Journal of Gender, Culture, and Health, Vol. 1, No. 2, 1996

Osteoporosis Risk Factors in First and Second Generation Japanese-American Women

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This study examined osteoporosis risk factors in first- and second-generation Japanese-American women. Dietary calcium intake was assessed via an adapted version of the food frequency method; other risk factors were assessed using specially designed questionnaires. All data were collected via interviews, which were conducted in either English or Japanese, depending on the women's preferences. Both first- and second-generation groups were at risk for osteoporosis, with dietary calcium intake averaging only slightly over 500 mg/d. They were generally of small stature, and many reported medical histories that suggested estrogen levels lower than what would be expected postmenopausally. Many were not on estrogen replacement therapy (ERT). There were also surprising differences between first- and second-generation women in their risk factor profiles. These differences were explained vis-à-vis sociocultural differences between Japanese and American cultures and their impact on diet, compliance to treatment regimens, and attributions of disease etiology.

KEY WORDS: osteoporosis; risk factors; menopause; Japanese-American; culture; generation; diet; calcium.

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1087-3201/96/0600-0135$09.50/0

INTRODUCTION

Research on osteoporosis has identified several risk factors, including age, age of onset of menopause, ethnicity, obstetrical or gynecological history affecting estrogen (e.g., hysterectomy, ovariectomy, parathyroid or hyperparathyroid disease), body stature, smoking, alcohol intake, and exposure to sunlight. One important factor is calcium intake. Calcium is important for normal bone development and remodeling, and people who consume an adequate amount of calcium have lower incidences of hip fractures compared to people with lower calcium intake (Matkovie, Kostial, Simonovic, Buzin, Brodarez, & Nordin, 1979; Nordin, Horsman, Marchsall, Simpson, & Waterhouse, 1979). High calcium intake is also associated with a reduction in postmenopausal and age-associated loss of bone (Heaney, Recker, & Saville, 1978, 1979; Riis, Thomsen, & Christiansen, 1987).

Increasing attention is also being given to the role of estrogen in the etiology of osteoporosis, and the effects of estrogen replacement therapy (ERT). Patients with less estrogen are at greater risk for osteoporosis (Ettinger, Genant, & Cann, 1987). Estrogen loss after menopause or medical intervention puts women especially at risk. ERT has been shown to be an effective combatant against bone loss (Ettinger *et al.*, 1987).

Recent interest in holistic health have also led to greater attention to the role of exercise as a risk factor for osteoporosis. Patients who engage in regular, weight-bearing exercise are at less risk to develop osteoporosis or suffer fractures (Notelovitz, 1986). This notion is also supported in cross-cultural studies of women who engage in heavy labor in their daily, physical routines (e.g., Hu, Zhao, Chen, Fitzpatrick, Parpia, & Campbell, 1994). Vigorous, regularly scheduled exercise promotes bone formation.

Several studies have documented differential rates of osteoporosis and fracture rates in different ethnic groups, and their impact on daily functioning (Dahl, 1980; Farmer, White, Brody, & Bailey, 1984; Hu *et al.*, 1994; Kanis and the WHO Study Group, 1994; Matkovie *et al.*, 1979; Melton, Kan, Frye, Wahner, O'Fallon, & Riggs, 1989; Smith & Rizek, 1966). For example, the Norwegian women in Dahl's study were 15 times more likely to die in the first month following hip fracture compared to the expected mortality rate for the same age women without fracture. In Farmer *et al.*'s (1984) study, White females had fracture rates one-and-a-half times greater than Black females after age 40. In Matkovic *et al.*'s (1979) study, two groups of Yugoslavic women had differential fracture rates of the proximal femur, and these rates were related to differences in daily calcium intake. These types of studies are important because they inform us about possible national and cultural variations in bone loss and bone disease mediators. Because of such variations, Kanis and the WHO Study Group (1994) have suggested that the validity of diagnostic criteria for osteoporosis differs across groups.

