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The prevalence and risk factors for osteoporosis among 18- to 49-year-old Turkish women

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ABSTRACT

The aim of this study was to determine the prevalence of osteoporosis and associated risk factors in Turkish women aged 18–49 years. A population-based, cross-sectional study was conducted between January and April 2014. The sample (n = 1,792) was comprised of women aged 18–49 years, who resided in Cubuk, Ankara, Turkey, and were selected by simple random sampling. The data were collected in face-to-face interviews using an Individual Information Form and an Osteoporosis Risk Estimation Scale. Bone mineral density was assessed using standard dual-energy X-ray absorptiometry. Multiple logistic regression and chi-square analyses were used for analyses. Most participants (80.1%) were at low risk of developing osteoporosis, while 6.9% were at medium to high risk of developing the disease. From bone mineral density levels, 33.3% were osteopenic; 4.0% were osteoporotic; 33.3% were osteopenic at the femoral neck; and 6.7% were osteoporotic at the lumbar vertebra L1–L4. Further, results of multiple logistic regression analyses showed that osteoporosis risk was significantly associated with smoking, having light skin, multiparity, and having a family history of osteoporosis ($p < .05$). These results indicated that public health screening strategies for protecting women's bone health at earlier ages than previously thought might be beneficial.

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Bone mineral density; osteoporosis; osteoporosis risk factors; women

Introduction

Osteoporosis is a metabolic bone disease that increases the fragility of the bone as a result of low bone mass and deformation in the microstructure of the bone (Shuler et al. 2012). The International Osteoporosis Foundation (IOF) states "osteoporosis decreases the life quality of the individuals in physical, social, and psychological aspects, causes morbidity and mortality, and increases the risk for bone fractures"

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(Dempster 2011; IOF 2010). In prior studies, some features, such as prior fracture, family history of fracture, being elderly, being white, lower body weight, sedentary lifestyle, smoking, excess alcohol consumption, having a diet lacking calcium and Vitamin D, nulliparity, late menarche, early menopause, and long-term glucocorticoid treatment were associated with osteoporosis (Andersen and Laurberg 2014; Pervaiz et al. 2013).

Critical years for building bone mass are during childhood. This pace continues until around the mid-20s when maximum bone density is normally reached. The Canadian Multicentre Osteoporosis Study identified the ages of peak hip bone mineral density (BMD) for women between 16 and 19 years of age (Berger et al. 2010). This is when bones have achieved their maximal density and strength. After peak bone mass is reached, bone density remains stable during adulthood, then it begins to decline around the age of 30 years. Osteoporosis affects more than 75 million people worldwide and causes more than 8.9 million fractures annually. The prevalence of osteoporosis increases markedly with age, from 3% at 50 years to more than 25% at 80 years in women (IOF, 2016a). Recognizing osteoporosis risk factors early in life and taking appropriate action can have enormous positive impact on bone health in later years (Weaver et al. 2016).

The number of osteoporotic fractures is projected to increase in both men and women by more than three-fold over the next 50 years (World Health Organization [WHO] 2007). In many regions of the world, the risks of osteoporotic fractures in men are about half those of women in the first 5 years after menopause. More modest variations have been observed for vertebral fracture risk (Becker, Kilgore, and Morrisey 2010; Bhalla 2010). The risk for osteoporosis related fracture is 50% for women after the age of 50 years, while this rate is 20% for men (Rahmani and Morin 2009). The risk for the occurrence of osteoporosis for women over 50 years of age is 30.3% in the United States, 40.8% in Denmark, 35.4% in Japan, 24.9% in Switzerland, 30% in Bangkok, and 41.6% in England (IOF 2010). In a study conducted by the Turkish Osteoporosis Society (TOS), based on BMD 27.6% of women over the age of 50 years was categorized as at risk for osteopenia, and 22.4% of women were at risk for osteoporosis (TOS 2012). On the other hand, osteoporosis data for women in younger age groups has not been, to our knowledge, included in the literature in Turkey.

Osteoporosis is a silent, ongoing disease, and diagnosing it prior to an initial fracture is very important. For this reason, if the risk factors related to osteoporosis are identified early and the medical or behavioral risk factors are controlled, then bone fractures and dependent disabilities can be prevented (Rahmani and Morin 2009). The likelihood of prevention is especially high when developed countries designate significant resources to target prevention and early diagnosis of the disease and support research projects aimed at developing more efficient, preventive, and diagnostic methods (IOF 2010;

Vasikaran et al. 2011). Addressing lifestyle as a risk factor may be one of the solutions for preventing osteoporosis. Providing education on bone health and increasing awareness of associated risk factors, such as smoking, diet, and exercise, if done as an early intervention, could lead to less morbidity from disease, particularly for those who have other risk factors. However, few studies have been conducted of screening for bone mass among younger age groups. Thus, the purpose of this study was to determine the prevalence of osteoporosis and associated risk factors in Turkish women aged 18–49 years.

