Gender Differences and Socioeconomic Factors Related to Osteoporosis

Noh, Jin-Won; Park, Hyunchun; Kim, Minji; Kwon, Young Dae

Published in:
Journal of womens health

DOI:
10.1089/jwh.2016.6244

Publication date:
2018

JOURNAL OF WOMEN'S HEALTH
Volume 27, Number 2, 2018

DOI: 10.1089/jwh.2016.6244

Gender Differences and Socioeconomic Factors Related to Osteoporosis: A Cross-Sectional Analysis of Nationally Representative Data

Jin-Won Noh, PhD,[1,2] Hyunchun Park, PhD,[1] Minji Kim, MHS,[1] and Young Dae Kwon, MD, PhD[3]

Abstract

Background: Osteoporosis has been considered a disease that primarily affects women, but recently male osteoporosis is also attracting attention. This study aims to comparatively analyze socioeconomic and other factors that are related to the prevalence of osteoporosis in both men and women.
Materials and Methods: This study used data from the Korean Community Health Survey conducted in 2013. To determine factors related to osteoporosis prevalence, researchers applied a binary logistic regression model, first for all research participants, then separately for male and female participants.
Results: Women were more likely than men to have osteoporosis (odds ratio 12.33, 95% confidence interval 11.55–13.17). Factors related to osteoporosis prevalence included age, education level, region, economic activity, alcohol consumption, salt intake, depression, and body mass index in both genders. Low education and income levels were more highly associated with osteoporosis prevalence in women than in men.
Conclusions: Most of the factors were not gender specific, but some socioeconomic determinants varied by gender. Future studies that will focus on the effects of socioeconomic factors on osteoporosis, as well as gender-related differences in prevention and control of osteoporosis, are needed.

Keywords: osteoporosis, socioeconomic status, gender difference and similarity

Introduction

The World Health Organization defines osteoporosis as a systemic skeletal disease characterized by decreased bone mass and microarchitectural deterioration of bone tissue.[1] Osteoporotic patients suffer from low bone density, which greatly increases their risk of fracture.[2] The number of people worldwide with hip fractures due to osteoporosis has increased from 1.3 million in 1990 to 1.6 million in 2000,[3] and it is expected that this number will increase threefold by 2050 due to the rapid aging of the population.[4] Osteoporosis has a significant effect not only on a person's individual health and finances but also on society in general.[5]

Socioeconomic factors have been identified as related factors of chronic diseases such as diabetes[6] and cardiovascular disease.[7] Also, potential risk factors for health behaviors such as smoking and alcohol consumption.[8] As above, socioeconomic factors are the key related factors of chronic diseases, and osteoporosis also needs such attention and research. The socioeconomic burden, including direct health costs, that is caused by osteoporosis has already reached a critically high level.[9] Treatment costs for osteoporosis in South Korea from 2007 to 2011 amounted to $\sim$290 million US dollars, and the societal loss during this period was estimated to be 924 million US dollars.[10] In the United States, 9.9 million people have osteoporosis,[11] and the medical costs for its treatment are expected to increase to $2.53 billion by 2025.[12]

There are many known risk factors for osteoporosis, such as old age, gender, low body weight, nutritional imbalance and dietary habits, family medical history, race, and drinking.[13–15] However, most studies have focused on gender because it has the biggest influence compared to other risk

[1]Department of Healthcare Management, Eulji University, Seongnam, Korea.
[2]University Medical Centre Groningen, University of Groningen, Groningen, The Netherlands.
[3]Department of Humanities and Social Medicine, College of Medicine and Catholic Institute for Healthcare Management, The Catholic University of Korea, Seoul, Korea.

factors, and osteoporosis is more prevalent in women.[16] Depletion of estrogen in menopausal women leads to lowered calcium absorption. During the first 5 to 7 years after menopause, a woman's bone density drops rapidly, which makes them more vulnerable to outside impacts.[17,18] Therefore, osteoporosis has been considered a very important health problem in postmenopausal women.[19]

However, since men have also been found to suffer from osteoporosis—even though there are significantly fewer male patients than female patients—interest in male osteoporosis is on the rise. It is estimated that one out of eight men older than 50 experience fractures caused by osteoporosis.[20] According to a survey conducted by the Korea Centers for Disease Control and Prevention, the prevalence rate of female osteoporosis from 2005 to 2007 remained 7.3%, but male osteoporosis increased from 0.5% to 0.8%.[21] The mortality rate for men after suffering an osteoporotic hip fracture is twice as high compared to women. While 71% of female osteoporotic patients get medical treatments, this occurs in only 27% of male patients, thus osteoporosis is a serious problem not only for women but also for men.[22,23]

Many previous studies on osteoporosis have focused on adult females to identify risk factors and analyze awareness levels and health behaviors, but few studies have focused on adult males. In addition, many studies have focused on health behaviors as one of the risk factors for osteoporosis,[13–15] but few have analyzed socioeconomic factors. Thus, in this study we perform comparative analysis of socioeconomic and other factors related to osteoporosis prevalence in men and women, using nationally representative data.

