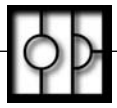

Research Article

Young Women's Knowledge and Beliefs about Osteoporosis: Results from a Cross-Sectional Survey of College Females

Mark J. Kasper, Michele Garber, and Kristie Walsdorf

Abstract

Background: *About 40% of White American women over age 50 experience osteoporosis-related fracture of the hip, spine, or wrist during their lives.* ***Purpose:*** *The purpose of this study was to determine the level of osteoporosis knowledge and beliefs among young women.* ***Methods:*** *University women (n=302) completed a self-administered osteoporosis risk factor questionnaire. Statistical analysis included descriptive statistics, chi-square analysis, analysis of variance, and the paired samples t-test.* ***Results:*** *Just 6 out of the 16 osteoporosis risk factors listed were correctly identified by at least 50% of the respondents; the mean risk factor knowledge score was 9.41 out of 20. Respondents strongly believed that osteoporosis is a serious disease, but less serious than heart disease and breast cancer. They also believed that they were somewhat responsible for getting osteoporosis, but less so than heart disease. In addition, they believed they were more likely to develop, and were more concerned about, breast cancer. African American women had lower knowledge scores than White women, were less likely to identify five of the risk factors correctly, and were less likely to believe they would develop osteoporosis.* ***Discussion:*** *The findings suggest that there are gaps in young women's ability to identify osteoporosis risk factors, and that they are somewhat complacent about the disease.* ***Translation to Health Education Practice:*** *This data suggests that educational programs concerning the prevention of osteoporosis in young women are warranted.*

BACKGROUND

Osteoporosis is a skeletal disorder characterized by low bone mass with a significant increased risk of fracture,[1(p5)] while osteopenia is low bone mass with some increased risk of fracture.[2(p77)] Both disorders are clinically determined by comparing an individual's bone mineral density against a mean value for healthy young adults.[2(p77)] The calculation is expressed as a T-score and indicates how much one deviates from maximal peak bone density.

About 40% of White American women over age 50 will experience an osteoporosis-related fracture of the hip, spine, or wrist during the remainder of their lives.[2(p68)] By the year 2020, low bone mass will become an even greater public health concern, with 50% of Americans over age 50 expected to have, or be at risk of developing, osteoporosis of the hip, and even more at risk of developing the disorder at any site.[2(p77)]

Although osteoporosis predominantly affects White women, 20% of Asian women over age 50 are estimated to have the disorder, while 52% are estimated to have osteopenia. Among African American women, 5% are estimated to have osteoporosis and 35% osteopenia.[3] Moreover, it is likely that the prevalence of osteopenia and osteoporosis in minority women is greatly underestimated.[4] There is a relative lack of population-based fracture data for non-White women and, more important, the reference population for determining a T-score is White women. If specific T-scores were

Mark J. Kasper is a professor in the Department of Kinesiology and Physical Education, Valdosta State University, 1500 North Patterson Street, Valdosta, GA 31698-0095; E-mail: mkasper@valdosta.edu. Michele Garber is associate program director with the Athletic Training/Sports Medicine Program, Department of Food, Nutrition, and Exercise Sciences, Florida State University, 412 Sandels Building, Tallahassee, FL, 32306-1493; E-mail: mgarber@mailer.fsu.edu. Kristie Walsdorf is an assistant professor in the Department of Sports Management, Recreation Management, and Physical Education, Florida State University, 200 Tully Gym, Tallahassee, FL 32306-4280; E-mail: walsdorf@mail.coe.fsu.edu.

available for minorities, a higher prevalence of osteoporosis in non-White populations would be observed.

What is known is that bone mineral density declines with increasing age, and post-menopausal osteoporosis is seen in all racial groups.[2(p78)] Thus, with the increasing population and longevity of all racial and ethnic groups in the United States, osteoporosis promises to become a more pressing public health concern in the coming decades. Accordingly, initiatives for preventing and treating osteoporosis should target all women rather than those of just White or Asian background.[3]

The main strategies for preventing osteoporosis are to maximize bone mineral density during the first three decades of life and to minimize its decline after age 40.[5] The majority of risk factors for low bone mass are behavioral in nature, with strong evidence that practicing bone health behaviors are conducive to both building and maintaining bone throughout the lifespan.[1(p2)] The two most emphasized strategies include appropriate physical activity and adequate nutritional intake, especially calcium consumption.[6] A low level of estradiol—typically a consequence of excessive dieting or exercise, or as a natural part of the aging process—also has a significant impact on bone density.[6] Low estradiol is commonly associated with infrequent menstruation (oligomenorrhea) or a total loss of menstruation (amenorrhea). Research points to low body mass index, current cigarette smoking, physical inactivity, and dietary calcium intake as the modifiable risk factors that best predict low bone mineral density in adult women.[4] Unfortunately, healthy behaviors are complex and influenced by multiple environmental, social, and individual factors, including a person's knowledge and beliefs about the disease.[7-13]