Research questions:

1. What is the osteoporosis risk level for Turkish women aged 18–49 years?
2. What is the BMD level for Turkish women aged 18–49 years?
3. Are individual characteristics related to osteoporosis risk levels in women aged between 18–49 years?

Methods

The study sample

A population-based, cross-sectional study was conducted from January to April 2014. The population source for the research consisted of 17,641 women aged 18–49 years living within the boundaries of Cubuk, Ankara, Turkey. The Turkish Statistical Institute (TUİK) conducted a population and housing census in 2013, which was designed as a comprehensive sample survey based on administrative registers (TUİK, 2013). Household addresses for the present study were obtained from these data from the TUİK. The sample size for the study was estimated using the formula for when the number of the individuals in the population was known, the participants met the inclusion criteria, and they were selected through simple random sampling from a group of adequate size who had agreed to participate in the study. Using the prevalence of osteoporosis as $p = .30$, standard deviation (SD) at ±2, power level at 0.80, and a (two-tailed) alpha level of 0.05, the estimated necessary total sample size was $n = 1{,}792$. The total number of women selected by random sampling (described below in the subsection on Procedures) of computer-generated random numbers was 1,810. The inclusion criteria for the sampling group was women aged 18–49 years, who resided within the boundaries of Cubuk, Ankara and who voluntarily accepted to participate in the study. The exclusion criteria were being postmenopausal, already diagnosed with osteoporosis, pregnant, or diagnosed with any physical or cognitive disability. The reason for excluding women previously diagnosed with osteoporosis was to evaluate the prevalence of osteoporosis and associated risk factors in a representative sample of women.

Pregnant women were excluded because dual X-ray absorptiometry (DXA) was used for measuring BMD in the second stage of the research and involved some radiation exposure. The eligibility rate among those sampled and the participation rate among those found eligible were 99.0% and 98.9%, respectively, resulting in a total final sample size of 1,792.

Data collection

Individual Information Form (IIF)

This form was prepared in compliance with the literature and included 27 questions to identify the age, education, marital status, employment and income status, social insurance, geographical location, osteoporosis risk factors, self-reported weight and height, age at menarche, number of pregnancies, prior duration of lactation, use of contraception, family history of osteoporosis, physical activity, nutritional habits, hair and skin color, history of chronic diseases, regular medication use, and smoking (Andersen and Laurberg 2014; Becker, Kilgore, and Morrisey 2010; Bhalla 2010; IOF 2014; Kayacan 2011; Kim et al. 2008; NOF 2010; Pervaiz et al. 2013; Society of Endocrinology and Metabolism of Turkey 2012; TOS 2012; Vasikaran et al. 2011). In the IIF, some activities, such as "walking a minimum of three times a week for at least 20 minutes, jogging, swimming, and doing sports" were considered as physical activity (Society of Endocrinology and Metabolism of Turkey 2012).

Body mass index (BMI) was computed as self-reported weight in kg/[height in m]^2: those under 18.5 kg/m^2 were considered to be "underweight"; those at 18.5–24.99 kg/m^2 were considered to be at a "healthy weight"; those at 25–29.99 kg/m^2 were considered to be "overweight"; and those at 30 kg/m^2 or more were classified as "obese" (WHO 2000). In addition, "early menarche" was defined as onset of menstruation at age 11 years or earlier; "normal menarche" was at 12–14 years of age; and "late menarche" was at the age of 15 years or later (Guldbrandsen et al. 2014). In the family history evaluation, history of osteoporosis was ascertained for first-degree relatives, such as mothers, sisters, and aunts.

Osteoporosis Risk Estimation Scale (ORES)

This scale was developed by Hacer Kayacan and accepted to be valid and reliable for the Turkish population to identify osteoporosis risk in women. In this study, the Cronbach's alpha was 0.82. The ORES includes 16 Likert-type questions. The total average score of the scale ranges from 0 to 48. No osteoporosis risk equates to scores 0–14; low risk equates to scores 15–28; medium risk equates to scores 29–40, and high risk equates to scores 41–48 (Kayacan 2011).