The United States offers a unique opportunity to conduct studies of ethnic group differences in osteoporosis risk factors. These studies, however, are complicated because many ethnic groups are represented across different generations. Japanese-Americans, for example, include those born and raised in Japan as well as those born and raised in the U.S. While they share the same ethnic lineage, they may be different in the etiology and maintenance of such diseases as osteoporosis, because of cultural differences in lifestyle and attitudes related to disease formation and treatment. Such differences are important to uncover, as that knowledge would aid the development of treatments that are sensitive to the specific risk factors for these groups. For example, knowledge of ethnicity-specific deficiencies in calcium intake or attitudes about ERT may allow practitioners to focus on such issues when discussing treatment alternatives with patients. Such knowledge would also aid the development of risk-factor-specific prevention programs with different ethnic groups.

In this study, we assessed osteoporosis risk factors in a sample of older (age 55 and up) Japanese-American women. While we were interested in the group as a whole, we were also interested in examining possible generational differences within this group. The entire group included two subgroups. One includes women born and raised in Japan, who were primarily enculturated in the Japanese culture, but who emigrated to the U.S. as adolescents or adults. The other group includes those who were born and raised in the U.S., primarily speak English, and were enculturated in the U.S. from birth.

While there is little direct information on Japanese Americans that allows us to generate hypotheses about osteoporosis risk, there are data about Japanese nationals that inform such generation. For example, previous research has shown considerable differences between another Asian group (Hong Kong Chinese) and Europeans in dietary intake of calcium (Pun, Chan, Chung, & Wong, 1987). Like the Chinese, lactase deficiency is common among Japanese (Itoh & Oka, 1986); milk consumption is relatively low, contributing to lower calcium intake in Japanese nationals living in Japan.

Besides milk, the traditional Japanese diet is quite different from American or western diets, implicating differential osteoporosis risk. The Japanese diet is less centered around red meats and potatoes, and instead includes greater consumption of fish and bean products. There is less consumption of dairy products (e.g., cheese), and overall caloric intake is lower. Thus, there should be less calcium intake via dairy products in the Japanese diet. At the same time, calcium intake from fish and bean products should be relatively greater. Still, because overall caloric intake is lower than in the western diet, and because of lower milk intake, overall dietary intake of calcium should be lower than in the western diet.

Sociocultural factors also need to be considered. Here, we briefly describe aspects of the Japanese culture that form an important backdrop to the study, and provide below some rationale for their mediation of osteoporosis risk. Japanese culture is collectivistic; individual needs, wishes, and desires are sacrificed for the group or collective (Reischauer, 1988). Conformity and compliance are necessities for harmony and cohesion. Sanctions, such as social isolation, exist for noncompliance (Benedict, 1946). American culture, however, is individualistic, promotes uniqueness and autonomy, and places individual needs, wishes, and desires above those of groups. Members of individualistic societies are encouraged to express themselves, and nonconformity and noncompliance are tolerated (Triandis, Bontempo, Villareal, Asai, & Lucca, 1988).

Japanese culture is highly status differentiating, and behaviors are linked to the status differential among interactants (Nakane, 1970). This is not true to the same degree in the U.S. (see Hofstede, 1980). Cultural differences in obedience to authority implicate differences in how first- and second-generation patients interact with health care providers, and comply with treatment regimens.

Japanese culture is influenced by Confucian and Buddhist teachings. Japanese people tend to attribute the cause for negative events to fate, luck, or predetermined destiny (e.g., see Matsumoto, Kudoh, Scherer, & Wallbott, 1988). Japanese people often assume less personal responsibility and control over events in their lives. American culture is characterized by pragmatism and logical determinism. Events have observable and understandable causes that can be influenced by one's behaviors. This cultural difference can affect how first- and second-generation patients view disease etiology, and their own role in treating it.

The concept of *amae* is central to relationships in Japanese culture (Doi, 1973). Loosely translated, this word contains elements of the English words dependence, naivety, and sweetness. *Amae* is linked with collectivism, as it helps build interdependence. American culture, however, discourages dependence, and encourages autonomy and self-reliance. Japanese *amae* fosters greater reliance on others and society in general to care for them; Americans reject this reliance.

These cultural differences implicate osteoporosis risk factors in several ways. First, the relatively greater reliance in the Japanese culture on fate, luck, or supernatural forces and *amae* would lead one to expect that Japanese individuals are less predisposed to supplementing their intake of calcium through vitamins. Vitamin consumption would be seen as more "abnormal" as it is less natural. Instead, there would be more of a reliance on mineral intake based solely on one's natural diet.