There is a plethora of research on women's knowledge about osteoporosis, but very few studies have reported on young women and minority groups, warranting further research in these populations.[14] One problem when comparing different studies of what women know about osteoporosis is that the surveys used to collect data have varied considerably in their degree of detail and comprehensiveness.[14] Nonetheless, in a review of the osteoporosis knowledge literature published between 1998 and 2004, women's knowledge tended to be high with regard to a select few risk factors (e.g., sedentary lifestyle, low calcium intake), but poor for the majority of risk factors.[14] Studies that were not included in the literature review but which included a sample of at least some college-age women have reported similar outcomes.[15-20] That is, young women were unable to correctly identify the majority of osteoporosis risk factors and had low osteoporosis knowledge scores.

Studies on young women's beliefs about osteoporosis are also limited. One instrument that has been used to measure such beliefs is the Osteoporosis Health Belief Scale.[21] Although developed for and validated in a population of elderly adults, the scale has been used in much younger populations of college-age women. In a convenience sample of 31 predominantly White college-age females of which 65% were either 18 or 19 years old, respondents believed osteoporosis to be a serious disease but did not feel susceptible to it.[18] Similar beliefs were observed in a group of 100 Asian women, mean age 18.5 years, who were enrolled as first-year nursing students in Bangkok, Thailand.[17] These beliefs were consistent with those in a slightly older population of 113 college women, mean age 25 years, although the authors did not report the racial makeup of the subjects.[19]

The Multiple Osteoporosis Prevention Survey, in various modified versions, is another tool that has been used to assess young women's beliefs about osteoporosis and other diseases.[15,16,22] In an initial study of 127 predominantly White college females, mean age 19.6 years, respondents believed very strongly that osteoporosis is a serious illness and were somewhat concerned about it.[15] However, they did not believe that they were likely to get, or that they were responsible for getting, the disease.[15] When osteoporosis was compared to other diseases, women were more concerned about, and believed that they were more likely to get, heart disease and breast cancer. Osteoporosis was also believed to be less serious than other common causes of morbidity and mortality, including AIDS and Alzheimer's disease. Similar beliefs were found in a follow-up study of 321 college women who were slightly older (mean age 21.6 years) and more racially diverse than the initial study,[16] as well as in a population of 206 African American and Hispanic women at a women's health care center, 80% of whom were less than 50 years old.[22]

PURPOSE

All women regardless of racial or ethnic background are at significant risk for developing osteoporosis.[3] Although a major component of prevention is education, studies are limited on knowledge and beliefs about osteoporosis in young women, including minority groups. The purpose of this study was to determine the level of young women's knowledge and beliefs about osteoporosis in order to help fill the void in the existing literature and to assist in the development of osteoporosis prevention programs.

METHODS

Women enrolled in an elective physical activity course at a southeastern state university were asked to participate in the study after approval to conduct the investigation was obtained from the institution's review board for the protection of human subjects. Subjects were asked to complete a questionnaire concerning their knowledge and opinions related to health issues. The Multiple Osteoporosis Prevention Survey was used, consisting of 50 questions.[15,16] Knowledge was assessed by listing 20 items, 16 of which are commonly identified by the National Osteoporosis Foundation as risk factors for the disease.[3] For each item, the respondent had five responses from which to choose: "definitely increases," "probably increases," "probably does not increase," "definitely does not increase," or "don't know." For the 16 osteoporosis risk factors, responses were dichotomized into either correct answers ("definitely or probably increases") or

incorrect answers ("probably or definitely does not increase" or "don't know"). Four items were listed that are not known osteoporosis risk factors ("eating a diet high in animal fat," "worry or anxiety," "having high blood cholesterol," and "getting sunburn"). These items were also dichotomized into either correct responses ("probably or definitely does not increase") or incorrect responses ("definitely or probably increases" or "don't know").

For respondents with complete risk factor knowledge data, a risk factor knowledge score was calculated by summing the number of correct responses for all 20 items (possible scores ranged from 0 to 20). Also determined was the percentage of respondents with a total knowledge score of at least 10 (greater than or equal to 50% correct), at least 12 (greater than or equal to 60% correct), and at least 14 (greater than or equal to 70% correct). Data was also analyzed to determine the percentage of respondents who correctly identified all risk factors from a specified group. The three risk factor groups were as follows: (1) lack of physical exercise; low calcium intake; skipped menstrual periods; (2) post-menopause; an early or surgically induced menopause; infrequent or skipped menstrual periods; and (3) a small, thin frame; smoking cigarettes; lack of physical exercise; and a diet low in calcium intake.

