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Bone Density, Health Beliefs, and Osteoporosis Preventing Behaviors in Men

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Abstract

The effect of bone mineral density (BMD) screening via dual energy x-ray absorptiometry (DXA) on osteoporosis preventing behaviors (OPB), knowledge of osteoporosis, and health beliefs of men ≥50 years of age (N=196) was evaluated. An experimental, 2-group longitudinal design was used. The independent variable was DXA; dependent variables were OPBs; and mediating variables were general knowledge of osteoporosis and Health Belief variables. Half of the men had low bone density. Men diagnosed to be osteoporotic increased their calcium intake. Health belief variables predicted calcium intake and/or exercise. In addition, nine men in the experimental group were taking medications to prevent/restore bone loss at Time 3. Health care providers play a significant role in assessing bone loss and preventing and treating osteoporosis in men. The cost of a DXA screen is far less than financial and social costs due to osteoporotic fractures.

Osteoporosis, which is characterized by compromised bone strength, is the most common age-related bone disorder and it is associated with an increased risk of fracture. The disorder occurs in both men and women, but men are underdiagnosed and undertreated (Kiebzak et al., 2002; National Osteoporosis Foundation, 2008a). Health information about osteoporosis often addresses general risk of the disease rather than specific individual risk. Hip fractures are predicted to increase significantly with related costs of over $25 billion by the year 2025 (National Osteoporosis Foundation, 2008c; National Osteoporosis Foundation, 2008b; National Osteoporosis Foundation, 2008a; U.S. Department of Health and Human Services, 2004).

Dual Energy X-ray Absorptiometry (DXA) a highly accurate, safe, and reasonably priced method of assessing bone mineral density (BMD) is the “gold standard” test for establishing the diagnosis and severity of osteoporosis and assessing changes over time in treated and untreated individuals(International Society for Clinical Densitometry, 2007; Kanis, Johnell, Oden, Johansson, & McCloskey, 2008).

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A dual energy x-ray absorptiometry (DXA) can provide personal knowledge of bone mineral density (BMD) and promote preventive health behavior changes for both women (Sedlak, Doheny, Estok, Zeller, & Winchell, 2007) and men (Doheny, Sedlak, Hall, & Estok, 2010). Increased use of DXA and communication of the results may thus decrease the burden of osteoporosis, prevent disabilities and improve health promotion (Cadarette, Gignac, Jaglal, Beaton, & Hawker, 2007). Persons younger than 65, however, are often not screened because of the costs involved despite the fact that waiting until age 65 may be too late because many already have severely compromised bone density by this age. Information obtained earlier about individual risk may more effectively promote prevention behaviors.

Efforts to increase older men's participation in OPB (increased dietary calcium and weight bearing exercise) are critical. Behavioral change, however, is a complex issue that requires theory and demonstrated usefulness. Two such theory-based models are the Health Belief Model (Rosenstock, 1966) and the Theory of Self-Efficacy (Bandura, 1977). The Health Belief Model (HBM) is a theoretical structure developed to explain why and under what conditions people will take preventive actions (Nemcek, 1990; Rosenstock, 1966) and the self-efficacy model is based on performance accomplishments, vicarious learning experiences, verbal persuasion, and emotional/physiological states (Bandura, 1977). These models are combined into a single model called the Revised Health Belief Model (RHBM) (Rosenstock, Strecher, & Becker, 1988) and are the basis for the present study.

Most studies regarding the relationship between HBM/knowledge and OPB have been conducted with women (Estok, Sedlak, Doheny, & Hall, 2007; Sedlak et al., 2007). Despite confusion regarding the role of knowledge in behavior change, understanding the role of knowledge as it is related to osteoporosis prevention is important. The relationship between knowledge and HBM variables on OPB behaviors has been inconsistent. In 1984, Janz & Becker (Janz & Becker, 1984) carried out a meta analysis of 46 HBM studies and found that individuals who had certain health beliefs were more likely to carry out prevention behaviors than others. They found perceived barriers and susceptibility to be the most powerful predictors of preventive behaviors. Specific HBM studies related to OPB have been the focus of Kim, Horan, and Gendler (Kim, Horan, Gendler, & Patel, 1991b) resulting in development of tools for assessment of osteoporosis health beliefs and self efficacy.