Likewise, there would be a greater reluctance in the Japanese culture to allow treatment regimens such as ERT to alleviate postmenopausal symptoms. Hormone replacement is viewed as unnatural in the Japanese culture. The Japanese culture's emphasis on conformity and compliance with treatment recommendations from higher-status doctors may also result in greater acceptance of such treatments as hysterectomies and ovariectomies, which result in decreased estrogen.

The focus in the Japanese culture on collectivism and status differentiation may also affect their osteoporosis risk profiles by predisposing them to disease states that increase the risk for osteoporosis. Previous research has not directly studied diseases related to osteoporosis, but has demonstrated a link between culture and other diseases. Triandis and his colleagues (e.g., Triandis *et al.*, 1988), for example, found that the dimension Individualism versus Collectivism (IC) was correlated with incidence for heart disease, with individualistic cultures having greater incidences. Matsumoto and Fletcher (1996) replicated this finding across 28 cultures. In addition, they found that Power Distance, a dimension closely related to status differentiation, was correlated with infectious and parasitic diseases, malignant neoplasms, circulatory diseases, and heart diseases. The exact mechanism for these relationships is not clear. Culture influences the regulation of stress and emotion, thereby having differential effects on physiology, some presumably being toxic. Culture influences lifestyle and diet, which will also play an important role in disease formation. Culture influences attitudes about disease etiology, help-seeking behaviors, and treatment compliance. All these influence disease formation, and suggest a link between culture and diseases related to osteoporosis, and we mention this possibility here.

There is a question about how much of traditional Japanese-culture may be applicable to Japanese-Americans. In fact, there is evidence that Japanese cultural patterns are relatively intact in Japanese-Americans, although the differences seem to diminish across generations. For example, Kitano (1976) surveyed attitudes regarding ethnic identity, means-ends, masculinity and responsibility, individual versus group orientation, passivity, and realistic expectations in first- second-, and third-generation Japanese-Americans. He found an increasing trend toward acculturation for each of the attitude types. Kitano (1961) also found differences between first- and second-generation Japanese-Americans in their attitudes regarding parental child-rearing, with first-generation subjects endorsing much more "restrictive" and "old-fashioned" attitudes. Personality differences congruent with these cultural differences between first- and second-generation Japanese-Americans have also been reported by DeVos (1973).

Based on this analysis, we hypothesized that the Japanese-American women as a whole would be at risk for osteoporosis, given accepted clinical and research standards. We also hypothesized that the first-generation women would be at greater risk than the second-generation women, because of the latter's greater consumption of calcium in their diet, greater acceptance of ERT and vitamin supplements, and greater reluctance to comply with estrogen-reducing treatments.

METHODS

Participants

Participants were 87 Japanese-American women living in the San Francisco Bay Area. All were over the age of 55 (mean age 65.85). Ads were placed in local English and Japanese language newspapers, recruiting participants in a study of "osteoporosis and diet." Interested women called the laboratory, and interview appointments were made; in exchange for their participation, we provided them with information about osteoporosis and referral sources. Contacts were also made with staff coordinators in charge of outreach programs in community agencies. The research team made presentations at agencies that desired them, and the study was introduced. Appointments were made with participants who volunteered at this time. This recruitment process may have skewed the sample; the subjects may have been more willing to share personal information than those who did not elect to participate. Also, they may have been more interested in self-care and volunteerism (which, in fact, may be more associated with American culture than Japanese). While these possibilities do not speak against finding differences between the generations, generalizations about nonparticipating Japanese-Americans should be made with this caveat.

The women were classified into two groups according to their place of birth, upbringing, religion, and primary language. Thirty-nine subjects were born and raised in the U.S., used English as their primary language, and reported Christianity as their primary religion; thirty-three subjects were born and raised in Japan, used Japanese as their primary language, and reported Buddhism as their primary religion. According to Japanese custom, we called the latter group first generation, and the former second generation. Fifteen subjects did not meet these classification criteria cleanly, and were excluded from the analysis.