The strength of women's beliefs about osteoporosis, heart disease, breast cancer, AIDS, Alzheimer's disease, and the common cold was measured with the use of a five-point Likert-type scale. Four questions were asked: "How concerned are you about getting _____ (disease)?"; "How likely are you to get _____ (disease)?"; "How serious is _____ (disease)?"; and "How responsible do you think a person is for getting _____ (disease)?" The scale ranged from 1 (respectively labeled "not at all concerned," "not at all likely," "not at all serious," and "not at all responsible") to 5 (respectively labeled "extremely concerned," "extremely likely," "extremely serious," and "extremely responsible"). The numbers two, three, and four of the scale were not labeled.

Content validity of the Multiple Osteoporosis Prevention Survey was established by a panel of expert colleagues in health education and osteoporosis.[15,16] The test-retest reliability was similar to that obtained with other self-administered epidemiological surveys.[15,16] An advantage of using the Multiple Osteoporosis Prevention Survey is that respondents were asked about the strength of their beliefs regarding osteoporosis and other illnesses. This allowed the investigators to measure the absolute strength of respondent's beliefs about osteoporosis and to make relative belief comparisons about osteoporosis against other common causes of morbidity and mortality. This survey has also been used in previous investigations, which allowed comparison of data across the different studies.

Data was evaluated using the following analysis. Descriptive statistics and frequency distributions were developed for each variable. Chi-square was used to test for differences in percentage of White versus African American respondents who correctly identified a specific osteoporosis risk factor or group of factors. Analysis of variance was used to test for differences between White and African American respondents for total osteoporosis knowledge scores. The paired samples t-test was used to evaluate for differences between beliefs about osteoporosis and other diseases (e.g., osteoporosis versus breast cancer, osteoporosis versus heart disease), and for differences between White and African American respondents in their beliefs about osteoporosis (e.g., how concerned they were). All analysis was done using SPSS 13.0 for Windows (Chicago, IL). The level for statistical significance was set at $p<0.05$.

RESULTS

Of the 331 women recruited for the study, 302 volunteered to answer the survey questionnaire, reaching 91% of the targeted population. Nearly two-thirds (194 out of 302) of the respondents were non-Hispanic White, and one-fourth (77 out of 302) were non-Hispanic African American. Nearly 84% (253 out of 301) ranged in age from 18 to 21 years, and 98% (295 out of 302) had heard some or a lot about osteoporosis. More than one-third (108 out of 297) self-reported a body weight of less than 127 pounds.

The percentage of respondents who correctly identified osteoporosis risk factors is presented in Table 1. A high percentage of all respondents was able to identify the risk factors of family history (89.1%), low calcium intake (86.1%), and a sedentary lifestyle (85.8%). About two-thirds of respondents were able to identify that female gender was a risk factor for osteoporosis, but just a small percentage were able to identify that Caucasian (28.5%), Asian (12.9%), African American (12.9%), or Hispanic (9.2%) race were risk factors. African Americans were less likely than Whites to correctly identify the following risk factors: female gender (51.9% vs. 73.2%; $\chi^2=11.28$; $P=0.001$), post-menopause (42.9% vs. 63.2%; $\chi^2=9.32$; $P=0.002$), small, thin frame (35.5% vs. 52.8%; $\chi^2=6.55$; $P=0.010$), use of steroid or thyroid medications (29.9% vs. 46.9%; $\chi^2=6.56$; $P=0.010$), and infrequent or skipped menstruation (20.8% vs. 39.7%; $\chi^2=8.74$; $P=0.003$).

Of note, 70% of respondents incorrectly identified high blood cholesterol and eating a diet high in animal fat as risk factors for osteoporosis. Similarly, 55% of respondents incorrectly identified worry or anxiety as contributing factors for osteoporosis, while 31% incorrectly identified getting sunburned as a factor. African Americans were more likely than Whites to incorrectly identify sunburn (48.1% vs. 25.8%; $\chi^2=12.55$; $P<0.001$) and a diet high in animal fat (80.5% vs. 68.6%; $\chi^2=3.90$; $P=0.048$) as risk factors.