Materials and Methods

Data and subjects

This study used data from the 2013 Community Health Survey conducted by the Korea Centers for Disease Control and Prevention. Community health surveys have been held nation-wide every year since 2008 to identify community resident health levels. For each community health center, 900 residents on average are selected as subjects. In 2013, the survey targeted 228,781 adults aged 19 and older. Women generally go through menopause as they enter their fifties when the incidence rate for osteoporosis increases, which is why previous studies have focused on that demographic.[24] On that basis, 126,269 participants aged 50 and older (54,958 men, 71,311 women) from the community health survey were selected for this study. Because we chose the participants aged more than 50, we have more women than men. In fact, in the 2015 total demographic data of the nation, the ratio of male to female by age group is 0.93 for 50–64, 0.80 for 65–79, and 0.61 for 80 years and older.

First, this survey extracted the sample points assigned to each ''rural city and smaller rural city unit of Korea'' from the sampling frame created by linking the resident population data and the housing data based on the number of households by type of ''village and smaller village unit of Korea.'' This survey sorted ''rural cities and smaller rural city units of Korea'' by names and extracted the extraction probabilities proportionally considering the number of households. Second, the sample households were selected as the systematic sampling method by determining the number of households of ''village and smaller village unit of Korea.'' If the ''village and smaller village unit of Korea'' are large and two or more sample points are allocated, the distribution of sample households is made as uniform as possible to minimize sample errors. Finally, an average of five households was selected as sample household by each sample point.

This study was reviewed and approved by the Institutional Review Board of the Catholic University of Korea with a waiver for informed consent (MC14EISI0111) because the data were obtained from a public database (https://chs.cdc.go.kr/chs/index.do) and analyzed anonymously.

Variables and measurement

The dependent variable was set as the presence of osteoporosis and was determined by the answer to the question, ''Have you ever been diagnosed with osteoporosis by a doctor?''

Independent variables were selected based on risk factors identified by previous studies and what the researchers thought was important, and can be categorized broadly into demographic, socioeconomic, and health-related variables. Demographic variables included gender and age (in years; 50–64, 65–79, 80 and older). Socioeconomic variables included education level (elementary school or lower, middle school, high school, college or higher), marital status (married or single; single includes separated, widowed, divorced, etc.), place of residence (urban or rural), economic activity, and annual household income of quintiles. Economic activity was measured by the following question that was answered by the panel respondents as either ''yes'' or ''no.'' ''Have you worked more than one hour for the last one week for the purpose of income or worked as unpaid family worker for over 18 hours?''

Health-related variables included alcohol consumption, regular exercise, salt habit, depression, and body mass index (BMI). Alcohol consumption was divided into ''current drinker,'' ''former drinker,'' and ''lifetime abstention.'' Those who worked out more than 30 minutes a day for more than 5 days a week were categorized as regular exercisers. Salt habit evaluated the participant's salt intake on a scale of three levels (salty, average, and bland). Participants who were diagnosed with depression by a doctor were defined as having depression. BMI was defined as weight in kilograms divided by height in meters squared (kg/m^2). BMI values were calculated based on self-reported weight and height. In this study, participants were classified as underweight, normal weight, overweight, or obese based on the World Health Organization Western Pacific Region suggested Asia-Pacific criteria (less than 18.5 kg/m^2, between 18.5 and 23 kg/m^2, between 23 and 25 kg/m^2, and more than 25 kg/m^2, respectively).[25]

As a result of multicollinearity test, all variance inflation factor values were less than 10 and there was no problem in multicollinearity.

Statistical analysis

To identify the general characteristics and distribution of study participants, frequency analysis was conducted by gender; statistics included frequency and percentage. To identify factors related to osteoporosis prevalence, multivariable logistic regression analyses were conducted, first for all research participants regardless of gender, then separately for each gender. Stata version 13.1 software (StataCorp LP, College Station, TX) was used to calculate model parameters.

Results

Among the participants for final analysis, there were more women (71,311) than men (54,958). In total, 1,282 men (2.3%) and 17,939 women (25.2%) were diagnosed with osteoporosis, confirming that the prevalence rate for the disease was much higher among women than men. The majority of participants were 50 to 64 years of age—29,658 (54.0%) men and 35,059 (49.2%) women. In total, 41,942 women (59.3%) and 16,675 men (30.5%) had an elementary school or lower education level. More men were economically active—38,122 men (69.4%) versus 31,579 women (44.3%) (Table 1).