The two generations of women differed on several demographic variables. The second-generation women were slightly older [mean age 68.59 vs. 60.21, $F(1,71) = 15.05, p < 0.001$] and reported higher annual incomes[6] [means 2.87 vs. 1.52, $F(1,71) = 17.11, p < 0.001$]. A greater proportion of second-generation women were currently working [46% vs. 24%, $\chi^2(1,72) = 4.07, p < 0.05$], and had other income (73% vs. 9%, $\chi^2(1,72) = 23.46, p < 0.001$]. The first-generation women reported higher socioeconomic environments during their upbringing[7] [means = 2.88 vs. 2.13, respectively, $F(1,71) = 11.04, p < 0.01$]. Because of these differences, we tested all findings twice, the second time controlling for the effects of these demographic variables by treating them as covariates.

Instruments

In addition to a demographic assessment that obtained basic biodata, subjects completed five measures. Dietary intake of calcium was assessed using the food-frequency interview method. Information about other osteoporosis-related risk factors was obtained via a Health Status and Osteoporosis Risk Factors Assessment, and a Medication and Vitamin Assessment. Two other scales focused on psychological variables, and are reported in another article (Matsumoto *et al.*, 1995). All protocols were developed in English. A Japanese version was used for those who preferred to answer in this language. Accuracy of the translation was verified using a back-translation procedure.

Dietary Intake of Calcium. The food frequency interview method was adapted for this population. This method has been used extensively with elderly populations, and provides reliable data concerning nutritional intake (Kohrs, O'Neal, Preston, Eklund, & Abrahams, 1978; Muller, Krantzler, Grivetti, Schultz, & Mselman, 1984). Each subject reported the frequency with which she consumed specific foods (daily, weekly, monthly, or yearly, as appropriate) that contain substantial amounts of calcium. Portion sizes were also assessed. Food groups consumed by Japanese people but not included on food frequency protocols for the general American population were included, such as tofu, dried fish, and other items taken from a previous study (Pun *et al.*, 1990). Calcium content of each food group was calculated according to food composition tables appropriate for each food type (Wu Leung, Butrum, Chang, Rao, & Polacchi, 1972), and calcium in-

[6]Annual incomes were coded as follows: <=$10,000 = 1, $10-$20,000 = 2, $20-$30,000 = 3, $30-$50,000 = 4, $50-$75,000 = 5, $75-$100,000 = 6, and >$100,000 = 7.

[7]Economic level during upbringing was coded as follows: Low Income = 1, Low Middle Income = 2, High Middle Income = 3, High Income = 4.

take was computed by weighing the content by the frequency and portion of consumption. Computation of each subjects' intake was performed independently by two members of the research team, and all data matched each other exactly. Calcium sources were grouped into five major categories: milk, vegetables and fruits, meat and bean products, cheese products, and other sources. Two total calcium intake scores were also computed, one reflecting dietary intake, the other total intake with supplements.

Health Status and Osteoporosis Risk Factors. This measure assessed each subject's medical history as it pertained to osteoporosis, including menstrual history, cessation dates, and presence or absence of 11 symptoms related to menses and menopause; obstetrical and gynecological history, including the number of pregnancies to term, oral contraceptive use, and obstetrical or gynecological surgery or interventions; family or personal history of drug use; physical attributes including height, weight, thinness, and loss of height; family or personal history of 24 diseases related to osteoporosis or bone loss, including parathyroidism and hyperparathyroidism; alcohol use; frequency and type of exercise; and previous bone fracture history.

Medication and Vitamin Assessment. This measure requested information about prescribed medications and vitamin supplements. Particular emphasis was made on the assessment of calcium supplementation through vitamins and ERT. In some cases, participants brought their medication and vitamin supplements, so that exact dosages could be ascertained.

Procedure

All women were interviewed individually, and had met their interviewers at a prior recruiting session, allowing them to build a rapport prior to the interviews. The interviewer spoke either English or Japanese, depending on the preference of the subject. Each interview lasted approximately one hour, as subjects were encouraged to provide as much information as they wished on open-ended response questions, and were given no time constraint. Interviews were conducted in homes or in community organizations frequented by the subjects.