There were 299 respondents with complete risk factor knowledge data. The mean risk factor knowledge score was 9.41 ±3.19 (range 0 to 17) out of 20, with African Americans scoring lower than Whites (mean 8.29 ±3.27, range 0 to 17, vs. mean 9.95 ±3.08, range 0 to 17; $F=15.28$; $P<0.001$). Only 51.5% of all respondents had a knowledge score of 10 or greater, while just 26.1% scored 12 or greater and a mere 7.7% scored 14 or greater (at least 70% correct). African Americans were less likely than Whites

Table 1. Percentage of Women Who Correctly Identified Osteoporosis Risk Factors

Risk Factor[a]	Percentage of all women who responded correctly	Percentage of White women who responded correctly	Percentage of African American who responded correctly	P*
A family history of osteoporosis	89.1	90.2	89.6	
A diet low in dairy products or other sources of calcium	86.1	88.1	85.7	
Lack of physical exercise	85.8	87.6	85.7	
Getting sunburn	68.5	74.2	51.9	*
Being female	65.9	73.2	51.9	*
Scoliosis or curved spine	65.2	67.0	59.2	
Being post-menopausal	56.0	63.2	42.9	*
Having a small, thin frame	46.4	52.8	35.5	*
Smoking cigarettes	44.7	48.5	39.0	
Drinking alcohol in excess	44.4	45.4	42.9	
Worry or anxiety	44.4	45.9	37.7	
Taking steroid or thyroid medication for asthma, arthritis, or other diseases	42.1	46.9	29.9	*
An early or surgically induced menopause	41.1	44.8	33.8	
Infrequent or skipped menstrual periods	35.1	39.7	20.8	*
Having high blood cholesterol	29.5	29.9	26.0	
A diet high in animal fat	28.1	31.4	19.5	*
Being Caucasian	28.5	27.8	32.5	
Being Asian	12.9	12.4	15.6	
Being African American	12.9	12.9	13.0	
Being Hispanic	9.2	9.3	9.1	

Notes:
[a] Data in the rows "Getting sunburn," "Worry or anxiety," "Having high blood cholesterol," and "A diet high in animal fat" represent the percentage of respondents who correctly identified the item as not being a risk factor for osteoporosis
*Chi-square p value<0.05 between White women and African American women

to have scores of 10 or greater (35.5% vs. 57.8%; χ^2=10.82; P=0.001) or 12 or greater (13.2% vs. 31.8%; χ^2=9.68; P=0.002).

Less than one-third (93 out of 301) of all respondents correctly identified all three of the most commonly emphasized risk factors in young women for the prevention of osteoporosis: lack of physical exercise, low calcium intake, and skipped menstrual periods. African Americans were less likely than Whites to correctly identify all three of these factors (16.9% vs. 35.6%; χ^2=9.11; P=0.003). Moreover, just 21.3% (64 out of 301) of respondents correctly identified all three risk factors linked to low levels of estradiol: post-menopause, an early or surgically induced menopause, and infrequent or skipped menstrual periods. Finally, just 19% of respondents correctly identified all four of the risk factors that best predict low bone mineral density in adult women: a small thin, frame, cigarette smoking, physical inactivity, and calcium intake.

The mean belief score for each disease is presented in Table 2. The mean belief score represents the strength of belief about the illness. It is noted whenever there was a statistical difference between respondents' osteoporosis beliefs and their beliefs about other diseases (e.g., osteoporosis vs. heart disease, osteoporosis vs. breast cancer), or between White and African American respondents' beliefs regarding osteoporosis (e.g., how concerned, how likely).

The women in this study stated that they were somewhat concerned about developing osteoporosis (mean response 2.85, range 1 to 5). However, they were significantly more concerned about, and believed they were more likely to get, breast cancer. African American respondents also expressed a greater concern about, and perceived susceptibility to, heart disease. Similarly, although women in this study stated that osteoporosis is a serious disease (mean response 4.24, range 2 to 5), they believed it to be significantly less serious than heart disease, breast cancer, AIDS, and, except for African American respondents, Alzheimer's disease.

The respondents also believed that they were less responsible for getting osteoporosis (mean response 2.83, range 1 to 5) than for getting heart disease. This difference,

Table 2. Mean Score (Standard Deviation) for Women's Beliefs about Diseases[a]

