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ORIGINAL ARTICLE

Osteoporosis-preventive behaviors and their promotion for young men

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Osteoporosis in men is a major and neglected public health issue. An experimental study with a sample of 37 young men tested an osteoporosis prevention education intervention to alter osteoporosis health beliefs and to increase osteoporosis-preventive behaviors, in order to determine effectiveness and make public health recommendations. After pretest, control and treatment interventions were administered, with the administration of a posttest 2 weeks later. For all osteoporosis health beliefs and osteoporosis-preventive behaviors measured, no group and time interaction was found to be statistically significant. Both groups had low perceived susceptibility to osteoporosis, low to moderate perceived severity of osteoporosis, high perceived benefits of exercise and calcium to prevent osteoporosis, low perceived barriers to exercise and calcium, and moderate to high levels of confidence in self-efficacy for exercise and calcium. Bouts of exercise per week were adequate; however, consumption of good sources of calcium per day appeared to be low. More research is needed for the promotion of osteoporosis prevention in men. Recommendations promoting preventive behaviors for men have been provided.

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Introduction

Osteoporosis is a severe bone disease that reduces the quality[1] and quantity[2] of life, as it greatly increases both morbidity and mortality. This severe bone disease is clinically diagnosed as having bone mineral density (BMD) that is 2.5 s.d.'s below the adult peak mean,[3] and it greatly decreases bone strength and increases fracture risk. Osteoporosis is often considered to be a *pediatric* disease with *geriatric* consequences, as the disease is not typically diagnosed after 50 years of age, but it is best prevented during youth at childhood and adolescence, as that is the time of the lifespan when BMD is most efficiently built. The combination of preventive behaviors such as weight-bearing physical activity and calcium consumption during youth has been shown to increase peak BMD compared with either behavior alone.[4,5] With weight-bearing physical activity and calcium consumption, BMD can still be built after childhood and adolescence, but it tends to reach peak BMD around the end of the third decade of life (around age 30) and then decreases because of age-related bone loss.[6] The National Institute of Health Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy[7] noted that osteoporosis can occur in all populations of all ages, and that preventing osteoporosis can be achieved by maximizing the peak BMD with weight-bearing physical activity and calcium consumption during childhood and adolescence, and up to the third decade of life (up to age 30), and then maintaining peak BMD and bone health thereafter. Thus, if BMD is low during youth, osteoporosis risk increases later in life, and if BMD is high during youth, osteoporosis risk decreases later in life. Therefore, although the disease is not typically diagnosed until late in adulthood, efforts to maximize bone health and to prevent osteoporosis should start during youth.

Although most cases of osteoporosis are diagnosed in women, osteoporosis in men is becoming a more significant issue. Men are also susceptible to osteoporosis; Szulc *et al.*[8] have found that men account for 20–25% of all cases of osteoporosis. Szulc *et al.*[9] state that 'osteoporosis in men is one of the major and most neglected public health problems' because of the following reasons: morbidity, mortality and decreased independence are greater in men than in women after a fracture; rate of fractures increases rapidly in men; the number of men who are at high risk of fractures is often underestimated; there has been less osteoporosis treatment research in men compared with postmenopausal women; and men with increased risk of fractures are rarely treated. In addition, although osteoporosis in men is a major public health issue, it is one of the most neglected ones, and more public health attention is needed to encourage young men to engage in

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osteoporosis-preventive behaviors to prevent the disease. When comparing osteoporosis in young men with that in young women, it is found that men do not perceive themselves as being susceptible to osteoporosis, nor do they find the disease to be as severe, whereas young women have higher perceived benefits of weight-bearing physical activity and calcium consumption than young men.[10] Moreover, whereas older men have been shown to have low perceived susceptibility to osteoporosis,[11] young men's perceived susceptibility to osteoporosis has been found to be significantly lower than older men.[12]

To determine whether young men's low perceived susceptibility to, and severity of, osteoporosis can be altered, an intervention was designed for an experimental research study. Osteoporosis prevention education interventions have been given with the intent to increase osteoporosis knowledge and osteoporosis-preventive behaviors, and although these interventions are effective in increasing osteoporosis knowledge, they are ineffective in increasing osteoporosis-preventive behaviors.[13] Rather than only increasing knowledge about osteoporosis, an intervention was designed attempting to alter osteoporosis health beliefs on the basis of the health belief model (HBM) of Rosenstock[14] to predict an increase in osteoporosis-preventive behaviors, and was experimentally tested to determine its effectiveness in making recommendations for public health practice.