RESULTS

Description of Risk Factors for the Entire Sample

The mean age for cessation of menses was 49, with an average of 4.39 menopausal symptoms. Twenty-three percent reported having a hysterec-

Table I. Differences Between First and Second Generation Women in Osteoporosis Risk Factors

Factor	Second	First	F	p
Differences that suggest second-generation women at greater risk				
Self disease history	1.10 (1.20)	0.55 (0.75)	5.26	<0.05
Family disease history	2.15 (1.50)	1.09 (1.30)	9.97	<0.01
Dietary intake Ca through milk	217.83 (202.00)	333.37 (359.09)	2.91	<0.10
Dietary intake Ca through vegetables	73.31 (67.35)	148.94 (245.45)	3.39	<0.07
Dietary intake Ca through meat/bean	57.14 (46.65)	165.67 (109.98)	31.57	<0.001
Dietary intake Ca through other sources	15.22 (14.41)	29.91 (31.32)	6.95	<0.05
Total dietary intake of Ca	366.50 (221.49)	681.98 (507.65)	12.29	<0.001
Differences that suggest second-generation women compensate for greater risk				
Regular exercise	1.10 (0.64)	0.79 (0.78)	3.53	<0.07
Calcium supplements	556.81 (553.35)	284.70 (326.65)	6.08	<0.01

tomy, and 18% reported having an ovariectomy. They weighed an average of 53.18 kg, and were 154.94 cm tall. They also reported an average of 0.87 diseases on the check-off list for themselves, and an average of 1.64 diseases known to them in their family.

Thirty-four percent of the women reported that they drank alcohol, although frequencies were generally low (<1 time/week). Twenty-five percent reported that they had or were currently receiving ERT. They reported standing or walking an average of six hours a week during the weekdays, and another six hours per week on the weekends. Other than standing and walking, they reported participating in 0.92 exercise activities per week regularly.

The women averaged a total of 514.17 (SD = 403.04) mg of calcium in their daily diets. However, they also averaged a total of 387.42 mg of calcium intake through vitamin supplementation. The average total calcium intake, therefore, through diet and supplementation was 901.59 (SD = 589.87) mg per day.

First Versus Second Generation Differences in Risk Factors

Differences between the two groups were tested on all the risk factors, and only significant differences are reported here. One-way Analyses of

Variance (Table I) indicated that, contrary to our prediction, the second-generation women were at greater risk for osteoporosis, reporting more osteoporosis-related diseases for themselves as well as for their families, and consuming less total calcium. When differences in dietary intake of calcium were examined separately by source, the differences were significant in meat/bean and other sources, and marginally significant in milk and vegetable sources.

Other findings supported our hypothesis. The second-generation women engaged in a greater amount of exercise (Table I), although this effect was only marginally significant, and consumed more calcium supplements. When total calcium intake including diet and supplements was compared, there were no differences between the two groups, $F(1,70) = 0.18$, ns. Chi-square analyses on the four nominal risk variables (presence or absence of hysterectomy or ovariectomy, estrogen use, and alcohol consumption) also indicated that significantly more second generation women (39% vs. 9%) received ERT, $\chi^2(1) = 8.62$, $p < 0.01$.

Demographic Influences on the Generation Differences

We computed product-moment correlations between each of the significant demographic variables and the calcium intake scores, separately for both generation groups. For the first-generation women, age was positively correlated with calcium intake via milk, $r(32) = .37, p < 0.05$; income was positively correlated with calcium intake via milk, vegetables, and other sources, $r(32) = .46, p < 0.01$; $r(32) = 0.42, p < 0.05$; and $r(32) = 0.50$, $p < 0.01$, respectively. Other income (1 = yes, 2 = no) was negatively correlated with calcium intake via milk, $r(32) = 0.72, p < 0.001$, and work (1 = yes, 2 = no) was negatively correlated with calcium intake via other sources, $r(32) = .40, p < 0.05$. For the second-generation women, age was negatively correlated with calcium intake via cheese products, $r(40) = -0.50, p < 0.001$.

The fact that the same correlations were not significant separately in both groups of women suggests that these demographics could not confound the results reported earlier. Nevertheless, we recomputed each of the ANOVAs on the calcium intake scores, as well as the two total intake scores, using the five demographic variables as covariates. The findings generally matched the original results, as the group differences were still statistically significant on milk and milk products, $F(1,57) = 14.35, p < 0.001$; and meat and bean products, $F(1,57) = 12.99, p < 0.001$. The differences between the two groups of women were also marginally significant on cheese products, $F(1,57) = 3.37, p < 0.08$. Moreover, the generation differences on total dietary intake of calcium across all food sources was significant even after controlling for the effects of the five demographic variables, $F(1,56) = 34.47$, $p < 0.001$. Quite surprisingly, the differences on total intake of calcium including supplementation were statistically significant, $F(1,56) = 7.61$, $p < 0.01$. This finding was not significant in the original analyses, and suggests that vitamin supplementation is accounted for by demographic, and not generational, differences.