Procedures

The research was conducted in two stages (Figure 1). The first stage included listing the addresses of women aged 18–49 years and all of the members living in that family. The interview started by asking the household contacts the total number of women (age 18–49 years) living in the household. If only one female lived in the household, that female was chosen for the interview. If two or more women lived in a household, the Kish selection method was used to select a female (age 18–49 years) at random after excluding the household contact. The KISH method (1949) includes: (1) First, everyone that fits the eligibility criteria, such as being over the age of 18 years, was listed. If only one such person was living in the household, that person was the primary survey respondent. (2) Then all those in the household were placed in a selection grid. (3) The researchers then choose a respondent based on their place in the grid, using some form (a random number is selected between "1" and "N." When we reached the end of the list in selecting the sample, we continued selection by starting again with numbers from the beginning of the list). This created a circular pattern in selecting the sample of random selection so as not to introduce bias into the data.

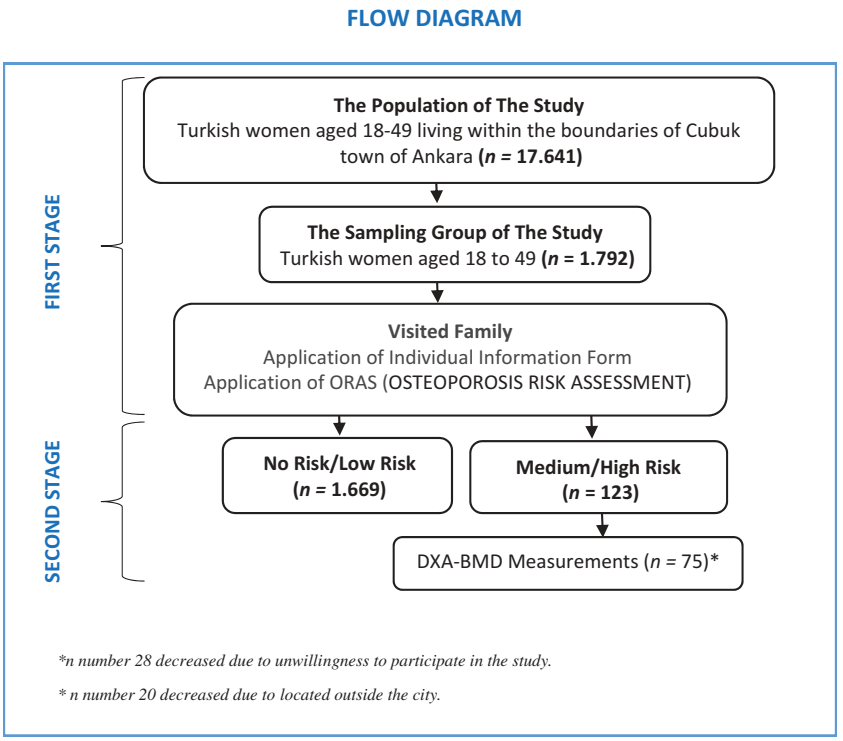


Figure 1. Flow diagram of research.

The data were collected in face-to-face interviews. Three visits were undertaken for each family, and if the person to be interviewed was absent during the first visit, a date and time was identified to visit her a second time. A standard portable measurement device (F. Bosch FB-721, Medizine technik, Guangdong, China) was used for measuring the height and weight of each woman.

In the second stage of the research, the women with medium risk and high risk (n = 123), based on the ORES, were invited to Ankara's Dr. Halil Sivgin Cubuk State Hospital to take BMD measurements. Assessment of BMD was performed for only 75 women because 20 women were outside the city when the DXA was administered, and 28 of them were unwilling to participate in the DXA measurement. Classification of participants was based on the average T-value for the four lumbar spine (anterior position between L1–L4) and proximal femur (neck, trochanter, and Ward's triangle) using DXA (Hologic QDR-4500, USA). This is the gold-standard method for assessing BMD (WHO 2003).

Based on WHO criteria, individuals with a BMD value within 1 standard deviation of that for healthy young adults were classified as having normal bone mass (i.e., T-value > −1); those with BMD values 1 to 2.5 standard deviations below the mean value for healthy young adults were diagnosed as osteopenia (i.e., −1 > T > −2.5); those with BMD 2.5 or more standard deviations below the average value for healthy young adults (i.e., T < −2.5) were diagnosed as osteoporosis (WHO 2003).

Ethical considerations

The data collection procedures for this study were approved by the research and ethics board of the university, and all participants provided written informed consent. Also, written approval of the scale inventory was obtained for the use of the ORES.