Results

Table 1 displays means and s.d.'s results for osteoporosis health beliefs and osteoporosis-preventive behaviors for both the control and treatment groups at pretest and posttest, in addition to a statistical analysis of group $\times$ time interaction. Two-way analysis of variance (ANOVA) with repeated measures showed that the group $\times$ time interaction was not statistically significant at the level of $P<0.05$ for any of the variables measured. For posttest measures, both the control and treatment groups had low perceived susceptibility to osteoporosis, with values of 2.16 and 2.06, respectively, and low to moderate perceived severity of osteoporosis, with values of 2.74 and 2.71, respectively. At posttest, both the control and treatment groups had high perceived benefits to prevent osteoporosis of exercise with a value of 4.18 for both groups, with high perceived benefits of calcium to prevent osteoporosis with values of 3.83 and 3.97, respectively. At posttest, both the control and treatment groups had low perceived barriers to exercise, with values of 1.58 and 1.59, respectively, and low perceived barriers to calcium, with values of 1.89 for both groups. At posttest, both control and treatment groups had moderate to high confidence levels of self-efficacy for exercise with values of 75.88 and 78.40, respectively, and moderate to high levels of self-efficacy for calcium, with values of 68.74 and 68.04, respectively.

For osteoporosis-preventive behaviors at posttest, both the control and treatment groups self-reportedly engaged in adequate to high amounts of exercise, with means of 5.94 and 6.47 bouts of exercise per week, respectively. At posttest, both the control and treatment groups self-reportedly engaged in consuming low to moderate amounts of calcium, with means of 2.68 and 2.91 good sources of calcium per day, respectively. Relating osteoporosis health beliefs to osteoporosis-preventive behaviors, both the control and treatment group scored higher on perceived benefits of exercise to prevent osteoporosis than perceived benefits of calcium to prevent osteoporosis, scored higher on self-efficacy for exercise than self-efficacy for calcium, and scored lower on perceived barriers to exercise than perceived barriers to calcium, which may have resulted in high amounts of bouts of exercise week and low to moderate amounts of good sources of calcium per day.

Discussion

Results of this experimental study showed that the osteoporosis prevention education intervention was ineffective in altering osteoporosis health beliefs to increase osteoporosis-preventive behaviors, and it did not increase the actual osteoporosis-preventive behaviors of self-reported weight-bearing physical activity and calcium consumption. Consistent with previous findings,[11,12] the participants for both the control and treatment groups had low perceived susceptibility to osteoporosis at pretest, which remained low after administration of the interventions and at posttest. Participants in the treatment group still had low perceived susceptibility to osteoporosis, even though the treatment intervention noted that osteoporosis can happen to both men and women of all races, and only low to moderate perceived severity of osteoporosis, even though the treatment intervention noted increased morbidity and mortality, and emphasized the visible severity while suggesting a proximal time of onset. However, it must be noted that, as modeled from the study by Klohn and Rogers[15] with a time of onset of osteoporosis in the early 20s, the intervention in this study more accurately noted that bone strength decreases after 30 years of age leading to osteoporosis, which is a decade later in time of onset, and that distal time of onset may have not created enough urgency to be proactive in preventing the disease. It is unclear whether the young men in this study did not have altered osteoporosis health beliefs or increased osteoporosis-preventive behaviors owing to the distal time of onset and/or because they felt that it was a disease that only or mainly affected women, and/or for other reasons. All of the young men in the treatment group at posttest correctly answered an item on osteoporosis risk factors, and all knew that osteoporosis can happen to anyone, which demonstrated that all of the young men clearly understood that osteoporosis is a disease that can also affect men. However, despite their risk awareness of osteoporosis, they still did not perceive themselves as susceptible to the disease, nor thought that the disease was severe if they were ever to be diagnosed with it. Perceived benefits of exercise and calcium to prevent osteoporosis were high, as participants already believed that weight-bearing physical activity and calcium consumption could prevent osteoporosis. In addition, perceived barriers to exercise and calcium were low, and self-efficacy for exercise and calcium was moderate to high, as participants felt that it would be relatively easy to engage in weight-bearing physical activity and calcium consumption; however, they were only moderately to highly confident that they could maintain and sustain weight-bearing physical activity and calcium consumption.