Generational differences on self and family disease history, and on reported amount of exercise, were also retested using ANACOVA. The differences between the first- and second-generation women on self disease history and amount of exercise were not significant, $F(1,52) = 2.27$, ns, and $F(1,52) = 0.67$, ns, respectively. These results indicated that the differences on these variables reported earlier could be accounted for by the demographic variables. The differences between the generations on family disease history, however, survived, $F(1,52) = 4.91$, $p < 0.05$.

DISCUSSION

As we predicted, the entire group was at risk for osteoporosis. Dietary intake of calcium averaged only slightly over 500 mg/d, which is considerably less than the 1,000 mg/d recommended daily allowance (RDA) in the U.S. for calcium, and the 1,500 mg/d recommended by the U.S. National Institutes of Health consensus conference for postmenopausal women. It is also less than what has been reported in the results of the USDA's Nationwide Food Consumption Survey (1988), which suggested that American women around the age of 65 consume approximately 600 mg/d. Thus, regardless of the index used, the women in this study consumed less calcium in their diets than published norms for other American women.

When calcium supplementation was taken into account, the average amount of calcium intake increased substantially. But, the women were still receiving less than the RDA of calcium in their daily diets. There are some suggestions that calcium may be absorbed at higher rates when consumed as part of diet and not through supplements, and that there are differences in absorption rates as a function of specific food group (e.g., through dairy products, with protein, etc.). Contemporary reviews of the relevant literature, however, suggest that "it is uncertain if there are biologically important differences in the absorption of calcium from different foods or diets" (National Research Council, 1989, p. 175). Also, other studies (e.g., Tellez *et al.*, 1995) have shown that differences in calcium absorption rates do not account for differences in bone loss and remodeling rates associated with osteoporosis. The research does suggest that absorption rates may differ as a function of physiologic requirement, intake levels, or the use of vitamin D. While absorption rates most likely vary depending on the food and supplement type, there appears to be no general consensus on this issue at this time, suggesting that total calcium scores (diet + supplements) are as good an index of calcium intake as any.

The women generally matched an osteoporotic profile on other factors as well. They were all generally of small stature, and a number of them reported medical histories that involved even further reductions in estrogen above and beyond that due to menopause. Many were not on ERT. These characteristics are comparable to risk factors for osteoporosis well accepted in the American clinical community.

Examination of the generational differences between the women on calcium intake, however, produced some interesting and surprising results. Contrary to our predictions, second-generation women had significantly less daily intake of calcium in their diets in all food categories. In fact, the amount of dietary calcium consumed by the first-generation women (682 mg/d) was very comparable to that consumed by American women as a whole (USDA, 1988), albeit still substantially less than the RDA. The second-generation women, therefore, had alarmingly low rates of calcium intake (367 mg/d). They also reported significantly greater disease histories that contribute to osteoporosis. These findings may be due to the fact that the first-generation women consumed a greater amount of foods from a typical Japanese diet that contained meaningful amounts of calcium and that are not part of a traditional American diet. These foods would include tofu, other bean products, whole dried fish, fish bones, and the like. The second-generation women may have consumed less of these products, replacing them with foods more typically considered American, but that contained less calcium. This interpretation, however, would not explain the greater consumption of milk by the first-generation women, nor would it explain the greater incidence of osteoporosis-related diseases in the second-generation women, both findings for which we have no interpretation.

Consistent with the hypothesis, second-generation women did take more supplements, and exercised more frequently. Also, a greater number of second-generation women were receiving estrogen as part of a medical regimen. As described in the Introduction, cultural differences make the use of vitamin supplements and estrogen more difficult for first-generation women. The Japanese culture views the use of hormone replacement therapies and vitamin supplementation as intrusive to the body's normal or natural healing mechanisms, and is antithetical to the Japanese culture's tendency to attribute the cause of disease to fate, luck, or destiny. As a result, fewer Japanese physicians would prescribe such therapies, and fewer first-generation women would ask for it or agree to receive it. The ANACOVA results, however, indicated that vitamin supplementation was accounted for by demographic differences, and suggest an important mediating role of education or economic status. Future studies can pinpoint which demographic factors influence the likelihood of vitamin supplementation, and education and diffusion programs can then be centered around such variables.