	Concerned[b]			Likely[c]			Serious[d]			Responsible[e]		
	All[f]	W[g]	AA[h]	All	W	AA	All	W	AA	All	W	AA
Osteoporosis	2.85	2.80	2.84	2.50†	2.60	2.26	4.24	4.20	4.30	2.83	2.76	2.90
	(1.19)	(1.13)	(1.51)	(1.04)	(1.02)	(0.99)	(0.88)	(0.87)	(0.90)	(1.07)	(1.05)	(1.05)
Heart disease	2.96	2.81	3.27*	2.57	2.58	2.53*	4.75*	4.76*	4.74*	2.98*	2.89	3.09
	(1.19)	(1.12)	(1.36)	(1.13)	(1.12)	(1.15)	(0.60)	(0.59)	(0.61)	(1.07)	(0.98)	(1.21)
Breast cancer	3.60*	3.53*	3.84*	2.83*	2.90*	2.83*	4.73*	4.71*	4.81*	1.78*	1.69*	1.88*
	(1.11)	(1.03)	(1.14)	(1.04)	(0.96)	(1.10)	(0.62)	(0.60)	(0.58)	(0.99)	(0.98)	(0.98)
AIDS	2.59*	2.27*	3.23*	1.59*	1.48*	1.74*	4.90*	4.92*	4.98*	4.22*	4.12*	4.35*
	(1.46)	(1.33)	(1.51)	(0.81)	(0.73)	(0.89)	(0.48)	(0.34)	(0.46)	(0.96)	(1.00)	(0.88)
Alzheimer's disease	2.80	2.71	2.87	2.37	2.38*	2.29	4.40*	4.39*	4.40	1.71*	1.62*	1.92*
	(1.30)	(1.28)	(1.31)	(1.15)	(1.16)	(1.13)	(0.85)	(0.84)	(0.87)	(1.00)	(0.86)	(1.26)
Common cold	2.65*	2.61	2.87	4.15*	4.23*	4.06*	2.15*	1.98*	2.47*	2.54*	2.43*	2.79
	(1.39)	(1.36)	(1.49)	(1.12)	(1.05)	(1.16)	(1.16)	(1.01)	(1.42)	(1.01)	(0.91)	(1.17)

Notes:
[a] Scale ranged from 1 to 5; 1 = Not at all; 5 = Extremely
[b] How concerned are you about getting _____ (disease)?
[c] How likely are you to get _____ (disease)?
[d] How serious is _____ (disease)?
[e] How responsible is a person for getting _____ (disease)?
[f] All = all women
[g] W = White women only
[h] AA = African American women only
* Paired sample t-test $p<0.05$ than osteoporosis
† Paired sample t-test $p<0.05$ between White and African American

however, was not significant within African American women only or White women only. Finally, African American respondents believed that a person is just as responsible for getting osteoporosis as for getting a common cold.

DISCUSSION

In discussing a public health approach to promote bone health, the Surgeon General's report on bone health and osteoporosis stated, "Perhaps the biggest problem is a lack of awareness of bone disease among the public … many of whom do not understand the magnitude of the problem, let alone ways in which bone disease can be prevented."[2(p7)] The results of this study and others lend support to the Surgeon General's statement. The vast majority of respondents in this study were able to identify the modifiable risk factors of a sedentary lifestyle and low calcium intake, but less than one-third were able to correctly identify all three risk factors most commonly emphasized for the prevention of osteoporosis in young women (lack of physical exercise, low calcium intake, skipped menstrual periods). Similarly, just 21% were able to correctly identify all three risk factors related to low bone mass as a result of endocrine changes (post-menopause, early or surgically induced menopause, or infrequent or skipped menstrual periods), while less than 20% were able to correctly identify all four risk factors that best predict low bone mineral density in adults (small thin frame, cigarette smoking, physical inactivity, calcium intake).

Collectively, just half of all respondents obtained an osteoporosis knowledge score of 10 or greater out of 20. Certainly, there are numerous combinations of risk factors which could have been grouped together and analyzed for percentage of respondents who were able to correctly identify the items. However, the bottom line in this study is that young women's ability to identify osteoporosis risk factors was poor. Just 6 out of the 16 osteoporosis risk factors listed were correctly identified by at least 50% of the respondents. African American respondents tended to score lower than White respondents across several risk factors.

These data mirror the results from two other similar populations surveyed in 1994 and 2001 using the same instrument,[15,16] including the finding that African American women were less likely than White women to correctly identify post-menopause status and having a small, thin frame as osteoporosis risk factors.[16] Several studies have also reported similar findings in which different populations, survey instruments, and scoring systems were used. In other words, there are significant gaps in women's knowledge about osteoporosis.[14-20,23-25]

Moreover, although women in this study reported that they were somewhat concerned about getting osteoporosis, they were much more concerned about, and believed they were more likely to get, breast cancer. African American respondents also expressed a greater concern for and likeli-

ness to get heart disease. This is inconsistent with statistics estimating that approximately 13% of women will develop breast cancer[26] and 33% will develop heart disease,[27] compared to the 40% who will be affected by osteoporosis.[2(p68)]

Rightly so, women in this study did believe that osteoporosis is a serious disease. Just one-third of individuals who experience an osteoporotic hip fracture will return to independent activities of daily living, and a similar percentage of women who experience a hip fracture will require long-term nursing home care.[1(p7)] Women with osteoporosis also experience a tremendous amount of fear and anxiety, which contributes to a high rate of depression.[1(p7)] All of these factors contribute to the 20% one-year mortality rate following hip fracture.[14]

