Determination of osteoporosis risk factors using a multiple logistic regression model in postmenopausal Turkish women

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ABSTRACT

Objectives: To determine the risk factors of osteoporosis using a multiple binary logistic regression method and to assess the risk variables for osteoporosis, which is a major and growing health problem in many countries.

Methods: We presented a case-control study, consisting of 126 postmenopausal healthy women as control group and 225 postmenopausal osteoporotic women as the case group. The study was carried out in the Department of Physical Medicine and Rehabilitation, Dicle University, Diyarbakir, Turkey between 1999-2002. The data from the 351 participants were collected using a standard questionnaire that contains 43 variables. A multiple logistic regression model was then used to evaluate the data and to find the best regression model.

Results: We classified 80.1% (281/351) of the participants using the regression model. Furthermore, the specificity value of the model was 67% (84/126) of the control group while the sensitivity value was 88% (197/225) of the case group. We found the distribution of residual values standardized for final model to be exponential using the Kolmogorow-Smirnow test (p=0.193). The receiver operating characteristic curve was found successful to predict patients with risk for osteoporosis. This study suggests that low levels of dietary calcium intake, physical activity, education, and longer duration of menopause are independent predictors of the risk of low bone density in our population.

Conclusion: Adequate dietary calcium intake in combination with maintaining a daily physical activity, increasing educational level, decreasing birth rate, and duration of breast-feeding may contribute to healthy bones and play a role in practical prevention of osteoporosis in Southeast Anatolia. In addition, the findings of the present study indicate that the use of multivariate statistical method as a multiple logistic regression in osteoporosis, which maybe influenced by many variables, is better than univariate statistical evaluation.

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Osteoporosis has recently been recognized as a major public health problem by some governments and health care providers. The number of men and women aged 65 years and older, will increase steadily and the most dramatic changes will occur in the very elderly, in whom the incidence of osteoporotic fracture is greatest in the European community.[1] As the population gets older, morbidity, mortality, and financial costs attributed to osteoporosis are expected to rise. The economic costs related to osteoporotic fractures are substantial and will almost certainly increase further unless effective preventive interventions are widely implemented.[2] We achieve the peak bone mass soon after puberty, and our bone is lost with various "insults", including ageing and postmenopausal

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changes. Factors influencing peak bone mass and loss range from nutrition, to lifestyle, to certain medical disorders. Educational level may also have an effect on bone mineral density as there is relationship between educational level and reproductive factors such as pregnancy and lactation and other lifestyle factors.[3-7] Early menopause or premenopausal estrogen reduction may increase the risk of osteoporosis. Inadequate intakes of calcium and vitamin D, sedentary lifestyle, tobacco, and alcohol abuse may also add to this condition. Secondary osteoporosis is a consequence of chronic conditions that contribute to an accelerated bone loss. Some of these chronic conditions include: endogenous and exogenous thyroxine excess, cancer, hyperparathyroidism, gastrointestinal diseases, medications, connective tissue diseases, renal failure, and a variety of other conditions.[8] As bone mineral density (BMD) is such an important predictor of future fracture, concerted efforts have been undertaken to understand the factors that influence BMD. However, these efforts have been complicated by the need to consider the dynamic properties of bone growth, as bone density at any given point in time reflects the cumulative balance of processes contributing to bone formation and bone resorption. Nevertheless, epidemiologic studies have revealed a number of environmental and lifestyle factors to be associated with reduced BMD, such as lean body size, cigarette smoking, steroid use, nutritional deficiency, and early menopause.[9,10] However, at least some of this ethnic variability can likely be accounted for by ethnic differences in other known risk factors for BMD, such as body size.[11]

Logistic regression is presented as the statistical method of choice for analyzing the effects of independent variables on a binary dependent variable in terms of the probability of being in one of its 2 categories versus the other.[12] Many methods have been proposed in regression models for variable selection. Classical methods for variable selection include forward selection, backward elimination, and stepwise regression.[13] The aim of this study is to determine the risk factors of osteoporosis using multiple binary logistic regression method, as this method is better than univariate logistic regression model when multiple risk factors were used. We obtained adjusted odds ratio of risk factors from multiple logistic regression model but univariate model gives crude odds ratio of risk factors. The values of sensitivity and specificity of final model were calculated to explain the results clearly.

