development of the multidimensional health locus of control (MHLC) scales. Health Educ Monogr 1978;6:161–70.
38. Lawton M, Moss M, Fulcomer M, Kleban M. A research and service-oriented multilevel assessment instrument. J Gerontol 1982;371:91–9.
39. Wallston K, Maides S, Wallston B. Health related information seeking as a function of health related locus of control and health values. J Res Pers 1976;10:215–22.

Received October 11, 1994
Revision requested November 10, 1994
Accepted May 5, 1995