All variables except for marital status and exercise had a significant effect on osteoporosis prevalence. Females (odds ratio [OR] 12.33, 95% confidence interval [95% CI] 11.55–13.17), aged 65 to 79 (OR 2.71, 95% CI 2.59–2.84), and aged 80 and older (OR 1.97, 95% CI 1.81–2.13) were at increased risk of having the disease. Compared to participants with an education level of college or higher, those with an elementary school education or lower (OR 1.79, 95% CI 1.64–1.95), middle school education (OR 1.38, 95% CI 1.26–1.51) were more likely to have osteoporosis, as were rural residents (OR 1.08, 95% CI 1.04–1.12) more likely to have osteoporosis. Participants who were not economically active were at higher risk of the disease (OR 1.24, 95% CI 1.18–1.29), and the risk of osteoporosis was higher in the first quartile, a low-income group (OR 1.21, 95% CI 1.12–1.25) and the second quartile (OR 1.12, 95% CI 1.06–1.19) than the third quartile of household income.

Former drinkers (OR 1.18, 95% CI 1.12–1.25) were more likely to have osteoporosis than current drinkers. Participants with high salt intake (OR 1.14, 95% CI 1.09–1.19) and low salt intake (OR 1.07, 95% CI 1.02–1.12) were all more likely to have osteoporosis compared to those with normal salt intake. Subjects with depression (OR 1.85, 95% CI 1.71–2.0) and participants who were underweight (OR 1.32, 95% CI 1.22–1.42) also tended to have higher osteoporosis prevalence. On the contrary, overweight (OR 0.86, 95% CI 0.82–0.91) and obesity (OR 0.79, 95% CI 0.75–0.83) status were related to a lower risk of osteoporosis (Table 2).

For men, age, education level, place of residence, economic activity, household income, alcohol consumption, salt habit, depression, and BMI were significant variables. Participants aged 64 to 79 (OR 2.67, 95% CI 2.29–3.12) and aged 80 and older (OR 2.85, 95% CI 2.25–3.61) had a higher osteoporosis prevalence. Participants with an education level of elementary school or lower (OR 1.42, 95% CI 1.17–1.73) were more likely to have osteoporosis, as were rural residents (OR 1.24, 95% CI 1.09–1.42), economically inactive participants (OR 1.30, 95% CI 1.13–1.49), income first quintile (OR 1.32, 95% CI 1.09–1.61), former drinkers (OR 1.27, 95% CI 1.11–1.46), participants who ate salty (OR 1.19, 95% CI 1.04–1.37) and bland (OR 1.27, 95% CI 1.10–1.46) food, participants with depression (OR 2.25, 95% CI 1.67–3.03), and underweight participants (OR 1.43, 95% CI 1.17–1.76). Overweight (OR 0.72, 95% CI 0.62–0.84) and obese participants (OR 0.68, 95% CI 0.58–0.81), on the contrary, were less likely to have the disease (Table 3).

For women, age, education level, place of residence, economic activity, household income, alcohol consumption, salt habit, depression, and BMI were significant variables. An age of 65 to 79 (OR 2.72, 95% CI 2.59–2.86) and 80 and older (OR 1.86, 95% CI 1.71–2.03) were associated with higher osteoporosis prevalence, as were an education level of elementary school or lower (OR 1.86, 95% CI 1.68–2.05), middle school (OR 1.44, 95% CI 1.29–1.60), residence in rural (OR 1.06, 95% CI 1.02–1.11), and lack of economic activity (OR 1.22, 95% CI 1.17–1.28). The prevalence of