Methods. The study was presented as a case-control study design and was carried out in the Department of Physical Medicine and Rehabilitation, Dicle University, Diyarbakir, Turkey between 1999-2002. The study protocol was reviewed and approved by the Dicle University Ethics Committee, and informed consent was obtained from all participants. The control group consists of 126 healthy women while the case group includes 225 women with osteoporosis. The data for all 351 individuals were collected using a standard questionnaire form, which contained 43 variables, of which 9 were continuous, 34 were categorical. The variations were eliminated between individuals who were in case and control groups by age and life conditions. In order to standardize the procedure, the patients and healthy controls answered the same specially developed questionnaire supervised by the physician (revised from the MEDOS Form).[14] A standardized interview was used during follow-up visit to obtain information on demographic, life-style, reproductive and menstrual histories, such as age at menarche, age at menopause, number of pregnancies, number of abortions, duration of menopause, duration of fertility, and duration of lactation. A total of 225 postmenopausal osteoporotic women, at 40-86 years of age (mean age of 62.38 $\pm$ 8.21 years) were considered. Bone mineral density of the spine and hip (neck and trochanter) were measured by dual-energy x-ray absorptiometry (NORLAND, 6938 CE, New York, USA). According to WHO[15] osteoporosis was defined as a lumbar BMD value more than 2.5 SD below the T-score, corresponding to 0.759 g/cm^2.[16] The variation coefficient for consecutive determinations on spine and femur images in our laboratory was 1.9% at the lumbar spine and 1.6 % at the femur region. All spinal scans were reviewed for evidence of vertebrae with collapse or focal sclerosis by an experienced radiologist. The following exclusion criteria were applied in selecting the sample subjects for further analyses: 1. fractures after the age of 25 years; 2. menopause before the age 40 years; 3. secondary amenorrhea greater than 6 months; 4. chronic conditions affecting bone density such as thyrotoxicosis and anorexia nervosa and 5. any use of corticosteroids. All patients were free from any past or present disease (hypercortisolism, thyrotoxicosis, hyperparathyroidism diabetes mellitus malabsorption) or medications (corticosteroids, estrogens) known to affect bone.

The level of education is categorized in 6 groups according to the number of school years and the highest qualification received; illiterate, literate, primary school (5 years), middle school (3 years), high school (3 or 4 years), university (4-6 years). Body mass index (BMI; weight/height^2) was obtained through height and weight measurements using a wall-mounted ruler and a digital scale. Recent dietary calcium intake (past 12 months) was assessed using standardized food models to estimate

portion sizes.[17] Dietary calcium intakes were analyzed in 2 groups as inadequate (<500 mg/day) and adequate (500-1000 mg/day).[18] The number of drinks consumed per week in the past 30 days, was used as the measure of current alcohol consumption (never use, very rare, frequently). Women who had smoked at least 10 cigarettes per day during the 5 postmenopausal years were classified as smokers.[18] All patients classified, in terms of their reported current and life long smoking, into such group: 1. never use, 2. less than 1 packet, 3. 1-2 packet, and 4. more than 2 packets per day. They were also classified, in terms of their reported current and life-long caffeine use, into such groups: 1. never use, 2. 2 or below cup caffeinated coffee per day, 3. 3 or more cups caffeinated coffee per day. Physical activity is assessed by inquiring number of 20-minutes sessions of leisure-time physical activity per week and physically active behavior, which is defined as participation in more than 2 sessions per week; job-related physical exercise is not taken into account.

The multiple logistic regression model. The multiple logistic regression model was used to evaluate the data collected and to find the best regression model. Furthermore, sensitivity, specifity, Kolmogorow-Smirnow test and the receiver operating characteristic (ROC) curves were used to interprete the data. Consider a collection of p independent variables, which will be denoted by the vector $x^1 = (x_1, x_2,....,x_p)$. Assume for the moment that each of these variables is at least interval scaled. Let the conditional probability that the outcome is present be detoned by:[10]

$$\Pr(\text{Osteoporosis} \mid X) = \frac{e^{g(x)}}{1 + e^{g(x)}}$$

in this model;

$$g(X) = \beta_o = \beta_1 x_1 + ... + \beta_k x_k + \varepsilon_i$$

g(X) : Predictor variables is a linear function and is referred to as logit function
X : Predictor or risk factors in **Table 1 & Table 2**
β_1 : Partial slopes or regression coefficient

Given the data, the first task in multiple regression is to specify a model, the mathematical form of the prediction equation. The simplest model takes each predictor, multiplies it by a numerical weight (coefficient), and adds the resulting quantities to an intercept term.
ε_i : Error term includes the effects of unpredictable and ignored factors.