The beliefs reported in this study are similar to those reported by other investigators in populations of young women.[15-19] That is, young women tend to be somewhat concerned about osteoporosis and believe that it is a serious disease. However, they do not feel all that likely to get osteoporosis. Of importance to health education programming, most women do not believe that they are responsible for developing osteoporosis. Educational messages need to stress that although lifestyle factors may account for a relatively small percentage of bone mass (somewhere in the range of 10 to 50%), just a mere 10% increase in bone mass may reduce the risk of fracture by up to 50%.[2(p111)] Behaviors, especially physical activity, calcium intake, and abstinence from cigarette smoking, can also retard the age-related loss of bone mass.[1(p2)]

Almost all of the respondents in this study reported that they have heard some or a great deal about osteoporosis, and yet their ability to identify the majority of risk factors was poor, and their beliefs about the disease were not consistent with current science and statistics. In a previous study, 73% of young women obtained osteoporosis information from magazines, and 40% read about the disease in newspapers.[16] However, when investigators examined the extent of coverage of osteoporosis in leading women's magazines and two major metropolitan newspapers, they concluded that it was not balanced toward science and fact, and that the information given on risk factors and preventive measures was very general.[29] It is possible, then, that women in this study have not received or retained enough detailed information about the primary prevention of osteoporosis. For example, the majority of television and magazine advertisements regarding osteoporosis target older peri- or post-menopausal woman for secondary and tertiary prevention of the disease (e.g., via bone-building drugs or calcium supplementation). Similar to many other health concerns, there appears to be a major gap between our clinical knowledge about the prevention of osteoporosis and its translation to the public.[2(p8)]

A similar disconnect exists between young people and their perceived susceptibility to illness, especially diseases that do not clinically manifest themselves until much later in life. Therefore, it was of no surprise that women in this study were not too concerned about osteoporosis. Because the clinical diagnosis of osteoporosis typically does not occur until the fifth decade of life and symptomology much later, it is reasonable for young women not to be concerned about a disease that will not strike them, if at all, until several decades in the future. In fact, women in this study did not believe that they were likely to get any of the chronic diseases identified, and except for breast cancer, they were not too concerned about any of them.

There are possible limitations to this study that warrant discussion. First, the respondents in this study may not be reflective of all young women. Although 91% of the targeted population was reached, the study sample was drawn from women enrolled in a college elective physical activity course. One would think, however, that women enrolled in higher education would have a greater level of health knowledge and a stronger belief about health and disease, including osteoporosis, than young women not in college or not partaking in a physical activity course. This is to suggest that osteoporosis knowledge may actually be lower, and beliefs about osteoporosis may actually be weaker, in a more representative sample of young women.

A second concern about the study results is that knowledge about osteoporosis was defined as the ability to identify risk factors. Arguments can be made that this type of format may have encouraged guessing and that identification of risk factors is not a comprehensive assessment of osteoporosis knowledge.[14] The survey used in the study, however, has demonstrated acceptable test-retest reliability in college women.[15,16] Furthermore, the ability to recognize is at the most elementary level of assessment, and guessing would likely favor the respondent who is not familiar with osteoporosis risk factors. It is likely that osteoporosis knowledge scores would have been lower than reported if the questionnaire items required more complex thinking skills. Finally, other investigators have used a number of different surveys, with different formats and degree of detail and comprehensiveness, and their conclusions have been similar: there are significant gaps in women's knowledge about osteoporosis.[14]

A third limitation of the study is that the bone health behaviors of the respondents were not assessed. It is possible that women in our study were practicing the behaviors linked to healthy bone and, thus, their knowledge or beliefs about the disease were irrelevant. Yet, even though women in this study were enrolled in a physical activity class (e.g., tennis, volleyball, walking, resistance training), it is important to note that partaking in the course by itself did not meet current recommendations for building or preserving bone.[5] For example, walking is an insufficient mechanical force for bone health, the frequency of the classes were less than three sessions per week, and only the weight lifting course involved heavy resistance training of all the major muscle groups. A major problem with measuring physical activity in these sorts of research studies is that there are no valid instruments currently available to assess physical activity for bone health.

What is known from the epidemiological data is that calcium intake in young women is significantly below the 1000 mg/day recommended level,[2(p50)] and approximately 19% of women smoke cigarettes.[30] In addition, over one-third of the respondents in this study self reported a body weight of less than 127 pounds—i.e., the "small, thin frame" risk factor, which, although not a behavior, nevertheless puts these women in the highest risk group for developing osteoporosis, given their gender.