Table 1. General Characteristics of the Study Participants

	Male (n = *54,958*)		*Female* (n = *71,311*)		*Total* (n = *126,269*)	
	n	%	n	%	n	%
Osteoporosis						
Yes	1,282	2.3	17,939	25.2	19,221	15.2
No	53,649	97.7	53,265	74.8	106,914	84.8
Age (years)						
50–64	29,658	54.0	35,059	49.2	64,717	51.3
65–79	21,734	40.0	29,094	40.8	50,828	40.3
≥80	3,566	6.5	7,158	10.0	10,724	8.5
Education						
Elementary school or less	16,675	30.5	41,942	59.3	58,617	46.7
Middle school	11,212	20.5	11,700	16.5	22,912	18.3
High school	16,594	30.4	12,602	17.8	29,196	23.3
College or higher	10,185	18.6	4,499	6.4	14,684	11.7
Marital status						
Married	47,756	87.0	43,858	61.5	91,614	72.6
Unmarried (single/ divorced/ widowed/ separated)	7,170	13.1	27,425	38.5	34,595	27.4
Residence						
Urban	25,344	46.1	32,163	45.1	57,507	45.5
Rural	29,614	53.9	39,148	54.9	68,762	54.5
Economic activity						
Yes	38,122	69.4	31,579	44.3	69,701	55.2
No	16,830	30.6	39,728	55.7	56,558	44.8
Annual household income						
First quintile	8,399	15.3	17,760	24.9	26,159	20.7
Second quintile	10,621	19.3	13,825	19.4	24,446	19.4
Third quintile	12,084	22.0	13,953	19.6	26,037	20.6
Fourth quintile	12,468	22.7	13,517	19.0	25,985	20.6
Fifth quintile	11,386	20.7	12,256	17.2	23,642	18.7
Alcohol consumption						
Current	37,998	69.2	29,192	40.9	67,190	53.2
Former	10,708	19.5	11,702	16.4	22,410	17.8
Abstention	6,247	11.4	30,404	42.6	36,651	29.0
Exercise						
Yes	9,840	17.9	13,606	19.1	23,446	18.6
No	45,064	82.1	57,623	80.9	102,687	81.4
Salt habit						
Normal	16,137	29.4	17,326	24.3	33,463	26.5
Salty	24,297	44.2	35,585	49.9	59,882	47.4
Bland	14,517	26.4	18,392	25.8	32,909	26.1
Depression						
Yes	913	1.7	3,341	4.7	4,254	3.4
No	54,037	98.3	67,926	95.3	121,963	96.6
BMI						
Underweight	2,085	4.0	3,164	5.2	5,249	4.6
Normal	21,826	41.2	27,084	44.5	48,910	43.0
Overweight	15,501	29.3	15,686	25.8	31,187	27.4
Obese	13,513	25.5	14,955	24.6	28,468	25.0

BMI, body mass index.

Table 2. Factors Related to Osteoporosis in Multivariable Logistic Regression

	OR	*95% CI*	
Gender			
Male	Ref.		
Female	12.33[a]	11.55	13.17
Age (years)			
50–64	Ref.		
65–79	2.71[a]	2.59	2.84
≥80	1.97[a]	1.81	2.13
Marital status			
Married	Ref.		
Unmarried (single/divorced/ widowed/separated)	0.96	0.92	1.00
Education			
Elementary school or less	1.79[a]	1.64	1.95
Middle school	1.38[a]	1.26	1.51
High school	1.02	0.93	1.12
College or higher	Ref.		
Residence			
Urban	Ref.		
Rural	1.08[a]	1.04	1.12
Economic activity			
Yes	Ref.		
No	1.24[a]	1.18	1.29
Annual household income			
First quintile	1.21[a]	1.12	1.25
Second quintile	1.12[a]	1.06	1.19
Third quintile	Ref.		
Fourth quintile	1.06	0.99	1.13
Fifth quintile	0.99	0.93	1.06
Alcohol consumption			
Current drinker	Ref.		
Former drinker	1.18[a]	1.12	1.25
Lifetime abstention	1.00	0.96	1.05
Exercise			
Yes	Ref.		
No	1.01	0.96	1.06
Salt habit			
Normal	Ref.		
Salty	1.14[a]	1.09	1.19
Bland	1.07[b]	1.02	1.12
Depression			
No	Ref.		
Yes	1.85[a]	1.71	2.0
BMI			
Normal	Ref.		
Underweight	1.32[a]	1.22	1.42
Overweight	0.86[a]	0.82	0.91
Obese	0.79[a]	0.75	0.83

[a]$p < 0.001$.
[b]$p < 0.01$.
CI, confidence interval; OR, odds ratio; Ref., reference.

Table 3. Factors Related to Osteoporosis in Multivariable Logistic Regression by Gender

	Male			*Female*		
	OR	*95% CI*		*OR*	*95% CI*	
Age (years)						
50–64	Ref.			Ref.		
65–79	2.67[a]	2.29	3.12	2.72[a]	2.59	2.86
≥80	2.85[a]	2.25	3.61	1.86[a]	1.71	2.03
Marital status						
Married	Ref.			Ref.		
Unmarried (single/ divorced/ widowed/ separated)	0.84[b]	0.70	1.01	0.97	0.93	1.02
Education						
Elementary school or less	1.42[b]	1.17	1.73	1.86[a]	1.68	2.05
Middle school	1.09	0.88	1.35	1.44[a]	1.29	1.60
High school	0.91	0.74	1.12	1.05	0.94	1.16
College or higher	Ref.			Ref.		
Residence						
Urban	Ref.			Ref.		
Rural	1.24[b]	1.09	1.42	1.06[b]	1.02	1.11
Economic activity						
Yes	Ref.			Ref.		
No	1.30[a]	1.13	1.49	1.22[a]	1.17	1.28
Annual household income						
First quintile	1.32[c]	1.09	1.61	1.19[a]	1.12	1.27
Second quintile	1.07	0.88	1.30	1.13[a]	1.06	1.20
Third quintile	Ref.			Ref.		
Fourth quintile	1.21	0.99	1.47	1.04	0.98	1.11
Fifth quintile	0.94	0.76	1.17	1.00	0.93	1.07
Alcohol consumption						
Current drinker	Ref.			Ref.		
Former drinker	1.27[b]	1.11	1.46	1.15[a]	1.09	1.22
Lifetime abstention	1.14	0.95	1.35	0.99	0.95	1.04
Exercise						
Yes	Ref.			Ref.		
No	1.10	0.95	1.29	1.00	0.95	1.05
Salt habit						
Normal	Ref.			Ref.		
Salty	1.19[c]	1.04	1.37	1.14[a]	1.08	1.19
Bland	1.27[b]	1.10	1.46	1.05[c]	1.00	1.11
Depression						
No	Ref.			Ref.		
Yes	2.25[a]	1.67	3.03	1.82[a]	1.68	1.97
BMI						
Normal	Ref.			Ref.		
Underweight	1.43[a]	1.17	1.76	1.30[a]	1.19	1.41
Overweight	0.72[a]	0.62	0.84	0.88[a]	0.84	0.93
Obese	0.68[a]	0.58	0.81	0.80[a]	0.76	0.84