As the intervention was designed to alter osteoporosis health beliefs to predict osteoporosis-preventive behaviors, changes in osteoporosis health beliefs still do not necessarily predict or

Table 1 Measures of osteoporosis health belief and osteoporosis-preventive behavior means for control and treatment groups at pretest and posttest

Measure	*Group*				*Group × time interaction*
	Control (n = 20)		*Treatment (n = 17)*		
	Time				
	Pretest	*Posttest*	*Pretest*	*Posttest*	
Osteoporosis health beliefs					
Perceived susceptibility to osteoporosis	2.00 (0.52)	2.16 (0.77)	2.07 (0.69)	2.06 (0.77)	0.6047
Perceived severity of osteoporosis	2.78 (0.74)	2.74 (0.81)	2.89 (0.74)	2.71 (0.64)	0.6759
Perceived benefits of exercise to prevent osteoporosis	4.03 (0.67)	4.18 (0.50)	3.97 (0.71)	4.18 (0.55)	0.8611
Perceived benefits of calcium to prevent osteoporosis	3.83 (0.55)	3.83 (0.46)	3.70 (0.59)	3.97 (0.49)	0.2623
Perceived barriers to exercise	1.38 (0.53)	1.58 (0.69)	1.46 (0.45)	1.59 (0.45)	0.7468
Perceived barriers to calcium	1.84 (0.60)	1.89 (0.67)	1.69 (0.62)	1.89 (0.72)	0.6112
Self-efficacy for exercise	77.09 (22.49)	75.88 (22.84)	79.29 (14.73)	78.40 (14.86)	0.7915
Self-efficacy for calcium	65.46 (23.73)	68.74 (21.99)	68.61 (18.35)	68.04 (19.54)	0.6977
Osteoporosis-preventive behaviors					
Bouts of exercise per week	5.95 (2.61)	5.94 (1.75)	5.85 (2.64)	6.47 (1.97)	0.5606
Good sources of calcium per day	4.07 (2.98)	2.68 (1.54)	2.45 (1.72)	2.91 (1.49)	0.0596
Health motivation	3.53 (0.79)	3.70 (0.81)	3.63 (0.83)	3.65 (0.89)	0.7076

Statistical analysis of group × time interaction was performed. For all measures, the interaction between group and time was not statistically significant at the 0.05 level.

guarantee changes in osteoporosis-preventive behaviors. In addition, the osteoporosis prevention education intervention was ineffective in, most importantly, increasing the osteoporosis-preventive behaviors of weight-bearing physical activity and calcium consumption, as there was not a significant group × time interaction for either osteoporosis-preventive behavior measured. Participants in this study self-reported being engaged in approximately six bouts of exercise per week, which is in an adequate range for improving and maintaining bone health according to recommendations by the American College of Sports Medicine of weight-bearing endurance activity three to five times per week and resistance exercise two to three times per week.[16] However, they also self-reported consuming less than three good sources of calcium per day, and, although it is possible, it is unlikely that less than three good sources of calcium per day would meet levels for adequate intake of 1000–1200 mg of calcium per day as established by the Food and Nutrition Board.[17] It is worth noting that, for all participants, perceived benefits of exercise to prevent osteoporosis was higher than perceived benefits of calcium to prevent osteoporosis, perceived barriers to exercise was lower than perceived barriers to calcium and self-efficacy for exercise was higher than self-efficacy for calcium. As participants felt that weight-bearing physical activity was more beneficial than calcium consumption to prevent osteoporosis, and that it was easier to engage in weight-bearing physical activity than calcium consumption and as they were more confident that they could maintain and sustain weight-bearing physical activity than calcium consumption, it may have resulted in high amounts of bouts of exercise per week and low to moderate amounts of good sources of calcium per day. Thus, perhaps if perceived benefits of calcium to prevent osteoporosis and self-efficacy for calcium can be increased, and if perceived barriers to calcium can be decreased, then consuming good sources of calcium per day could possibly increase from low to moderate up to high amounts.