TRANSLATION TO HEALTH EDUCATION PRACTICE

The leading modifiable behavioral causes of premature death and disability in the United States are cigarette smoking, diet, and a sedentary lifestyle.[31] Health education messages should continue to stress the importance of these behaviors for the prevention of several diseases, including osteoporosis. The Dietary Guidelines for Americans is an appropriate dietary message for the prevention of osteoporosis in young women.[32] However, because of the synergistic effect of calcium and exercise, it is important to emphasize that calcium intake below the recommended 1,000 mg/day, even in the presence of adequate physical activity, may result in less than optimal bone health.[2(p129),5] A rough guide to determine the amount of dietary calcium intake in women is to calculate 290 mg plus 300 mg for each 8 oz. serving of milk or other calcium-rich foods.[2(p163)]

Over exercising (high energy expenditure), under eating (low caloric intake), or both, which may result in hormonal or dietary deficiencies, are also linked to either low bone mass or loss of bone.[5] Women should be informed that menstrual irregularities may signify hormonal deficiencies that can affect bone health.[33] Women who are oligomenorrheic (three to nine periods per year) or amenorrheic (two or fewer periods per year or no period within the past six months) should consult their physician.

Adhering to the public health message of obtaining daily 30-minute bouts of moderate-intensity physical activity can result in significant benefits for overall health.[34] This recommendation, however, may be insufficient to augment or preserve bone across the lifespan. Although the specific type or dose of exercise has yet to be determined, it appears that the optimal exercise prescription for bone health is high-intensity skeletal loading exercises.[5] Modalities that are weight bearing and involve jumping (e.g., volleyball, basketball, running, step aerobics) are best. Walking, by itself, has shown to be relatively ineffective; consequently, encouragement of short bouts of jogging during walking sessions should be encouraged, if appropriate.[5] Furthermore, resistance training to increase or preserve muscle mass has shown to be effective in increasing and preserving bone mass.[5] As with other lifestyle diseases, the behaviors linked to osteoporosis prevention must be maintained or the benefits will be lost. It is important to reiterate that health behaviors are complex and determined by numerous factors other than knowledge and beliefs.[7-13]

Packaged osteoporosis educational materials are available from a variety of sources. Powerful Bones Powerful Girls™ is designed to promote bone health in girls between the ages of 9 and 12.[35] This campaign, based at the Centers for Disease Control and Prevention, has a website with numerous educational games and activities, including a calcium intake calculator. Although the website targets girls, the material is still appropriate for young women. The National Osteoporosis Foundation also has educational material available for purchase, including a script-based PowerPoint educational lecture.[36] The effectiveness of Powerful Bones Powerful Girls™ or the National Osteoporosis Foundation's educational material with regard to influencing knowledge, beliefs, or behaviors related to the prevention of osteoporosis in young women has not been reported in the literature.

CONCLUSIONS

Young women's beliefs about osteoporosis in this study did not match current knowledge about its prevention ("how responsible") or its incidence rate ("how likely"). Although women felt somewhat complacent ("how concerned") about osteoporosis, they did believe very strongly that osteoporosis is a serious disease. Nevertheless, the majority of the respondents were unable to correctly identify commonly discussed osteoporosis risk factors. This data suggests that educational programs concerning the prevention of osteoporosis in young women are warranted. Additionally, it is essential for these educational interventions to address their effectiveness in influencing knowledge of, beliefs about, and behaviors toward this bone-crippling disease.

REFERENCES

1. Osteoporosis Prevention, Diagnosis, and Therapy: NIH Consensus Statement. March 27-29, 2000;17(1):1-45. Available at: http://consensus.nih.gov/2000/2000Osteoporosis111html.htm. Accessed November 27, 2006.

2. U.S. Department of Health and Human Services. Bone Health and Osteoporosis: A Report of the Surgeon General. Rockville, MD: U.S. Department of Health and Human Services, Office of the Surgeon General; 2004. Available at: http://www.surgeongeneral.gov/library/bonehealth/content.html. Accessed November 27, 2006.

3. National Osteoporosis Foundation. F*ast Facts.* Available at: http://www.nof.org/osteoporosis/diseasefacts.htm. Accessed November 27, 2006.

4. Broussard DL, Manus JH. Risk assessment and screening for low bone mineral density in a multi-ethnic population of women and men: does one approach fit all? *Osteoporosis Int.* 2004;15:349-360.

5. American College of Sports Medicine. Position stand: physical activity and bone health. *Med Sci Sports Exerc.* 2004;11:1985-1996.

6. Borer K. Physical activity in the prevention and amelioration of osteoporosis in women: interaction of mechnical, hormonal and dietary factors. *Sports Med.* 2005;35:779-830.

7. Ajzen I, Fishbein M. *Understanding Attitudes and Predicting Social Behavior.* Englewood Cliffs, NJ: Prentice-Hall; 1980.

8. Ajzen I, Madden TJ. Prediction of goal directed behavior: attitudes, intentions, and per-

ceived behavioral control. *Journal of Experimental Social Psychology.* 1986;22:453-474.