[a]$p < 0.001$.
[b]$p < 0.01$.
[c]$p < 0.05$.

osteoporosis was higher in low-income groups, such as the first quartile (OR 1.19, 95% CI 1.12–1.27) and the second quartile (OR 1.13, 95% CI 1.06–1.20), than the middle-income group. Former drinkers (OR 1.15, 95% CI 1.09–1.22) were more likely to have the disease. A salty diet (OR 1.14, 95% CI 1.08–1.19) and a bland diet (OR 1.05, 95% CI 1.00–1.11) were related to osteoporosis prevalence. Those with depression (OR 1.82, 95% CI 1.68–1.97) and those who were underweight (OR 1.30, 95% CI 1.19–1.41) were more likely to have the disease, whereas overweight (OR 0.88, 95% CI 0.84–0.93) and obese (OR 0.80, 95% CI 0.76–0.84) participants were less likely (Table 3).

Discussion

Osteoporosis is widely thought of as a disease affecting women. This study confirmed that the prevalence rate of

osteoporosis was more than 10 times higher in Korean women (25.2%) than in men (2.3%). Multivariable analysis results also indicated that women were significantly more likely than men to have the disease (OR 12.33). Women have a higher prevalence rate of osteoporosis because depletion of estrogen after menopause causes an imbalance between new bone formation and old bone resorption.[26] Female osteoporosis is primary osteoporosis caused by physiological changes, rather than external or environmental factors. The cause of male osteoporosis, on the contrary, is not as clear; 60% of male osteoporosis was caused by secondary osteoporosis through a combination of factors, such as being underweight, drinking, and insufficient physical activity.[27–29]

Many studies have identified risk factors or contributing factors of osteoporosis, but few studies have comprehensively analyzed differences between men and women, especially with a focus on socioeconomic factors. Thus, this study sought to identify factors related to osteoporosis prevalence by gender, with emphasis on socioeconomic factors

Common factors for both genders appeared to be age, education, place of residence, economic activity, household income, alcohol consumption, salt habit, depression, and BMI. Older age was associated with higher disease risk, which is in line with the results of previous studies. Age is accompanied by declines in body function and hormone levels, which appears to affect osteoporosis risk.[30] Many previous studies have suggested alcohol consumption to be a factor related to secondary osteoporosis.[17,31] According to Nishiguchi et al.,[32] increased alcohol consumption leads to decreased bone density. This study showed that for both men and women, compared to current drinkers, those who used to drink but are currently nondrinkers have a higher ratio of osteoporosis. Some research results showed that appropriate alcohol consumption was not harmful and even good for bone.[33–35] This study, however, has the limitation that it did not consider the period of alcohol drinking and the amount of alcohol consumption.

Salt intake had a significant relationship with osteoporosis risk in both men and women, salty intake and bland intake both led to a higher risk of osteoporosis. Excessive consumption of salt stimulates calcium discharge from bones, which increases osteoporosis risk,[36,37] This study, unlike previous studies, revealed that people who ate bland food also had a higher prevalence of osteoporosis. However, the results may be biased, since the questionnaire used in our study did not ask for an objective measure of salt intake and was instead based on subjective measures of dietary habits.

This study also indicated that underweight people have higher osteoporosis prevalence, whereas overweight and obese people are less likely to have the disease. Climacteric changes can affect libido and concentration, as well as leading to a sense of loneliness and depression.[38] Decreased physical activity and nutritional deficit caused by loss of appetite are both factors brought on by depression that could raise the risk of osteoporosis.[39] This study also found that people with depression were more likely to suffer from osteoporosis.