The purpose of this experimental longitudinal study was therefore to evaluate the effect of bone mineral density (BMD) screening via dual energy x-ray absorptiometry (DXA) on knowledge of osteoporosis, health beliefs, and on osteoporosis preventing behaviors (OPB), of men ≥50 years. The following research questions were addressed: Is personal knowledge from a DXA screen related to general knowledge of osteoporosis? Is personal knowledge gained via DXA screen related to osteoporosis preventing behavior (OPB) scores? Does general knowledge of osteoporosis or revised health beliefs have a stronger effect on osteoporosis preventing behaviors? For men who have a DXA; Is there a difference in OPB among men with normal DXA T-scores (>−1), osteopenic T-scores (−1.0 to −2.5), and osteoporotic T-scores (<−2.5) when controlling for knowledge?

Materials and Methods

An experimental, two-group longitudinal design was used to examine the relationship of BMD screening by DXA to osteoporosis behaviors in men 50 years of age and older. The independent variable was personal knowledge of bone density which relates to the DXA screening score obtained. Dependent variables were osteoporosis preventions behaviors (OPB), including calcium intake, exercise, smoking, alcohol intake, and osteoporosis preventing medications. Mediating variables were knowledge of osteoporosis and health beliefs. Selected sociodemographic variables were also assessed. A battery of questionnaires

was completed by study participants at three time points: at entry into the study and at 6 months and 12 months after entry. Following completion of the initial questionnaires, the first participant was randomly assigned to an experimental or control group by the flip of a coin and subsequent participants were alternated between experimental and control groups.

All men in the study were mailed the National Osteoporosis Foundation (NOF, 2005) pamphlet about osteoporosis titled "*Stand Up To Osteoporosis*" after receiving the first questionnaire. Those in the experimental group scheduled a free DXA scan within 2 weeks. Those in the control group were offered a free DXA following completion of the final questionnaire. A registered x-ray technician performed the DXA, which took no more than 15 minutes to complete. Scans were interpreted by a radiologist certified in reading bone density scans. Through a secure courier, DXA results and participant forms were delivered to the researchers. The researchers then developed letters at an eighth grade level with information for interpretation of the participant's DXA results (normal bone, low bone mass/ osteopenia, or osteoporosis) which were sent to the participant. For DXA revealing abnormal results, follow-up was recommended with the participant's physician.

Community-based men aged 50–93 who responded to media advertisements and met study criteria made up the convenience sample. To be eligible, the men had to be able to read and write English; have had no prior bone density test; be in general good health with no chronic diseases; taking no medications that could affect bone density; and able to travel to a DXA office site for a bone density test. The Institutional Review Board approved the study, and formal written informed consent was obtained from the participants. The number of participants required for the research design specifications was 160 completed observations. Oversampling was done to account for subject loss in a longitudinal design. Two hundred twenty-six men were recruited and 196 men completed the study, for an 87% retention rate. Incentives included store merchandise certificates given at two data collection time frames when DXA scans were not provided.

Instruments

Dual-energy x-ray absorptiometry (DXA) is the most widely used measure of bone density because of its high accuracy, low precision error, low radiation exposure, and ability to measure multiple skeletal sites (Binkley et al., 2007; Lewiecki et al., 2006). Measurements of the bone mineral density of the AP lumbar spine (L1-L4, anterior posterior) and femur were made using the GE Lunar DPX-IQ or DPX-A dual energy x-ray absorptiometer (DXA). The study included one scan for the AP lumbar spine (L1-L4) and one scan for the femur.