Analysis of the data

Results were analyzed by using SPSS version 15.0 (Chicago, IL, USA). Continuous data were expressed by means and standard deviations; categorical data were expressed by counts and percentages. The differences in frequencies of categorical data between groups were tested by the chi-square test. The prevalence of osteoporosis was estimated along with the 95% confidence interval. Based on this model, variables associated with this outcome at a level of significance (p < .05) were entered into the final model of the multivariate logistic regression, which was used to compute adjusted odds ratios (aOR) and 95% confidence intervals (95% CI) to assess the independent associations of these variables with osteoporosis risk. A forward Wald method was selected for this model. For assessing model fit of multivariable regressions, Hosmer-Lemeshow tests were used. Binary interactions between variables were also

analyzed. No variables generated a significant risk increase/decrease when the Enter model approach was used. Either only simple interaction or no interaction was observed when binary interactions were analyzed by the forward Wald method.

Results

Descriptive characteristics of the study sample

The average age of the women in the study was 33.49 ± 9.8 (min = 18, max = 49) years. Few women (18.0%) were in the 45–49-year old age group; 71.6% were married; 69.4% were housewives; 85.2% had social security; and 67.1% had middle incomes. In addition, 3.0% of women's BMI were underweight; 45.7% of women had a healthy weight; 33.0% were overweight; and 18.3% of women were obese. We found that 26.2% had a chronic disease (7.6% hypertension, 4.9% thyroid, 4.3% diabetes, and 2.4% lung disease), and 20.5% had used medications long-term.

When the women's food source calcium consumption rates were examined, we found that 28.0% consumed dairy products regularly with consumption at a few times per week (49.6% consumed a glass of milk every day; 56.7% consumed one piece of cheese per day; and 53.3% consumed one cup of yogurt per day). When coffee consumption and smoking habits of the women were examined, 17.7% identified as daily coffee drinkers (57.2% of coffee drinkers drank one to two cups/day), and 23.1% smoked (47.7% 10–20 cigarettes every day).

The study examined the women's risk factors for osteoporosis and investigated the women's knowledge regarding the disease. A total of 26.1% of participants reported receiving daily direct sunlight exposure, and 56.3% engaged in regular physical activity (minimum three times/week for at least 20 minutes/day). More than half (58.3%) of women had knowledge about osteoporosis, and 25.3% gained information from their friends or internet sources. When the women's family histories were examined, 18.1% had, at minimum, one first-degree relative diagnosed with osteoporosis, and 2.6% had a family history of osteoporosis-related fractures. Obstetric and gynecologic features of women were examined, and 72.3% were identified to have menarche between the ages of 11 and 13 years; 91.6% had a history of three or less pregnancies, and 85.7% had parity between one and three.

Results of unadjusted bivariate analyses

When we examined the osteoporosis risk distribution, 80.1% of women were identified to have low risk for osteoporosis, based on the ORES; 6.9% had medium and high risk; and 13.0% did not have any risk (Figure 2). When BMD levels of the women with medium to high risk for osteoporosis were

assessed at the femoral neck, 62.7% were normal; 33.3% had osteopenia; and 4.0% had osteoporosis. At the lumbar vertebra, 60.0% were normal; 33.3% had osteopenia; and 6.7% had osteoporosis. The mean T score at the femoral neck was −0.55 ± 1.17; the mean T score at lumbar vertebra 2–4 was −0.56 ± 1.18 (Figure 3).

When the osteoporosis risk for women was examined in relation to certain characteristics (Table 1), 90.5% of women aged 18–34 years had risk factors for osteoporosis, while this rate was 83.3% for women aged 35–49 years ($p < .001$). The majority (85.3%) of women whose education levels were primary school and lower had risk factors, while this rate was slightly higher (89.2%) for women who had higher education levels ($p = .016$). Most (90.5%) of women who smoked were included in the risk group for osteoporosis, while this rate was slightly lower (86.0%) for non-smokers ($p = .017$). Most of the women not participating in regular physical activity (88.4%) had risk factors, while this rate was slightly lower (86.0%) for women who participated in regular physical activity ($p < .001$).