Among socioeconomic factors, lower education level was associated with higher osteoporosis risk, and this relationship was even more apparent in women. It has been hypothesized that people with lower education levels are less likely to practice sufficient self-care, which affects their health and may increase the risk of osteoporosis.[40,41] In previous studies, men and women belonged to different social conditions, and the different response characteristics to the conditions contributed to the gender difference in health. In a study by Hraba et al.[42] and Umberson et al.,[43] the authors argued that similar social conditions result in similar psychological responses, and that gender differences in health are due to differences in the social structure of men and women. The fact that education level is closely connected to economic status may also have relevance.[44] In terms of socioeconomic factors, there is a difference in gender segregation and structural position among women, such as being engaged in a lower job than men and receiving lower wages for the same occupation or lower occupation than men. The poverty of women in socioeconomic conditions is more prominent in old age, and the socioeconomic changes experienced with increasing age are also present in the elderly women.

Economic activity had significant effects on osteoporosis prevalence in both men and women. People who were not economically active were at a higher risk of osteoporosis, which may be connected to the relationship between physical activity and osteoporosis risk.[45] Economically active people are more active physically as well because of their work, which may result in lower osteoporosis prevalence. Rural residents were more likely to have osteoporosis than urban residents. This is likely the result of a difference in level of social activity and access to healthcare. Rural residents have more limited access to medical institutions and have fewer options for extracurricular activities other than their main work, which may increase osteoporosis risk.[46]

Household income was significantly higher for both men and women, but more pronounced for women. This means that people with low household income do not have enough healthcare to affect their health, especially among women, such as those with lower education levels. In a study of Prus and Gee,[47] household income was found to have a greater effect on the health of elderly women, and higher household income was related to a lower risk of osteoporosis.[48] Higher income may be an indicator of healthier living habits,[49] more physical activity,[49] and better access to healthcare services.[50] Previous study results showing that economic status influenced women more than men in terms of health and access to healthcare were also confirmed in this study.[51–54] Also, the results of the study corresponded with those of previous studies that found as the socioeconomic status of family income is lower, women were more likely to have osteoporosis.[55] Socioeconomic status of women is more associated with obesity and stroke than men, as there are differences in enough of nutritional consumption and level of stress depending on the level of socioeconomic status.[56,57]

There are several limitations to this research. This study has a limitation of cross-sectional analysis. Collected data do not normally describe which variable is the cause and which is the effect. Therefore, serial analysis or causal relationship analysis studies are needed in the future. In inquiring about the participants' dietary habits, such as salt intake and drinking, the questionnaire used subjective indicators, and assessment bias could not be completely controlled. In addition, any current use of alcohol, no matter how little, is considered ''current drinker,'' so the power of this variable to recognize true alcohol abuse is limited. Similarly, we could not measure how much salt intake was really associated with a diagnosis of osteoporosis.

Also, diagnosis was determined by the answer to the question, ''Have you ever been diagnosed with osteoporosis by a doctor?'' However, because the questionnaire did not allow for detailed information related to osteoporosis diagnosis, such as participant bone density and the severity of osteoporosis, this could not be corrected for. Also, it was difficult to explain why osteoporosis is higher in rural areas than in cities because of various factors such as vitamin D intake, nutrition, and physical activity due to outdoor activities. Therefore, further study is needed to clarify these detailed factors. Finally, the social role of women, which is a social determinant of osteoporosis revealed in this study, may vary from culture to culture.

Conclusions

This study involved comparative analysis of socioeconomic and other factors related to osteoporosis prevalence in men and women. Most factors (age, education, place of residence, economic activity, drinking, salt habit, depression, and BMI) affected osteoporosis in both genders; however, some socioeconomic factors showed gender differences. Low education and income levels were more significant factors in women. Future studies that will focus on the effects of socioeconomic factors on osteoporosis, as well as gender-related differences in prevention and control of osteoporosis, are needed.

Author Disclosure Statement

No competing financial interests exist.