Although this intervention was ineffective, more research is needed to develop interventions that can alter osteoporosis health beliefs and increase osteoporosis-preventive behaviors. However, until an effective intervention is developed and young men continue to have low perceived susceptibility to, and perceived severity of, osteoporosis, instead of promoting the osteoporosis-preventive behaviors of weight-bearing physical activity and calcium for the purpose of preventing osteoporosis, public health efforts can instead promote these behaviors for other reasons that young men will find more motivating. Instead of preventing osteoporosis or other diseases, young boys have been found to be motivated to engage in physical activity and to alter their nutrition intake to improve physical appearance and gain muscle.[18] Although it is commonly known that physical activity can increase muscle mass and improve physical appearance, it could be made aware and promoted that consuming calcium can reduce weight,[19–21] which can enhance muscle tone and definition. In addition, if neither disease prevention nor improved physical appearance is motivating enough, weight-bearing physical activity and calcium consumption could also be promoted for their enjoyment. Although disease prevention and improved physical appearance can help to motivate young people to start engaging in physical activity, they will more likely be able to sustain physical activity if it is enjoyable and fun[22] and to socialize and spend time with friends.[23] Good taste is the main reason people choose the foods they eat,[24] and although young people have been found to consume calcium-rich foods because they may be healthy for them, they will mainly consume them if they taste good and to spend time with friends.[25] Thus, the osteoporosis-preventive behaviors of weight-bearing physical activity and calcium consumption do not necessarily have to be promoted for the purpose of osteoporosis prevention, but they may be promoted for other benefits that can be more motivating to young men, such as improved physical appearance, enjoyment and spending time with friends.

Table 2 Demographic information

	Control (n = 20)	*Treatment (n = 17)*
Age (years)	$M = 20.05$	$M = 21.79$
Ethnicity	20 (100%) Caucasian	15 (88.2%) Caucasian

This experimental research study was not without limitations. Convenience sampling limited generalizing the interpretation of results for other demographics, such as men of other ages, ethnicities, various levels of education and in different geographic regions of the country. Concerns with self-reported data, such as social desirability and random responding, may have resulted in inaccurate information reported from the participants. In addition, it is possible that participants did not thoroughly review their interventions between pretest and posttest to test their effectiveness.

Conclusions

As a major and neglected public health problem, more research is needed to determine how to alter young men's osteoporosis health beliefs to increase their osteoporosis-preventive behaviors. However, until that is accomplished, public health efforts to promote osteoporosis-preventive behaviors, such as weight-bearing physical activity and calcium consumption, can focus on their other benefits that have been found to be more motivating, such as to improve physical appearance, and to enjoy these behaviors, especially in the company of friends. From a public health perspective, as long as young men are engaged in these osteoporosis-preventive behaviors, for whatever reasons, they will receive desired benefits associated with them, and will also reduce their chances of acquiring osteoporosis later in life.