Generational differences on self- and family-disease histories related to osteoporosis risk factors were found, although some of these effects may be accounted for by demographic differences. The data, however, were not sufficiently complete nor the sample size large enough to pinpoint exactly which types of diseases appeared to occur more frequently in the two generations. Should the differences we observed in this study prove to be reliable across future studies, other research can then identify the diseases on which differences are found, and search for the sociocultural correlates of those diseases, much as Triandis *et al.* (1988) and Matsumoto and Fletcher (1996) did in their studies. Once the relevant sociocultural factors are elucidated, the mechanisms mediating those relationships, whether psychological, physiological, or both, can be investigated.

These findings have different implications for treatment and prevention for these two groups of women. Increasing the consumption of calcium rich foods in their diet should be a major goal for all these women, given their overall low calcium intake levels. This is especially an area of concern for the second-generation women, because their dietary calcium intake was quite low. Calcium supplementation may need to be introduced more vigorously to the first-generation women, in culturally sensitive ways.

Education concerning ERT is important for women of both groups, and should be more available for those for whom this type of therapy is not contraindicated. Sociocultural differences between these two groups will make acceptance of this treatment easier for one and more difficult for the other. In fact, sociocultural differences between the two groups, and between the group as a whole and contemporary American culture, make other lifestyle changes more challenging, regardless of the specific domain of behavior involved. Physicians treating these groups of women need to be aware of the contribution of such variables to the etiology and treatment of osteoporosis, and should consider incorporating comprehensive sociocultural histories as part of their patient profiles and demographic information in their intake procedures.

ACKNOWLEDGMENTS

This research was supported in part by a Faculty Affirmative Action Grant and a California State University Award for Research, Scholarship, and Creative Activity awarded to the first author, and by a research grant from Minoru Kadowaki. We thank Carinda Wilson Cohn, Nathan Yrizarry, Galin Luk, Minjoo Lee, Cenita Kupperbusch, and Erin Milligan for their assistance in our general research program.

REFERENCES

Benedict, R. (1946). *The chrysanthemum and the sword: Patterns of Japanese culture.* Boston: Houghton Mifflin.

Dahl, E. (1980). Mortality and life expectancy after hip fractures. *Acta Orthopaedica Scandinavia, 51,* 163-170.

DeVos, G. (1973). *Socialization for achievement: Essays on the cultural psychology of the Japanese.* Berkeley: University of California Press.

Doi, T. (1973). *The anatomy of dependence.* Tokyo: Kodansha.

Ettinger, B., Genant, H. K., & Cann, C. E. (1987). Postmenopausal bone loss is prevented by treatment with low dosage estrogen with calcium. *Annals of Internal Medicine, 106,* 40-45.

Farmer, M. E., White, L. R., Brody, J. A., & Bailey, K. (1984). Race and sex differences in hip fracture incidence. *American Journal of Public Health, 74,* 1374-1380.

Heaney, R. P., Recker, R. R., & Saville, P. D. (1978). Menopausal changes in calcium balance performance. *Journal of Laboratory and Clinical Medicine, 92,* 953-963.

Heaney, R. P., Recker, R. R., & Saville, P. D. (1977). Calcium balance and calcium requirements in middle-aged women. *American Journal of Clinical Nutrition, 30,* 1603-1611.

Hofstede, G. (1980). *Culture's consequences.* Newbury Park, CA: Sage.

Hu, J. F., Zhao, X. H., Chen, J. S., Fitzpatrick, J., Parpia, B., & Campbell, T. C. (1994). Bone density and lifestyle characteristics in premenopausal and postmenopausal Chinese women. *Osteoporosis International, 4,* 288-297.

Itoh, R., & Oka, J. (1986). Calcium requirement and its intake of the elderly in Japan: An attempt to improve its intake. *Journal of Nutritional Science and Vitaminology, 31,* 7-10.

Kanis, J. A., & the WHO Study Group (1994). Assessment of fracture risk and its application to screening for postmenopausal osteoporosis: Synopsis of a WHO report. *Osteoporosis International, 4,* 368-381.