Results. In this study, 43 variables were examined to obtain the statistical results. We presented descriptive statistics for 34 categorical variables (count and percent) (**Table 1)** and the mean ± SD for 9 continuous variables (**Table 2).**

To elaborate the multiple logistic regression model, firstly, these 43 variables were included into the model, and then, those variables, which were found to have had no significant relationship with osteoporosis through backward-LR method were excluded from the model. After the elimination of variables, a total of 23 variables remained in the model, 2 of which were continuous and 21 of which were categorical variables. The -2Log-likelihood value of obtained final model was 281.4, which was found to be statistically significant (p=0.0001). The variables remaining in this model are referred to as risk factors of osteoporosis. The results obtained in view of these risk factors as well as their hypothesis controls are given in **Table 3**. Odds ratio (OR) values are adjusted OR values since variables were included into the model at the same time. However, OR values calculated in **Table 1** are crude OR values. **Table 3** shows the results of risk factors in final model and hypothesis test. When smoking habit is taken into account, those smoking one packet or more daily were taken as reference category, and it was observed that non-smokers and those smoking less than half packet a day had less osteoporosis risk; however, there was not any significant difference between reference category and those smoking-packet a day. As for alcohol intake, those not drinking alcohol were taken as reference category, and those drinking infrequently were determined to have significantly less risk with respect to non-drinkers (p=0.033). However, those drinking frequently were found to carry 1.795 times higher osteoporosis risk with respect to non-drinkers. Those drinking 7 or more glasses of tea were chosen as reference group, and non-drinkers and those drinking 1-2 glasses of were determined to carry osteoporosis risk 2.67 and 2.54 times higher than reference group. On the other hand, no significant difference was observed between those drinking 3-4, 5-6 and 7 or more glasses of tea daily. In view of coffee intake, those never drinking were taken as reference group was chosen as reference category, and those drinking one cup of coffee and those drinking 2 or more cups of coffee were established to carry osteoporosis risk 2.55 and 3.62 times higher, respectively. However, there was not any significant difference between those drinking rarely and reference category in terms of the disease risk. When **Table 3** is examined, the education level is seen to be an effective factor on osteoporosis. The illiterates of this risk factor were selected as reference category. In this case, it can be said that literate, namely; those who graduated from elementary and high schools, have significantly much less osteoporosis risk with respect to illiterates, whereas university graduates do not have the risk. Another risk factor is marital status, when

Table 1 - Descriptive statistics for categorical variables among female cases of osteoporosis and their controls in Diyarbakir, Turkey (1999-2002 years).

Categorical variables	Osteoporosis n (%)	Control n (%)
Occupation		
Housewife	185 (82.2)	100 (79.4)
Other	40 (17.8)	26 (20.6)
Education Level		
Illiterate	57 (25.3)	24 (19)
Literate	24 (10.7)	12 (9.5)
Primary school	76 (33.8)	46 (36.5)
Middle school	28 (12.4)	16 (12.7)
High school	20 (8.9)	26 (20.6)
University	20 (8.9)	2 (1.6)
Marital status		
Unmarried	8 (3.6)	10 (7.9)
Married	149 (66.2)	88 (69.8)
Divorce	68 (30.2)	28 (22.2)
Skin color		
Swarthy	52 (23.1)	36 (28.6)
Blonde	143 (63.6)	68 (54)
Auburn	30 (13.3)	22 (17.5)
Eye color		
Brown	175 (77.8)	96 (76.2)
Hazel	40 (17.8)	14 (11.1)
Blue	6 (2.7)	14 (11.1)
Green	4 (1.8)	2 (1.6)
Body mass index		
Overweight	55 (24.4)	22 (17.5)
Normal	96 (42.7)	74 (58.7)
Underweight	74 (32.9)	30 (23.8)
Place of living at childhood		
Village	122 (54.2)	74 (58.7)
Small town	39 (17.3)	22 (17.5)
City	64 (28.4)	30 (23.8)
Place of living at adolescent		
Village	138 (61.3)	82 (65.1)
Small town	53 (23.6)	28 (22.2)
City	34 (15.1)	16 (12.7)
Place of living at adult		
Village	188 (83.6)	112 (88.9)
Small town	17 (7.6)	6 (4.8)
City	20 (8.9)	8 (6.3)
Premenopausal status		
Regular	161 (71.6)	94 (74.6)
Irregular	64 (28.4)	32 (25.4)
Menopausal status		
Normal	175 (77.8)	108 (85.7)
Iatrogenic	50 (22.2)	18 (14.3)
Use of oral contraceptives		
Yes	10 (4.4)	22 (17.5)
No	215 (95.6)	104 (82.5)
Use of estrogen at postmenopause		
Estrogen (yes)	18 (8)	8 (6.3)
Estrogen (no)	207 (92)	118 (93.7)
Liver disease		
Yes	8 (3.6)	6 (4.8)
No	217 (96.4)	120 (95.2)
Kidney disease		
Yes	10 (4.4)	4 (3.2)
No	215 (95.6)	122 (96.8)
Physical activity at childhood		
Inactive	28 (12.4)	22 (17.5)
Mildly activity	122 (54.2)	76 (60.3)
Serious activity	75 (33.3)	28 (22.2)
Physical activity at adolescent		
Inactive	32 (14.2)	22 (17.5)
Mildly activity	106 (47.1)	58 (46)
Serious activity	87 (38.7)	46 (63.5)