Materials and methods

Participants and procedures

For this experimental study, approval was granted from the Institutional Review Board of the University. At a university setting, a convenience sample of 37 male undergraduate college students in an undergraduate health education class volunteered to participate in this experimental study. Most participants were Caucasian and were in their early 20s; they were randomly assigned to a treatment or control group to receive an osteoporosis prevention education intervention or stress management intervention, respectively. Seventeen participants were randomly assigned to a treatment group, and the other twenty were randomly assigned to a control group (see **Table 2**). At pretest, all participants were given a written letter of consent, a demographic information sheet and a pretest consisting of the Osteoporosis Health Belief Scale (OHBS),[26] Osteoporosis Self-Efficacy Scale (OSES),[27] and Exercise and Calcium Behaviors Scale (ECBS) for pretest measures. After the pretest, the treatment and control groups received an osteoporosis prevention education intervention or stress management intervention, which they were asked to review. To encourage participants to thoroughly review their interventions, they were informed that a short quiz would be given on the intervention in 2 weeks, and the highest scores would win a free gift card to a popular retail store chain. After administration of the interventions, participants were informed that there would be a posttest, which was administered 2 weeks later to measure differences in osteoporosis health beliefs and osteoporosis-preventive behaviors.

Treatment intervention

To increase osteoporosis-preventive behaviors that were to be measured with the ECBS, a treatment intervention of a handout designed to alter osteoporosis health beliefs on the basis of HBM was used and were to be measured with the OHBS and OSES. Handouts are advantageous for widespread dissemination in public health practice and mass media campaigns,[28] but they must only include adequate and essential information to avoid being too extensive and overwhelming.[29] For osteoporosis-preventive behaviors, 'weight-bearing physical activity' was replaced with the term 'exercise' and 'calcium consumption' was shortened to 'calcium' to make those terms simpler for the participants and to correspond to those same terms used in the OHBS, OSES and ECBS. Constructs for each osteoporosis health belief on the basis of HBM were incorporated into the treatment intervention, including perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of exercise and calcium to prevent osteoporosis, perceived barriers to exercise and calcium and self-efficacy for exercise and calcium.

To increase perceived susceptibility to osteoporosis, the treatment intervention noted that osteoporosis can happen to anybody, in both men and women of all races, and it clearly noted that men are also susceptible to osteoporosis. To increase the perceived severity of osteoporosis, the treatment intervention in this study also noted increased morbidity and mortality to increase the perceived severity of osteoporosis, and in addition Smith Klohn and Rogers[15] found that emphasizing the visible severity of osteoporosis with a more proximal time of onset can significantly increase the perceived severity of osteoporosis and, in their study, emphasizing the visible severity of osteoporosis, such as looking frail and disfigured, having a hunch back and being shorter in stature, with a time of onset at the early 20s, can increase the perceived severity of osteoporosis in young individuals. This treatment intervention in this study also emphasized the visible severity of osteoporosis, illustrating how osteoporosis makes one look frail and disfigured, have a hunch back and become shorter in stature; however, it noted a time of onset that after the age of 30 bones will become weaker, leading to osteoporosis; as this statement is factual, unlike the time of onset of early 20s from Smith Klohn and Rogers[15] which is not typical. With an increase in the perceived susceptibility to, and perceived severity of osteoporosis, the perceived benefits of exercise and calcium should also increase,[30] and the treatment intervention also noted how those two particular behaviors can prevent osteoporosis, especially while they were still young and before they reached 30 years of age.

Moreover, to decrease perceived barriers of exercise and calcium while increasing self-efficacy for exercise and calcium, various types, examples and amounts of exercise and calcium were provided to allow participants to understand that there were numerous options of exercise and calcium sources to choose from. Perceived barriers to exercise and calcium are inversely related to self-efficacy for exercise and calcium, respectively, and if the treatment intervention could decrease perceived barriers to exercise and calcium, then self-efficacy for exercise and calcium is expected to increase, respectively.[30] For exercise, recommended exercises were activities that involved weight-bearing and/or jumping three to five times per week; listing activities such as jogging, volleyball and basketball; resistance exercise two to three times per week, mentioning weight lifting and resistance exercise with elastic bands or tubing. For calcium, the adequate intake was noted to be 1000–1200 mg/day, and listed numerous sources of calcium-rich foods, including dairy products, broccoli and leafy greens, sardines and canned salmon, tofu, calcium-fortified foods and calcium supplements.