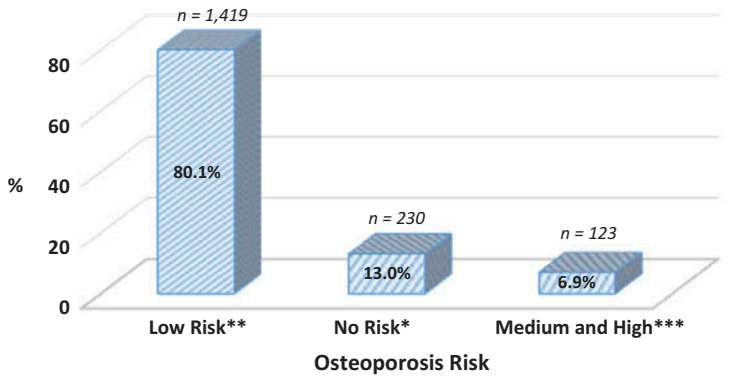


Figure 2. Women's risk of osteoporosis distribution ($n = 1.792$).
*No risk was scores on the ORES of 0–14. **Low risk was scores on the ORES of 15–28. ***Medium and high risk were scores on the ORES of 29–48.

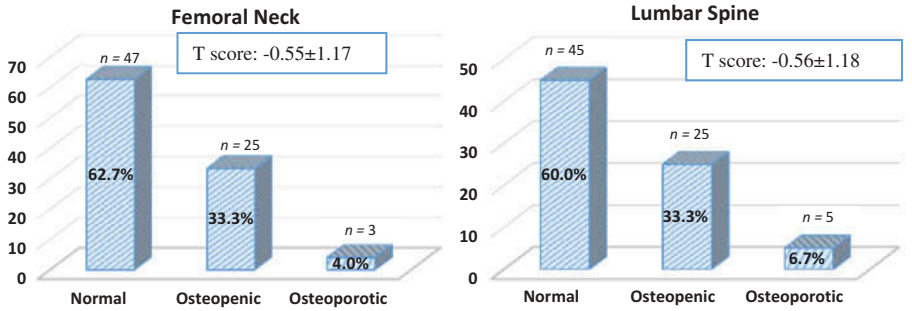


Figure 3. Women's T score results of the femoral neck and lumbar spine distribution ($n = 75$). Normal bone mass: T-value > −1; Osteopenic bone mass: −1 > T > −2.5; Osteoporotic bone mass: T < −2.5.

Table 1. Distribution of osteoporosis risk according to some characteristics of women.

Characteristics	Risk of osteoporosis: No *n* (%)	Yes[a] *n* (%)	Statistical analysis[b]
Age (*n* = 1,772), years			
18–34	87 (9.5)	828 (90.5)	20.274
35–49	143 (16.7)	713 (83.3)	$p < .001$
Education status (*n* = 1,772)			
Primary school	146 (14.7)	848 (85.3)	5.850
High school and greater	84 (10.8)	694 (89.2)	$p = .016$
Smoking (*n* = 1,772)			
Smokers	38 (9.5)	364 (90.5)	5.726
Non-smokers	192 (14.0)	1,178 (86.0)	$p = .017$
Regular physical activity (*n* = 1,772)			
Yes	141 (14.0)	865 (86.0)	63.263
No	89 (11.6)	677 (88.4)	$p < .001$
BMI[c] (*n* = 933)			
Underweight (<18.5 kg/m^2)	2 (3.8)	50 (96.2)	6.106
Overweight + obese (>25 kg/m^2)	148 (16.8)	733 (83.2)	$p < .013$
Skin color (*n* = 1,772)			
Light	59 (8.8)	610 (91.2)	16.471
Dark	171 (15.5)	932 (84.5)	$p < .001$
Osteoporosis in the family history (*n* = 1,772)			
Yes	30 (9.3)	294 (90.7)	4.859
No	200 (13.8)	1,248 (86.2)	$p = .028$
Late menarche (15+ years) (*n* = 1,772)			
Yes (≥15 years)	26 (8.1)	296 (91.9)	8.382
No (12–14 years)	204 (14.1)	1,246 (85.9)	$p = .004$
Multigravida[d] (*n* = 1,346)			
Yes	15 (9.9)	136 (90.1)	4.150
No	195 (16.3)	1,000 (83.7)	$p = .042$

[a]Low-medium-high risk.
[b]X^2 test.
[c]Normal BMI is not included.
[d]Only married women included.