The DXA score is expressed as a T-score (or young adult Z-score), which compares the DXA result with the mean peak bone mass of a young adult in terms of a standard deviation (SD). For every SD below young adult normal, the risk of fracture increases significantly. Low bone mass (osteopenia) is a T-score between −1 and −2.5 SD below young adult mean peak bone density. Osteoporosis represents a value for BMD or bone mineral content (BMC) that is more than 2.5 SD below young adult mean peak bone density (WHO Study Group, 1994). At any skeletal site, a decrease in bone mass of one SD approximately doubles the relative risk of subsequent fracture. In this study, actual T-scores were compared across groups; and data were coded and examined across groups using the WHO (WHO Study Group, 1994) prescribed categories with 0= normal (T-score above −1 in both sites); 2= osteopenia (T-score between −1 and −2.5) in one or both sites; and 3= osteoporosis in one or both sites (T-score below −2.5).

Osteoporosis Knowledge Test (OKT), developed by Kim, et al. (Kim, Horan, & Gendler, 1991a) is a 24-item tool consisting of multiple choice questions on knowledge of

osteoporosis. The OKT has two subscales: OKT Calcium and OKT Exercise. Reliability coefficients for internal consistency (KR 20) for OKT Calcium and OKT Exercise were .72 and .69, respectively. For this study, 2 items related to female hormonal status were removed. The KR 20s for the 22 item tool were r=.80; for OKT Calcium and OKT Exercise, they were .72 and .69, respectively.

The Osteoporosis Health Belief Scale (OHBS), developed by Kim et al. (Kim et al., 1991b), is a 42-item tool consisting of 7 subscales (susceptibility, seriousness, benefits of [calcium and exercise], barriers to [calcium and exercise], and motivation). The tool focuses on calcium intake and physical exercise. Subjects rate each item on a 5 point scale: 1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree. The range of scores for each subscale is 6 to 30, with a possible total range of 42 to 210. Test-retest reliabilities were .90 for the total instrument and .71–.82 for the subscale reliabilities. Concurrent validity was established through assessment of calcium and exercise behaviors (Kim et al., 1991b). For construct validity, principal components factor analysis was used. Factor loadings on the calcium subscale ranged from .40 to .80; factor loadings on the exercise subscale ranged from .45 to .80.

Osteoporosis Self-Efficacy Scale (OSES), developed by Kim, et al., (Horan, Kim, Gendler, Froman, & Patel, 1998; Kim et al., 1991a) is a 21-item scale. Subjects circle the number (0=least confident, 10=most confident) that indicates their confidence in increasing exercise and calcium intake. The tool has two subscales, one for exercise and one for calcium. Scoring is done by multiplying the number circled on each item in the subscale by 10 and dividing by the number of items in the subscale. The possible range of scores for each subscale is 0 to 100, with a possible score range of 0 to 200 for the total scale. Reliability coefficients for the subscales were .94 and .93. Construct validity was established by principal components factor analysis and hierarchical regression analysis. Factor loadings on the calcium subscale ranged from .38 to .86; factor loadings on the exercise subscale ranged from .70 to .83.

Dietary Calcium Rapid Assessment (RAM) Intake is a 30 food item tool developed by Hertzler and Frary (Hertzler & Frary, 1994) to measure daily calcium intake. Food items are listed in five categories: dairy (milk, yogurt, cheeses); fruit and vegetables; bread, cereal, rice and pasta; meat, fish, poultry, dried beans and nuts; fat, sugar and alcohol. Respondents indicate the number of servings of each food they ate on a typical day in the last week. For scoring, servings are converted to milligrams of calcium by multiplying servings by calcium values and then summing the values. Test-retest reliability at 3 weeks was r=.80. Construct validity, established by comparing RAM scores with 3-day food records, was r= .68 (Hertzler & Frary, 1994). Cummings et al. (Cummings, Block, McHenry, & Baron, 1987) reported an r=.64 to .76 between sections of the RAM and 7 day dietary records.

For supplemental calcium intake, researcher developed items asked respondents to identify the type of calcium supplement they were taking, the amount of calcium, in mg in each tablet/pill/unit, and the number of tablets/pills/units taken/day. The mg/tablet was multiplied by number/day for the total calcium supplement intake. To assess dietary calcium, a variable was calculated using sources of dairy calcium (milk, yogurt, cheese) and supplemental calcium.