Kitano, H. (1961). Differential child rearing attitudes between first and second generation Japanese in the United States. *Journal of Social Psychology, 61,* 13-16.

Kitano, H. (1976). *Japanese Americans.* Englewood Cliffs, NJ: Prentice Hall.

Kohrs, M. B., O'Neal, R., Preston, A., Eklund, D., & Abrahams, O. (1978). Nutritional status of elderly residents in Missouri. *American Journal of Clinical Nutrition, 31,* 2186-2197.

Matkovie, V., Kostial, K., Simonovic, I., Buzin, R., Brodarez, A., & Nordin, B. E. C. (1979). Bone status and fracture rates in two regions of Yugoslavia. *American Journal of Clinical Nutrition, 32,* 540-549.

Matsumoto, D., & Fletcher, D. (1996). Cultural influences on disease. *Journal of Gender, Culture, and Health, 1,* 71-82.

Matsumoto, D., Kudoh, T., Scherer, K., & Wallbott, H. (1988). Emotion antecedents and reactions in the U.S. and Japan. *Journal of Cross-Cultural Psychology, 19,* 267-286.

Matsumoto, D., Pun, K. K., Nakatani, M., Kadowaki, D., Weissman, M., Fletcher, D., McCarter, L., & Takeuchi, S. (1995). Cultural differences in attitudes, values and beliefs between first and second generation Japanese American women about osteoporosis. *Women and Health, 23,* 39-56.

Melton, L. J., Kan, S. H., Frye, M. A., *et al.* (1989). Epidemiology of vertebral fractures in women. *American Journal of Epidemiology, 129,* 1000-1011.

Muller, M. J., Krantzler, N. J., Grivetti, L. E., Schultz, H. G., & Mselman, H. L. (1984). Validity of a food frequency questionnaire for the determination of individual food intake. *American Journal of Clinical Nutrition, 39,* 136-143.

Nakane, C. (1970). *Japanese society.* Berkeley: University of California Press.

National Research Council. (1989). *Recommended dietary allowances,* 10th Edition. Washington, DC: National Academy Press.

Nordin, B. E. C., Horsman, A., Marshall, D. H., Simpson, M., & Waterhouse, G. M. (1979). Calcium requirement and calcium therapy. *Clinical Orthopaedics, 140,* 216-239.

Notelovitz, M. (1986). Postmenopausal osteoporosis: A practical approach to its prevention. *Acta Obstetrica et Gynecologica Scandinavia, 134,* 67-80.

Pun, K. K., Chan, L. W. L., Chung, V., & Wong, F. H. W. (1987). Calcium and other dietary constituents in Hong Kong Chinese in relation to age and osteoporosis. *Journal of Applied Nutrition, 42,* 12-17.

Reischauer, E. (1988). *The Japanese today.* Cambridge, MA: Harvard University Press.

Riis, B., Thomsen, K., & Christiansen, C. (1987). Does calcium supplement prevent postmenopausal bone loss? *New England Journal of Medicine, 316,* 173-177.

Smith, R. W., & Rizek, J. (1966). Epidemiological studies of osteoporosis in women of Puerto Rico and Southeastern Michigan with special reference to age, race, national origin and to other related or associated findings. *Clinical Orthopaedics, 45,* 31-48.

Tellez, M., Arlot, M., Mawer, E., Diaz, A., Hesp, R., Hulme, P., Edouard, D., Green, J., Meunier, P., & Reeve, J. (1995). Gastrointestinal calcium absorption and dietary calcium load: Relationships with bone remodeling in vertebral osteoporosis. *Osteoporosis International, 5,* 14-22.

Triandis, H. C., Bontempo, R., Villareal, M. J., Asai, M., & Lucca, N. (1988). Individualism and collectivism: Cross-cultural perspectives on self-ingroup relationships. *Journal of Personality and Social Psychology, 4,* 323-338.

USDA (U.S. Department of Agriculture). (1988). Nationwide Food Consumption Survey. Hyattsville, MD: US Department of Agriculture.

Wu Leung, W. T., Butrum, R. R., Chang, F. H., Rao, M. N., & Polacchi, W. (1972). *Food composition table for use in East Asia.* U.S. Department of Health, Education, and Welfare, Bethesda, MD.