References

1. Kanis JA, McCloskey EV, Johansson H, Oden A, Melton LJ, Khaltaev N. A reference standard for the description of osteoporosis. Bone 2008;42:467–475.
2. Dawson-Hughes B, Lindsay R, Khosla S, et al. Clinician's guide to prevention and treatment of osteoporosis. Washington DC: National Osteoporosis Foundation, 2008.
3. Johnell O, Kanis J. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporos Int 2006;17:1726–1733.
4. World Health Organization. WHO scientific group on the assessment of osteoporosis at primary health care level. Summary meeting report. Geneva: WHO Press, 2007:5–7.
5. Ha YC. Epidemiology and economic burden of osteoporosis in South Korea. J Korean Fract Soc 2011;24:114–120.
6. Eachus J, Williams M, Chan P, et al. Deprivation and cause specific morbidity: Evidence from the Somerset and Avon survey of health. BMJ 1996;312:287–292.
7. Eames M, Ben-Shlomo Y, Marmot MG. Social deprivation and premature mortality: Regional comparison across England. BMJ 1993;307:1097–1102.
8. Baumann M, Spitz E, Guillemin F, et al. Associations of social and material deprivation with tobacco, alcohol, and psychotropic drug use, and gender: A population-based study. Int J Health Geogr 2007;6:50.
9. Ministry of Health & Welfare. Ministry of Health and Welfare Statistical Year Book 2010.
10. Park EJ, Joo IW, Jang MJ, Kim YT, Oh K, Oh HJ. Prevalence of osteoporosis in the Korean population based on Korea National Health and Nutrition Examination Survey (KNHANES), 2008–2011. Yonsei Med J 2014;55:1049–1057.
11. Wright NC, Looker AC, Saag KG, et al. The recent prevalence of osteoporosis and low bone mass in the United States based on bone mineral density at the femoral neck or lumbar spine. J Bone Miner Res 2014;29:2520–2526.
12. Burge R, Dawson-Hughes B, Solomon DH, Wong JB, King A, Tosteson A. Incidence and economic burden of osteoporosis-related fractures in the United States, 2005–2025. J Bone Miner Res 2007;22:465–475.
13. Albers MM. Osteoporosis: A health issue for women. Health Care Women Int 1990;11:11–19.
14. Mazess RB, Barden HS. Bone density in premenopausal women: Effects of age, dietary intake, physical activity, smoking, and birth-control pills. Am J Clin Nutr 1991;53:132–142.
15. Riggs BL, Melton III LJ. Involutional osteoporosis. N Engl J Med 1986;314:1676–1686.
16. Lee L, Lai E. Osteoporosis in older Chinese men: Knowledge and health beliefs. J Clin Nurs 2006;15:353–355.
17. Gambert SR, Schultz B, Hamdy RC. Osteoporosis. Clinical features, prevention, and treatment. Endocrinol Metab Clin North Am 1995;24:317–371.
18. Levinson W, Altkorn D. Primary prevention of postmenopausal osteoporosis. JAMA 1998;280:1821–1822.
19. Turner LW, Taylor JE, Hunt S. Predictors for osteoporosis diagnosis among postmenopausal women: Results from a national survey. J Women Aging 1998;10:79–96.
20. Drake MT, Khosla S. Male osteoporosis. Endocrinol Metab Clin North Am 2012;41:629–641.
21. Kim BH. Osteoporosis knowledge and health behavior in Korean adult men. Nursing Science 2009;21:47–62.
22. Kiebzak GM, Beinart GA, Perser K, Ambrose CG, Siff SJ, Heggeness MH. Undertreatment of osteoporosis in men with hip fracture. Arch Intern Med 2002;162:2217–2222.
23. Lane JM, Serota AC, Raphael B. Osteoporosis: Differences and similarities in male and female patients. Orthop Clin North Am 2006;37:601–609.
24. Compston J, Cooper A, Cooper C, et al. Guidelines for the diagnosis and management of osteoporosis in postmenopausal women and men from the age of 50 years in the UK. Maturitas 2009;62:105–108.
25. WHO. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004;363:157.
26. Johnston Jr. CC, Longcope C. Premenopausal bone loss—A risk factor for osteoporosis. N Engl J Med 1990;323:1271–1273.
27. Cooper C, Campion G, Melton Iii L. Hip fractures in the elderly: A world-wide projection. Osteoporos Int 1992;2:285–289.
28. Eastell R, Boyle I, Compston J, et al. Management of male osteoporosis: Report of the UK Consensus Group. QJM 1998;91:71–92.
29. Orwoll ES. Osteoporosis in men. Endocrinol Metab Clin North Am 1998;27:349–367.
30. Chapuy MC, Arlot ME, Delmas PD, Meunier PJ. Effect of calcium and cholecalciferol treatment for three years on hip fractures in elderly women. BMJ 1994;308:1081.
31. Chang YK, Seo HJ, Jin YW, et al. The prevalence and risk factors of osteopenia and osteoporosis in 40–59 year-old male workers. J Occup Environ Med 2006;18:130–137.
32. Nishiguchi S, Shiomi S, Tamori A, et al. Effect of ethanol on bone mineral density of rats evaluated by dual-photon X-ray absorptiometry. J Bone Miner Metab 2000;18:317–320.