Yale Physical Activity Survey (YPAS) is a 39-item survey that measures a broad range of activities from high to low intensity (e.g., work, exercise, recreational activities) in older adults (Dipietro, Caspersen, Ostfeld, & Nadel, 1993). The first section contains a work, exercise, and recreational checklist to assess time spent in groups of related activities during a typical week in the past month. The second section contains Likert scale items to assess

current participation in several different types of activities (e.g., vigorous activity, low intensity walking and general moving about). Three indices are calculated: 1) total time (for all activities expressed as hours/week); 2) energy expenditure (activity multiplied by an intensity code); and activity dimension (a duration score for each of five specific activities (vigorous activity, leisurely walking, moving, standing, and sitting). Test-retest correlations over 2 weeks ranged from .42–.65. Construct validity was established through known groups (retirement home/community center elders) t=8.41, p< .0001; other self-report measures (i.e., CHAMPS r= .68, p< .0001); physiologic measures (i.e., estimated oxygen capacity, VO 2max; percent body fat; and body mass index). The YPAS activity dimension summary index correlated positively (r=.58, p = .004) with VO2max (Dipietro et al., 1993), and negatively with percent body fat (r=–.43, p = .03) (Bonnefoy et al., 2001). To better assess weight bearing activity of the men, a variable called “exercise” was calculated from the activity dimension scores using the summed scores for vigorous activity and walking exercise and the sum of activity, walking, moving, standing, and stairs.

Results

Sample

All statistical analyses were carried out using the Statistical Package for Social Sciences (SPSS) version 16.0 statistical software. As noted above, questionnaires were completed at all three data collection points (baseline, 6 and 12 months) by 196 community-based men, representing an 87% retention rate. No significant sociodemographic differences were found between the experimental and control groups (χ^2 (2) =.454, p=.797). Mean age was 65.94 years, mean height was 69.91 inches, and mean weight was 187.78 pounds. The majority, 190 (96.9%), were Caucasian; 1 was African American, 3 Hispanic, and 2 Asian. Most, 153 (78%), were married; 43 (22%) were single/widowed/divorced. Twenty-eight (14%) were high school graduates or less, 57 (30%) had some college or vocational education, 57 (30%) were college graduates, and 54 (26%) were post graduates.

Personal Knowledge

To determine whether personal knowledge about bone density from a DXA screen was related to general knowledge of osteoporosis, a repeated measures ANOVA was conducted using variable scores at Times 1, 2, and 3 comparing experimental and control subjects. Knowledge increased from a mean of 13.4 at Time 1 to 14.2 at Time 2 to 14.6 at Time 3 (Wilks’ λ = 13.51; df = 2, 193; p = .000). No significant differences were found between the experimental and control groups and there was no group by time interaction effect. All participants’ knowledge of osteoporosis increased over time.

To determine if personal knowledge gained via DXA screen was related to osteoporosis preventing behavior (OPB) scores for calcium intake, a repeated measures ANOVA was conducted using variable scores at Times 1, 2, and 3 comparing experimental and control groups. Calcium intake was higher at Times 2 and 3 than at Time 1, but the difference was not significant (X_1 = 802.6; X_2 = 841.2 X_3 = 903.7; Wilks’ λ F = 2.72; df = 2, 183; p = .068). The difference between the experimental and control groups was small at Time 1 (X_{1diff} = 825.6-780.0 = 45.6; an increase at Time 2, (X_{2diff} = 984.9-700.6 = 284.3); and a slight decrease at Time 3 (X_{3diff} = 965.5-843.2 = 122.3; Wilks’ λ F = 4.73; df = 2, 183; p = .009), however, overall there was an increase in calcium intake from Time 1($X_{\text{experimental group}}$ = 925.3; $X_{\text{control group}}$ = 774.6; F = 3.69; df = 1, 184; p = .056).

To determine whether knowledge of osteoporosis or health beliefs had effects on osteoporosis preventing behaviors, a “knowledge score” was created by summing the relevant “knowledge items,” and a “beliefs” score by using the scores predicting exercise

and calcium intake at three time points from the set of nine belief scores (susceptibility, seriousness, benefits of exercise, benefits of calcium, barriers to exercise, barriers to calcium, health motivation, self-efficacy for exercise and self-efficacy for calcium). The "knowledge score" and the "beliefs score" were then used to predict each outcome.