Almost all (96.2%) women included in the underweight group had risk factors for osteoporosis, while this rate was 83.2% for women in the obese plus overweight groups ($p < .013$). Most (91.2%) light-skinned women had risk factors for osteoporosis, while this rate was 84.5% for darker-skinned women ($p < .001$). Most (90.7%) women with osteoporosis in their family history had risk factors for osteoporosis, while this rate was 86.2% for women who did not have a family history of osteoporosis ($p = .028$). Most (91.9%) women who had late menarche had risk factors for osteoporosis, while this rate was 85.9% for women who did not have late menarche ($p = .004$). Most (83.7%) women who had three or fewer pregnancies had risk factors for osteoporosis, while this rate was 90.1% for women who had four or more pregnancies ($p = .042$).

Results of multivariable analyses

The relationships between the presence of osteopenia and osteoporosis, according to the ORES results for risk category, with smoking, skin color, family history

of osteoporosis, and pregnancy history, were examined with a multiple logistic regression (Table 3). Presence of osteopenia or osteoporosis was 2.2 times higher for smokers (aOR = 2.2; 95% CI = 1.34–3.62), 1.6 times higher for light-skinned was compared to dark-skinned (aOR = 1.6; 95% CI = 1.11–2.41), 2.0 times higher for those having a positive family history of osteoporosis (aOR = 2.0; 95% CI = 1.20–3.55), 0.1 times lower for women who had one to three pregnancies (aOR = 0.1; 95% CI = 0.06–0.41), and 0.2 times lower for those having four or more pregnancies (aOR = 0.2; 95% CI = 0.08–0.72) compared to nulliparous women.

Discussion

In the 21st century, health strategies for the prevention of osteoporosis as a pandemic of the time have gained more importance than treatment methods. Thus, identification of women with increased risk for osteoporosis and taking the required precautions is the most efficient way to decrease the load on the health system (United States National Institutes of Health [USNIH] 2000). However, it seems that the studies oriented for the identification of osteoporosis and its risks in women, especially in the younger age groups, are very limited, as the studies have mainly included peri-menopausal and post-menopausal women (Stetzer 2011). In this respect, the results of our study contribute to the identification of osteoporosis risk in young women especially in the 18–49-year age group.

The risk of osteoporosis is potentially modifiable; therefore, women need to be aware of the risk factors for osteoporosis and engage early counseling strategies. Knowing the risks and providing education on bone health is the first step in the fight against osteoporosis. Most modifiable risk factors directly affect bone biology and result in a decrease in BMD (IOF, 2016b). Young people should focus on building the peak bone mass that will keep them in good stead for the rest of their lives (Becker, Kilgore, and Morrisey 2010; Bhalla 2010).

In the present study, nine of every ten women had a risk for osteoporosis (Figure 2). According to their BMD levels, of the women having medium to high risk for osteoporosis in the femoral neck and lumbar vertebra, 33.3% were osteopenic. At the femoral neck 4.0% were osteoporotic, and at the lumbar vertebra, 6.7% were osteoporotic. In the literature, bone mass is acquired between the ages of 20 to 30 years, and the peak bone mass is reached at the age of 35 years (NOF 2010). The risk for osteoporosis particularly increases after menopause (TOS 2012). For this reason, it was expected that BMD levels of women in the younger age group in our survey would be higher when compared to BMD levels of the elderly women. However, most young women included in this survey had risk factors for future osteoporosis. These results are important for the development of strategies for preventing osteoporosis, especially in younger-aged women who had risk factors. When we examined factors related

to the osteoporosis risk levels of women, some important results were obtained (Table 3). Osteoporosis risk levels were positively associated with smoking, light skin color, family history of osteoporosis, and fewer pregnancies ($p < .05$).

A number of studies have demonstrated that age is negatively associated with BMD (Becker, Kilgore, and Morrisey 2010; IOF 2010). According to the literature, peak bone mass is reached between the ages of 30 and 35 years, and BMD decreases with increasing age (Bhalla 2010; TOS 2012). In the present study, contrary to the literature findings, the risk for osteoporosis in unadjusted analyses was high for younger women ($p < .05$; Table 1), but this association was no longer apparent in multivariable analyses. We thus hypothesized that these findings might have been due to the youngest women in the study not yet having reached peak bone mass or that other factors associated with age (e.g., number of pregnancies or smoking) accounted for the finding.

The tobacco metabolites in cigarettes have toxic effects on the users, which increase cortisone levels in the blood and have a negative impact on bone tissue. In addition, this bone mass loss is proportional to the number of cigarettes smoked and the period of smoking (Wong, Christie, and Wark 2007). Significant research has indicated that smoking is related to osteoporosis (Matziolis et al. 2011; Truntzer et al. 2015). In our study, the prevalence of osteoporosis was 2.2 times higher for women who smoked than in non-smokers ($p < .05$; Table 3), supporting prior findings.