33. Feskanich D, Korrick SA, Greenspan SL, Rosen HN, Colditz GA. Moderate alcohol consumption and bone density among postmenopausal women. J Womens Health (Larchmt) 1999;8: 65–73.
34. Williams FM, Cherkas LF, Spector TD, MacGregor AJ. The effect of moderate alcohol consumption on bone mineral density: A study of female twins. Ann Rheum Dis 2005;64:309–310.
35. Sripanyakorn S, Jugdaohsingh R, Mander A, Davidson SL, Thompson RP, Powell JJ. Moderate ingestion of alcohol is associated with acute ethanol-induced suppression of circulating CTX in a PTH-independent fashion. J Bone Miner Res 2009;24:1380–1388.33.
36. Chobanian AV, Hill M. National Heart, Lung, and Blood Institute Workshop on Sodium and Blood Pressure: A critical review of current scientific evidence. Hypertension 2000;35:858–863.
37. Teucher B, Dainty JR, Spinks CA, et al. Sodium and bone health: Impact of moderately high and low salt intakes on calcium metabolism in postmenopausal women. J Bone Miner Res 2008;23:1477–1485.
38. Fedor-Freybergh P. The influence of oestrogens on the well-being and mental performance in climacteric and postmenopausal women. Acta Obstet Gynecol Scand 1977;56:2–91.
39. Choi J, Han S, Shin A, et al. Prevalence and risk factors of osteoporosis and osteopenia in Korean women: Cross-sectional study. J Korean Soc Menopause 2008;14:35–49.
40. Speake DL, Cowart ME, Pellet K. Health perceptions and lifestyles of the elderly. Res Nurs Health 1989;12:93–100.
41. Yang KR, Rhee SJ. A study on degree of daily living activities among women with osteoarthritis. J Muscle Joint Health 1998;5:57–71.
42. Hraba J, Lorenz F, Lee G, Pechachova Z. Gender differences in health: Evidence from the Czech Republic. Soc Sci Med 1996;43:1443–1451.
43. Umberson D, Chen MD, House JS, Hopkins K, Slaten E. The effect of social relationships on psychological well-being: Are men and women really so different?. Am Sociol Rev 1996;837–857.
44. Krieger N, Williams DR, Moss NE. Measuring social class in US public health research: Concepts, methodologies, and guidelines. Annu Rev Public Health 1997;18:341–378.
45. Yang R, Kim KY, Lee MS, Kim DK, Roh YS. A study on the relationship between body composition, exercise status, fitness status and bone mineral density in some rural residents. J Korea Acad Indust Coop Soc 2009;10:3405–3411.
46. Yi S, Shoe C, Kim M, Kim S. Effect of health calisthenics program of body composition, blood pressure and serum lipid living in the rural elderly women. Korean J Phys Educ 2006;45:541–554.
47. Prus SG, Gee E. Gender differences in influence of economic, lifestyle and psychosocial factors on later-life health. Can J Public Health 2003;99:306–309.
48. Hernandez-Rauda R, Martinez-Garcia S. Osteoporosis-related life habits and knowledge about osteoporosis among women in El Salvador: A cross-sectional study. BMC Musculoskelet Disord 2004;5:29.
49. Crespo CJ, Smit E, Andersen RE, Carter-Pokras O, Ainsworth BE. Race/ethnicity, social class and their relation to physical inactivity during leisure time: Results from the Third National Health and Nutrition Examination Survey, 1988–1994. Am J Prev Med 2000;18:46–53.
50. Yang YT, Iqbal U, Ko HL, et al. The relationship between accessibility of healthcare facilities and medical care utilization among the middle-aged and elderly population in Taiwan. Int J Qual Health Care 2015;27:222–231.
51. del Rio Barquero L, Baures MR, Segura JP, et al. Bone mineral density in two different socio-economic population groups. J Bone Miner Res 1992;18:159–168.
52. Oliveira C, Economou T, Bailey T, Mendonça D, Pina M. The interactions between municipal socioeconomic status and age on hip fracture risk. Osteoporos Int 2015;26:489–498.
53. Pearson D, Taylor R, Masud T. The relationship between social deprivation, osteoporosis, and falls. Osteoporos Int 2004;15:132–138.
54. Wang M-C, Dixon LB. Socioeconomic influences on bone health in postmenopausal women: Findings from NHANES III, 1988–1994. Osteoporos Int 2006;17:91–98.
55. Myong JP, Kim HR, Choi SE, Koo JW. The effect of socioeconomic position on bone health among Koreans by gender and menopausal status. Calcif Tissue Int 2012;90:488–495.
56. Kim YM, Jung-Choi K. Socioeconomic inequalities in health risk factors in Korea. J Korean Med Assoc 2013;56:175–183.
57. Goldstein LB, Adams R, Alberts MJ, et al. Primary prevention of ischemic stroke: A guideline from the American Heart Association, American Stroke Association Stroke Council. Stroke 2006;37:1583–1633.

Address correspondence to:
Young Dae Kwon, MD, PhD
Department of Humanities and Social Medicine
College of Medicine and Catholic Institute for Healthcare Management
The Catholic University of Korea
222 Banpo-daero, Seocho-gu
Seoul 06591
Korea

E-mail: snukyd1@naver.com