Multiple regression analyses were conducted to predict exercise and calcium at Time 3 from knowledge and a linear combination of beliefs at Times 1, 2, and 3. These analyses are presented in Table 1; they show the effects of OPBs (exercise and calcium) and the effects of knowledge on calcium, but a lack of effects of knowledge on exercise.

Exercise

To measure exercise, a repeated measures ANOVA was conducted using vigorous activity and walking exercise scores at Times 1, 2, and 3 comparing experimental and control groups. The overall mean number of minutes in vigorous activity ranged from 19.6 minutes per day at Time 1, to 21.5 minutes per day at time 2, to 20.5 minutes per day at Time 3. The mean number of minutes of vigorous activity was 22.0 in the experimental group and 19.0 minutes in the control group, but the differences were not significant.

The mean number of minutes walking ranged from 13.2 per day at Time 1, to 14.7 at Time 2, to 13.9 at Time 3. The number of minutes of walking was 15.3 per day in the experimental group and was 12.59 per day in the control group. The differences, however, were not significant.

To consider the effects of the mediating variables, knowledge and health beliefs, at Time 1 on exercise at Time 3, we combined the health belief variables (susceptibility, seriousness, benefits of exercise, benefits of calcium, barriers to exercise, barriers to calcium, motivation, health, total self-efficacy) to predict exercise at Time 3. The linear combination of health beliefs had a .417 ($p<.001$) zero order correlation with exercise; the corresponding part correlation, representing the incremental effect of beliefs on exercise above and beyond that explained by knowledge, was .408 ($p<.001$). Knowledge was not significantly correlated with exercise.

Next, we considered the effects of the mediating variables at Time 2 on exercise at Time 3. The linear combination of beliefs had a .371 ($p<.001$) zero order correlation with exercise; the corresponding part correlation, representing the incremental effect of beliefs on exercise above and beyond that explained by knowledge, was .367 ($p<.001$). Knowledge was not significantly correlated with exercise, however, at Time 3, health beliefs also predicted exercise. The linear combination of beliefs had a .348 ($p<.001$) zero order correlation with exercise; the corresponding part correlation, representing the incremental effect of beliefs on exercise above and beyond that explained by knowledge, was .347 ($p<.001$). Knowledge was not correlated with exercise.

Calcium

Similar analyses were conducted using health beliefs (susceptibility, seriousness, benefits of exercise, benefits of calcium, barriers to exercise, barriers to calcium, motivation, health, total self-efficacy) and total knowledge at Time 1 to predict calcium intake at Time 3. The linear combination of health beliefs had a .265 ($p < .01$) zero order correlation with calcium intake; the corresponding part correlation, representing the incremental effect of beliefs on calcium above and beyond that explained by knowledge, was .236 ($p < .01$). Knowledge was significantly correlated with calcium intake, ($p<.05$).

Analyses were also conducted using health beliefs and total knowledge at Time 2 to predict calcium at Time 3. The linear combination of beliefs had a .233 ($p<.05$) zero order

correlation with calcium intake; the corresponding part correlation, representing the incremental effect of health beliefs on calcium above and beyond that explained by knowledge, was .169 (p<.05). Knowledge was significantly correlated with calcium, (p<. 05).

Analyses were also conducted using health beliefs and total knowledge at Time 3 to predict calcium at Time 3. The linear combination of health beliefs had a .267 (p<.001) zero order correlation with calcium intake; the corresponding part correlation, representing the incremental effect of beliefs on calcium above and beyond that explained by knowledge, was .158 (p = .05). The correlation between total knowledge at Time 3 with calcium intake was .317 (p<.001); the corresponding part correlation representing the incremental effect of health beliefs on calcium above and beyond that explained by knowledge, was .232 (p<.01) (see Table 1).

Additional Findings

For the subsample of men who had a DXA, we looked at differences in OPB between men with normal DXA T-scores (>−1), osteopenic T-scores (−1.0 to −2.5), and osteoporotic T-scores (<−2.5), controlling for knowledge. Based on the World Health Organization (WHO) criteria, of the 100 men in the experimental group, 44 were classified as osteopenic and 6 as osteoporotic. Thus, 50 of the men had already experienced significant bone loss.