9. Bandura A. *Social Learning Theory.* Englewood Cliffs, NJ: Prentice-Hall; 1977.

10. Becker MH. The health belief model and personal health behavior. *Health Education Monographs.* 1974;2:324-473.

11. Deci E, Ryan R. Self-determination theory: when mind mediates behavior. *Journal of Mind and Behavior.* 1980:1(1);33-43.

12. Prochaska JO, DiClemente CC, Norcross JC. In search of how people change: applications to addictive behaviors. *Am Psychol.* 1992;47: 1102-1114.

13. Green LW, Kreuter MW. *Health Promotion Planning: An Educational and Ecological Approach.* 4th ed. New York, NY: McGraw Hill; 2005.

14. Werner P. Knowledge about osteoporosis: assessment, correlates and outcomes. *Osteoporosis Int.* 2005;16(2):115-127.

15. Kasper MJ, Peterson GE, Allegrante JP, et al. Knowledge, beliefs, and behaviors among college women concerning the prevention of osteoporosis. *Arch Fam Med.* 1994;3:696-702.

16. Kasper MJ, Peterson MGE, Allegrante JP. The need for comprehensive educational osteoporosis prevention programs for young women: results from a second osteoporosis prevention survey. *Arthritis Care Res.* 2001;45:28-34.

17. Piaseu N, Belza B, Mitchell P. Testing the effectiveness of an osteoporosis educational program for nursing students in Thailand. *Arthritis Care Res.* 2001;45:246-251.

18. Sedlak CA, Doheny MO, Jones SL. Osteoporosis prevention in young women. *Orthop Nurs.* 1998;17(3):53-60.

19. Taggart HM, Connor SE. The relation of exercise habits to health beliefs and knowledge about osteoporosis. *J Am Coll Health.* 1995;44(3):127-130.

20. Ziccardi SL, Sedlak CA, Doheny MO. Knowledge and health beliefs of osteoporosis in college nursing students. *Orthop Nurs.* 2004;23(2):128-133.

21. Kim KK, Horan ML, Gendler P, et al. Development and evaluation of the osteoporosis health belief scale. *Res Nurs Health.* 1991;14(2):155-163.

22. Geller SE, Derman R. Knowledge, beliefs, and risk factors for osteoporosis among African-American and Hispanic women. *J Natl Med Assoc.* 2001;93(1):13-21.

23. Winzenberg TM, Oldenburg B, Frendin S, et al. Effects of bone density feedback and group education on osteoporosis knowledge and osteoporosis self-efficacy in premenopausal women: a randomized controlled trial. *J Clin Densitom.* 2005;8(1):95-103.

24. Brown SJ, Schoenly L. Test of an educational intervention for osteoporosis prevention with U.S. adolescents. *Orthop Nurs.* 2004;23(4):245-251.

25. Cook B, Noteloviz M, Rector C, et al. An osteoporosis patient education and screening program: results and implications. *Patient Educ Couns.* 1991;17:135-145.

26. American Cancer Society. *How Many Women Get Breast Cancer?* Available at: http://www.cancer.org. Accessed November 27, 2006.

27. Heart disease and stroke statistics, 2006 update: a report from the American Heart Association statistics committee and stroke statistics subcommittee. *Circulation.* 2006;113(6): e85-e151.

28. Leibson CT, Tosteson AN, Gabriel SE, et al. Mortality, disability, and nursing home use for persons with and without hip fracture: a population-based study. *J Am Geriatr Soc.* 2002;50:1644-1650.

29. Wallace LS, Ballard JE. Osteoporosis coverage in selected women's magazines and newspapers, 1998-2001. *Am J Health Behav.* 2003;27(1):75-83.

30. National Center for Health Statistics. *Health, United States, 2006, with Chartbook on Trends in the Health of Americans.* Washington, DC: U.S. Government Printing Office; 2006. Available at: http://www.cdc.gov/nchs/hus.htm. Accessed November 27, 2006.

31. Mokdad AH, Marks JS, Stroup DF, Gerberding JL. Actual causes of death in the United States, 2000. *JAMA.* 2004;291:1238-1245.

32. U.S. Department of Health and Human Services. *Dietary Guidelines for Americans 2005.* U.S. Department of Agriculture, 2005. Available at: http://www.healthierus.gov/dietaryguidelines. Accessed November 27, 2006.

33. Drinkwater B, Bruemner B, Chesnut C. Menstrual history as a determinant of current bone density in young athletes. *JAMA.* 1990;263:545-548.

34. U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General.* Atlanta, GA: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion; 1996. Available at: http://www.cdc.gov/nccdphp/sgr/sgr.htm. Accessed November 27, 2006.

35. Powerful Bones. Powerful Girls.™ website. Available at: http://www.cdc.gov/powerfulbones/index.html. Accessed June 11, 2007.

36. National Osteoporosis Foundation website. Available at: http://www.nof.org. Accessed November 27, 2006.