Regular physical activity decreases cytokine levels and increases osteoclast stimulation and, in this way, decreases bone loss (Clarke and Khosla 2010). The mechanical pressure caused by physical activity increases prostaglandin E2 and prostaglandin I2 levels of bone cells, stimulates bone formation, and contributes positively to the formulation of peak bone mass and protection of current bone mass (Truntzer et al. 2015). In our study, similar to the findings in the literature, the risk for osteoporosis was high for nine women out of ten who did not do any physical activity regularly ($p < .05$; Table 1), although this finding was not sustained in multivariable analyses after adjustment for other risk factors. In the other studies, a negative correlation has been reported between doing regular physical exercise and the progress of osteoporosis (Chahal, Lee, and Luo 2014; Pinar et al. 2009; Vásquez et al. 2013). Osteoporosis more easily develops with a decrease in physical activity, especially after the age of 40 years.

Obesity has been reported to be protective against osteoporosis as a combination of mechanical and hormonal factors (Crepaldi et al. 2007). Body weight forms a mechanical stress on the skeleton system and ensures the maintenance of BMD, while estrogen is synthesized in the fatty tissues and also provides a protective effect on bone mass (Migliaccio et al. 2011). In our study, underweight body mass index was related to osteoporosis risk only in unadjusted analyses ($p < .05$; Table 1) but was no longer significant in multivariable analyses. Other studies have shown a positive correlation

between low body weight and osteoporosis (Kanis et al. 2013; Pinar et al. 2009). This finding is consistent with studies in the literature.

Vitamin D formulation may change depending upon the time of day of sun exposure and an individual's skin color. Vitamin D levels tend to be high in dark-skinned people, depending on the amount of sun exposure and time of day (Nimitphong and Holick 2013). This increases the risk for osteoporosis for fair-skinned women (TOS 2012). In our study, the occurrence of osteopenia and osteoporosis was 1.6 times higher for light-skinned people compared to dark-skinned ($p < .05$; Table 3). Other studies have reported similar results indicating that light-skinned women had more risk than dark-skinned women (Pinar et al. 2009; Vivanco-Muñoz et al. 2012).

Genetic studies have shown that some genes have been identified as affecting BMD levels. For this reason, women who have close relatives diagnosed with osteoporosis are at increased risk for BMD loss (Mäkitie et al. 2016). In our study, the frequency of osteopenia and osteoporosis was 2.0 times higher in women having a family history of osteoporosis ($p < .05$; Table 3). Prior studies have also found that osteoporosis was more frequently seen in women having a family history of osteoporosis and fracture (Chen et al. 2007; Cummins et al. 2013; Kim et al. 2008; Pinar et al. 2009). In this context, the result of our study was similar to those of prior surveys.

In the literature, late menarche has been shown to affect skeletal system development negatively, causing estrogen deficiency during the growing period; high fertility increases calcium requirements of the body (Chevalley et al. 2011). In unadjusted analyses, women having a late menarche history had osteopenia and osteoporosis 1.8 times more frequently (Table 2), but this relation was not sustained in multivariable analyses after adjusting for other risk factors. In other studies performed, menarcheal age has shown a strong relationship with peak bone formation; late menarche increased the risk for developing osteoporosis (Chevalley et al. 2008; Mendoza-Romo et al. 2014).

With multiple pregnancies, calcium needs of the body increase. This can contribute to a risk for osteoporosis. Even though a physiologic increase in calcium absorption usually occurs as an adaptation mechanism during pregnancy, bone formation, nevertheless, decreases approximately 3% during pregnancy (Gemalmaz et al. 2007; Sioka et al. 2010). However, in our study, the frequency of osteopenia and osteoporosis was significantly lower in women having one to three pregnancies and four or more pregnancies compared to nulliparous women ($p < .05$; Table 3). Other studies examining the relationship between the number of pregnancies and osteoporosis support our findings (Bas et al. 2010; Gemalmaz et al. 2007; Londono et al. 2013).

In addition, in unadjusted analyses, osteoporosis risk increased ($p < .05$) as education level increased (Table 1), although this increase disappeared in multivariable analyses adjusted for other risk factors. Studies have shown a negative correlation between lower education level and osteoporosis risk (Okumus et al.

Table 2. Univariate logistic regression analysis results of the association of individual characteristics with osteoporosis risk.