Calcium—DXA T- scores predicted level of calcium intake. Table 2 shows the change across time. From Time 1 to Time 3 controlling for knowledge at Time 1, respondents in the experimental group who had a normal DXA decreased their calcium intake by 32 mg; those with low bone mass DXA increased their calcium intake by 145 mg; and those with osteoporosis increased their calcium intake by 667 mg.

There was also an interactive effect of DXA T-scores and time on calcium intake (Wilks' λ F=4.575; df =4, 190; p=.002). The changes in calcium intake at Times 1, 2, and 3 are shown in Figure 2. There were no significant knowledge effects, no significant group effects, and no other significant interaction effects. Thus, increasing calcium intake appeared to be an attempt at preventing further bone loss and future fracture. There was no significant effect of DXA T-score on exercise.

Medications—One criterion for entry in the study was that the men were not taking osteoporosis preventing medications. At Time 2, 6 men were taking osteoporosis preventing medications, and at Time 3, an additional 3 men were taking these medications. All men who were taking osteoporosis preventing medications were in the experimental group and all had been diagnosed via DXA to have compromised bone density.

Discussion

In this sample, DXA served as a motivator and stimulator for OPB. Both groups had the same osteoporosis educational pamphlet and both increased their knowledge of osteoporosis significantly during the 12- month study. Knowledge was significantly related to calcium intake in both groups. A significant number of men in the experimental group also began taking osteoporosis preventing medications. General knowledge related to osteoporosis, however, was not a predictor of calcium intake or exercise at Time 3 while health beliefs were predictors of both.

Controlling for knowledge of osteoporosis and health beliefs, there were no significant differences in calcium intake between men in the experimental group and the control group. Men with an osteoporotic DXA-T score increased their calcium intake. However, the

amount of calcium these men were taking (1107 mg/day) was still below the recommended amount of 1200–1500 mg per day. The association between an abnormal DXA result and calcium intake is consistent with the research of Estok and Sedlak (Estok et al., 2007; Sedlak et al., 2007). A study of women (Sedlak et al., 2007) found that while an increase in calcium intake persisted for 12 months after having a DXA, it began to decrease at 12 months. Even though men in the current study were exercising, they were not exercising at the 150 minutes a week level recommended by U.S. Department of Health and Human Services (2008) {U.S. Department of Health and Human Services, 2008 1442 /id} and no significant increase in exercise occurred during the 12- month study. There was a significant increase in the use of antiresorptive medications; nine men in the experimental group were taking the medication at Time 3, but no men in the control group took these medications.

The findings indicated that health beliefs predicted both calcium intake and exercise. Further, except at Time 3, health beliefs were more powerful predictors of outcomes than knowledge. At Time 3, general knowledge was more strongly correlated with calcium intake than beliefs. These analyses point to the strength of beliefs and the weakness of knowledge in predicting exercise. However, the analyses also show that both beliefs and knowledge have independent effects on calcium. Indeed, personal knowledge of bone density status was a motivator for men to take greater amounts of calcium.

More research is needed to determine how to encourage men to recognize their susceptibility to osteoporosis and to begin and maintain OPB. Though exercise is important in maintaining bone health, this was not increased by having a DXA. The explanation may be that it takes more effort to initiate and maintain an exercise program than to take calcium supplements, or sensitivity and specificity of the exercise measurement tool used in the study may have had inadequacies. Also, half of the men had normal BMD, they may have perceived themselves not at risk for osteoporosis and therefore, they were not interested in prevention activities. Even though the men exercised below recommended levels, they did participate in exercise at a much higher level than that reported by women in an earlier study by Sedlak (2007). (Sedlak et al., 2007)

The increase in calcium intake peaked at 6 months and was lower at 12 months, providing support for Connell et al.'s (Connell, Sharpe, & Gallant, 1995) concern regarding sampling frame at time points since behavior changes are difficult to initiate and maintain. Assessment done too quickly after an intervention may miss a delay in initiation of the behavior change, and waiting too long to assess may miss termination of the maintenance of the behavior change. Clearly, there is a need for periodic reinforcement to maintain health promoting behaviors.