Table 1 - *continuation*

Categorical variables	Osteoporosis n (%)	Control n (%)
Physical activity at adult		
Inactive	66 (29.3)	42 (33.3)
Mildly activity	114 (50.7)	52 (41.3)
Serious activity	45 (20)	32 (25.4)
Use of nonsteroidal anti-inflammatory drugs		
Used	105 (46.7)	64 (50.8)
Never used	120 (53.3)	62 (49.2)
Use of antidiabetic drugs		
Used	22 (9.8)	203 (90.2)
Never used	14 (11.1)	112 (88.9)
Use of antihypertension drugs		
Used	54 (24)	22 (17.5)
Never used	171 (76)	104 (82.5)
Use of cardiovascular disease drugs		
Used	8 (3.6)	217 (96.4)
Never used	2 (1.6)	124 (98.4)
Use of corticosteroids		
Used	2 (0.9)	2 (1.6)
Never used	223 (99.1)	124 (98.4)
Use of hyperthyroidism drugs		
Used	- -	225 (100)
Never used	4 (3.2)	122 (96.8)
Vegetable		
Sufficient	203 (90.2)	112 (88.9)
Insufficient	22 (9.8)	14 (11.1)
Protein		
Sufficient	164 (72.9)	94 (74.6)
Insufficient	61 (27.1)	32 (25.4)
Carbohydrate		
Sufficient	193 (85.8)	104 (82.5)
Insufficient	32 (14.2)	22 (17.5)
Fat		
Sufficient	191 (84.9)	106 (84.1)
Insufficient	34 (15.1)	20 (15.9)
Milk		
Sufficient	116 (51.6)	62 (49.2)
Insufficient	109 (48.4)	18 (50.8)
Sunlight		
Absent	24 (10.7)	56 (14.3)
Little	115 (51.1)	48 (44.4)
Middle	76 (33.8)	4 (38.1)
Much	10 (4.4)	110 (3.2)
Cigarette		
Never used	191 (84.9)	6 (87.3)
1/4 pack/day	10 (4.4)	2 (4.8)
1/2 pack/day	10 (4.4)	8 (1.6)
1 pack/day	14 (6.2)	66 (6.3)
Coffee		
Never used	121 (53.8)	50 (52.4)
Rare	72 (3)	6 (39.7)
1 cup/day	28 (12.4)	4 (4.8)
2 cups/day	4 (1.8)	114 (3.2)
Alcohol		
Never used	215 (95.6)	8 (90.5)
Rarely	4 (1.8)	4 (6.3)
Frequently used	6 (2.7)	(3.2)
Tea		
Never used	20 (8.9)	8 (6.3)
1-2 glass/day	68 (30.2)	28 (22.2)
3-4 glass/day	76 (33.8)	44 (34.9)
5-6 glass/day	40 (17.8)	24 (19)
≥7 glass/day	21 (9.3)	22 (7.5)

Table 2 - Descriptive statistics for continuous variables (Mean ± SD) among female cases of osteoporosis and their controls in Diyarbakir, Turkey (1999-2002 years).

Variables	Mean + SD
Age at menarche	
Osteoporosis	13.93 ± 1.23
Control	13.79 ± 1.30
Age at menopause	
Osteoporosis	44.86 ± 6.33
Control	46.21 ± 6.02
Duration of fertility	
Osteoporosis	30.93 ± 6.49
Control	32.41 ± 6.08
Age	
Osteoporosis	61.86 ± 7.23
Control	59.38 ± 7.67
Duration of postmenopause	
Osteoporosis	16.99 ± 8.41
Control	13.17 ± 7.90
Number of live births	
Osteoporosis	3.72 ± 2.26
Control	3.62 ± 2.62
Number of still birth	
Osteoporosis	0.18 ± 0.66
Control	0.14 ± 0.47
Number of abortions	
Osteoporosis	1.04 ± 1.80
Control	0.83 ± 1.18
Number of total pregnancy	
Osteoporosis	4.86 ± 3.68
Control	4.52 ± 3.37

Table 3 - Risk factors and its hypothesis test results in final model among female cases of osteoporosis and their controls in Diyarbakir, Turkey (1999-2002 years).