Variables	Odds ratio	95% CI (lower; upper)	Wald	*p*
Smoking				
Non-smokers	1	1.25–2.59	10.17	.001*
Smokers	1.80			
Regular physical activity				
No	1	0.93–1.64	2.20	.137
Yes	1.24			
BMI				
Overweight + obese (>25 kg/m^2)	1	1.21–20.97	4.96	.026*
Underweight (<18.5 kg/m^2)	5.04			
Skin color				
Dark	1	1.38–2.59	16.06	$p < .001$*
Light	1.89			
Osteoporosis history in the family				
No	1	1.04–2.35	4.79	$p < .001$*
Yes	1.57			
Late menarche (15+ years)				
No (12–14 years)	1	1.20–2.83	7.85	.005*
Yes (≥15 years)	1.84			
Pregnancy history				
No	1	0.15–0.40	32.30	$p < .001$*
1–3	0.25	0.22–0.89	5.13	.023*
≥4	0.44			

Note: CI: Confidence interval; BMI: Body mass index.
*$p < .05$.

Table 3. Factors related to osteoporosis risk in multivariable logistic regression analysis.

Variables	Adjusted odds ratio	95% CI (lower; upper)	Wald	*p*
Smoking				
Non-smokers	1	1.34–3.62	9.77	.002*
Smokers	2.20			
Skin color				
Dark	1	1.11–2.41	6.24	.012*
Light	1.63			
Osteoporosis history in the family				
No	1	1.20–3.55	6.88	0.009*
Yes	2.06			
Pregnancy history				
No	1	0.06–0.41	6.54	$p < .001$*
1–3	0.16	0.08–0.72		.011*
≥4	0.24			

Note: CI: Confidence interval.
*$p < .05$.

2013; Piao et al. 2015). We hypothesized that this relationship might be caused by the low rate of educated women included in the study, osteoporosis history in the family, low socio-economic level of women, and possibly different eating habits. Increasing wealth and education in developing countries might lead to change from the traditional, but healthy behaviors, toward less healthy life styles,

including a reduction of regular physical activity (Grgurevic, Gledovic, and Vujasinovic-Stupar 2010).

Our results have shown that, along with the postmenopausal period, osteoporosis risk factors might have been prevalent among young fertile women aged 18–49 years. This result was important for educating young women about appropriate behaviors to prevent osteoporosis.

Study strengths and limitations

While epidemiologic (large population) studies have established the importance of demographic and medical characteristics related to increased risk for osteoporosis, they had a number of limitations. The present study had both strengths and weaknesses. One strength of the study was the inclusion of BMI measurement. Relying upon participant's recollection of previous height or height loss can often be inaccurate. To overcome this problem, height and weight were measured in specialty clinics for moderate and high-risk populations while participants were standing, wearing light clothing, and no shoes. The second strength of the study was that the ORES was used as a cost-effective primary diagnostic instrument for identification of osteoporosis risk in women. It is the only population-based scale that has been developed with known sensitivity and specificity for assessing osteoporosis risk factors in primary health-care institutions.

The study also had limitations. First, because all participants were volunteers, they may have had more interest in their health or be healthier than the general population and thus may not be representative of the general population, resulting in reduced generalizability of results. The second limitation was that not all of the parameters which could affect bone mass were included in this study, such as gender, mental evaluation, clinical examination of risk factors, biochemical markers of bone metabolism, and genetic risk factors, which may have played a role in detecting osteoporosis risk, thus potentially resulting in inadequate control of confounding. Despite these limitations, BMD remains the single best predictor of fracture risk available today (Unnanuntana et al. 2010). Lastly, forearm BMD measurement could be done for predicting osteoporosis risk at other sites, but in this study the National Osteoporosis Foundation recommendations were used with the mean score for the L1 to L4 vertebrae to calculate spine BMD. The International Society of Clinical Densitometry also states that BMD at the femoral neck is the best predictor of hip fracture.

Conclusion

Our study determined that most women aged 18–49 years had osteoporosis risk factors. Women who smoked, had light skin color, were multigravida,

and had a family history of osteoporosis were identified to carry high risk for osteoporosis ($p < .05$).

It is important to initiate awareness regarding osteoporosis, to control the medical or behavioral risk factors, and to spread training and consultancy services for women, especially for the young and those who were included in risk groups. In this context, it is recommended that strategies be developed to protect bone health in our country. These strategies need to be implemented effectively and we need to ensure their sustainability. More epidemiologic research regarding young women susceptible to osteoporosis risk factors should also be explored. Health-care professionals need to be aware of a number of potential risk factors to decrease the burden of bone disease in the population.

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