Conclusions

Screening for low bone mineral density via DXA is an easy and cost effective way to identify men who may be asymptomatic but at risk for osteoporosis. In this study, personal knowledge of one's own bone density was a more powerful stimulus to change OPB than general knowledge. This is an important consideration for health care providers; the cost of a DXA screen is far lower than the financial and social costs of osteoporotic related health conditions. Importantly, older men who present with stress fractures or other bone related complaints should be screened for osteoporosis. As the men in the study had limited awareness of their susceptibility to osteoporosis, many health care providers also may underestimate this risk in men.

The availability of new medications for osteoporosis treatment, increased life expectancy, and the increase in numbers of baby boomers entering the later decades of life, make

promotion of bone health important. New alternatives for prevention and management of osteoporosis require active participation by persons involved. Factors related to men's decisions to initiate and continue health promotion activities to maintain or increase bone density need to be identified.

The men in this study lacked knowledge of osteoporosis and their susceptibility to it, and yet almost half of those who had a bone density assessment were diagnosed with low bone mass or osteoporosis. Health care providers can play a significant role in assessing bone loss and preventing and treating osteoporosis in men. Health education programs for men need to show the relationship of bone health to effective functioning and quality of life. Men should also be receiving evidenced-based therapies currently available to treat and prevent osteoporosis.

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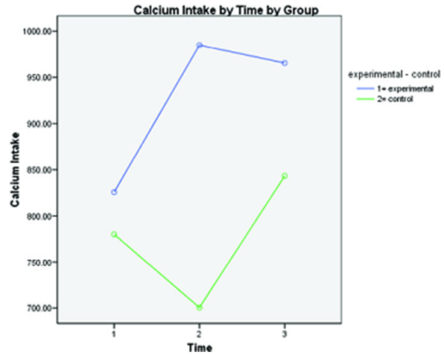

Figure 1.
Calcium Intake by Time by Group

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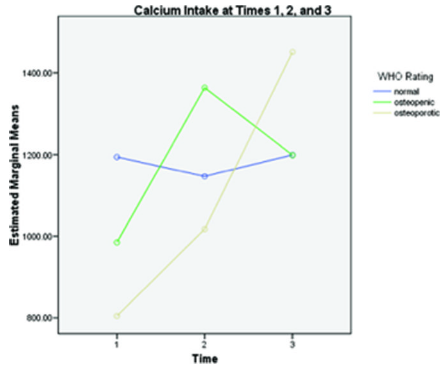

Figure 2.
Graphic Presentation of Calcium Intake at Times 1, 2, and 3

Table 1

Correlations of Knowledge and Beliefs with Exercise and Calcium Intake across Time

Time	Intervening Variable	Exercise 3		Calcium Intake 3	
		r	r_{part}	r	r_{part}
1	Knowledge	.090	.029	.188*	.144*
	Beliefs	.417***	.408***	.265**	.236**
2	Knowledge	.054	−.013	.220*	.151*
	Beliefs	.371***	.367***	.233*	.169*
3	Knowledge	.042	.024	.317***	.232**
	Beliefs	.348***	.347***	.267***	.158*

* $p<.05$

** $p<.01$

*** $p<.001$

Table 2

WHO Criteria for DXA T-score and Daily Calcium Intake

	WHO Rating	Mean	Std. Deviation	N
Calcium T1	Normal	1154.5600	882.06731	50
	Osteopenic	966.5114	466.13799	44
	Osteoporotic	800.0000	296.64794	6
	Total	1050.5450	704.49953	100
Calcium T2	Normal	1092.1500	807.15181	50
	Osteopenic	1303.5341	632.12794	44
	Osteoporotic	1033.1667	613.48200	6
	Total	1181.6200	725.95214	100
Calcium T3	Normal	1122.6600	678.96141	50
	Osteopenic	1111.1136	581.94313	44
	Osteoporotic	1466.6667	707.57803	6
	Total	1138.2200	638.38305	100