Control intervention

The control intervention was a topic unrelated to osteoporosis prevention, which was a handout of a stress management intervention. The control intervention was developed to define stress, and to increase awareness of its consequences, while providing advice and methods to avoid and relieve stress.

Measures

To measure osteoporosis health beliefs to predict osteoporosis-preventive behaviors, the OHBS combined with the OSES was used to measure the constructs of the HBM for both pretest and posttest. The OHBS is a 42-item instrument developed by Kim *et al.*[26] with six items measuring each construct of the classic HBM applied to osteoporosis: (1) perceived susceptibility to osteoporosis, (2) perceived severity of osteoporosis, (3) perceived benefits of exercise to prevent osteoporosis, (4) perceived benefits of calcium to prevent osteoporosis, (5) perceived barriers to exercise, (6) perceived barriers to calcium and, although not a construct of the HBM, (7) health motivation. Responses to each item are a 5-point Likert scale, in which the participant rated each item by selecting one of the five following responses on the Likert scale with corresponding score: SD (STRONGLY DISAGREE) = 1, D (DISAGREE) = 2, N (NEUTRAL) = 3, A (AGREE) = 4 and SA (STRONGLY AGREE) = 5. For each construct, the means were calculated and they ranged from 1 to 5. The OSES is a 12-item instrument developed by Horan *et al.*[27] with six items measuring self-efficacy for each osteoporosis prevention behavior: (1) self-efficacy for exercise and (2) self-efficacy for calcium. Each item has a response scale that was a 100-mm analog scale from 0 = 'Not at all confident' to 100 = 'Very confident,' to describe levels of confidence, and both constructs calculated the means that ranged from 0 to 100.

In addition to measuring osteoporosis health beliefs to predict osteoporosis-preventive behaviors, actual self-reported osteoporosis-preventive behaviors were measured using the ECBS for both pretest and posttest. The ECBS is an 8-item instrument developed by the researcher designed to measure two self-reported osteoporosis-preventive behaviors: (1) exercise behavior and (2) calcium behavior, with the types and examples of exercise and calcium on the instrument corresponding directly to the treatment intervention developed by the researcher. Two items measure the two types of self-reported exercises: (1) exercise that is weight-bearing and/or involved jumping but is not resistance exercise and (2) resistance exercise, both with a 6-point response scale with corresponding score of the number of times a week: 'Never' = 0, '1 time a week' = 1, '2 times a week' = 2, '3 times a week' = 3, '4 times a week' = 4 and '5 or more times a week' = 5. To determine the total times of exercise per week, adding the number of times both types of exercises are performed a week gives a 'bouts of exercise per week' score with a range from 0 to 10. Six items measure six different types of self-reported calcium sources: (1) dairy products, (2) broccoli and/or leafy greens, (3) sardines and/or canned salmon, (4) tofu, (5) calcium-fortified foods and (6) calcium supplements. Each of the six items measuring calcium behavior had a 9-point response scale that mimicked a food frequency questionnaire[31] response scale: 'Never,' 'Less than once a month,' '1–3 times a month,' 'Once a week,' '2–4 times a week,' '5–6 times a week,' 'Once a day,' '2–3 times a day' and '4 or more times a day.' To determine the total times calcium is consumed per day, adding the number of times a day and fraction of times a day for each item gives a 'good sources of calcium per day' score with a range from 0 to 24.

Statistical analysis

Two-way (2 × 2) ANOVA with repeated measures was conducted for group (control and treatment) by time (pretest and posttest) for group × time interaction for each measure and were calculated for statistically significant differences at the level of $P < 0.05$. For osteoporosis health beliefs, variables measured and analyzed were perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of exercise to prevent osteoporosis, perceived benefits of calcium to prevent osteoporosis, perceived barriers to exercise, perceived barriers to calcium, self-efficacy for exercise and self-efficacy for calcium. For osteoporosis-preventive behaviors, variables measured and analyzed were bouts of exercise per week and good sources of calcium per day. Although not an osteoporosis health belief, health motivation was measured with the OHBS, and it was included in the measures and analysis.

Conflict of Interest

The author declares no conflict of interest.

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