Risk Factors	*P*-value	OR (95% Confidence interval)
Education		
Illiterate (R)	-	- -
Literate	0.012	0.161 (0.039 - 0.664)
Primary school	0.006	0.253 (0.094 - 0.680)
Middle school	0.148	0.384 (0.105 - 1.404)
High school	0.000	0.033 (0.006 - 0.170)
University	0.346	2.761 (0.334 - 22.850)
Marital status		
Unmarried	0.005	0.085 (0.015 - 0.474)
Married	0.072	0.431 (0.172 - 1.080)
Divorce (R)	-	- -
Eye color		
Brown	0.059	10.763 (0.916 - 126.491)
Hazel	0.011	34.213 (2.269 - 515.909)
Blue	0.449	0.334 (0.020 - 5.708)
Green (R)	-	- -
Place of living at youth		
Village	0.012	4.715 (1.410 - 15.765)
Small town	0.240	2.133 (0.604 - 7.542)
City (R)	-	- -
Age at menopause	0.001	0.895 (0.838 - 0.955)
Age	0.000	1.134 (1.071 - 1.200)

Table 3 - *continuation*

Risk Factors	*P*-value	OR (95% Confidence interval)
Premenopausal status		
Normal	0.003	0.209 (0.074-0.593)
Iatrogenic (R)	-	- -
Use of oral contraceptives		
Yes	0.001	0.096 (0.023-0.391)
No (R)	-	- -
Menopausal status		
Estrogen (Yes) (R)	-	- -
Estrogen (No)	0.050	0.183 (0.033-1.00)
Kidney disease		
Yes (R)	-	- -
No	0.006	0.017 (0.001-0.315)
Physical activity at childhood		
Inactive	0.039	0.172 (0.032-0.919)
Mildly activity	0.039	0.325 (0.112-0.943)
Serious activity (R)	-	- -
Physical activity at adolescent		
Inactive	0.161	2.887 (0.656-12.707)
Mildly activity	0.332	1.134 (1.103-8.905)
Serious activity (R)	-	- -
Use of nonsteroidal anti-inflammatory drugs		
Used	0.064	0.463 (0.206-1.045)
Never used (R)	-	- -
Use of antidiabetic drugs		
Used	0.004	0.180 (0.056-0.586)
Never used (R)	-	- -
Use of antihypertension drugs		
Used (R)	-	- -
Never used	0.051	0.377 (0.142-1.004)
Vegetable		
Sufficient (R)	-	- -
Insufficient	0.002	0.138 (0.040-0.473)
Protein		
Sufficient	0.046	0.443 (0.199-0.987)
Insufficient (R)	-	- -
Carbohydrate		
Sufficient (R)	-	- -
Insufficient	0.050	0.319 (0.100-1.00)
Fat		
Sufficient (R)	-	- -
Insufficient	0.005	5.418 (1.659-17.697)
Cigarette		
Never used	0.002	0.089 (0.020-0.401)
1/4 pack/day	0.000	0.015 (0.001-0.149)
1/2 pack/day	0.274	6.005 (0.243-148.598)
1 pack/day (R)	-	- -
Coffee		
Never (R)	-	- -
Rare	0.313	0.78 (0.49-1.26)
1 cup/day	0.049	2.55 (1.00-6.46)
2 cups/day	0.022	3.62 (0.13-2.25)
Alcohol		
Never (R)	-	- -
Very rare	0.033	0.265 (0.08-0.90)
Frequently	0.041	1.795 (0.22- 2.88)
Tea		
Never	0.049	2.67 (1.10-7.23)
1-2 glass/day	0.014	2.54 (1.21-5.35)
3-4 glass/day	0.099	1.81 (0.89-3.66)
5-6 glass/day	0.163	1.75 (0.79-3.82)
≥ 7 glass/day (R)	-	- -

(R) - Reference category of variable

the divorced or widowed are taken into consideration as reference category, never-married ones are less likely to have osteoporosis risk than the divorced or widowed ones; however, it was observed that there was not any significant difference between the married and divorced or widowed in terms of the risk to get osteoporosis. Furthermore, of all the variables, only age for menopause and age of individuals were observed to have a significant risk in the development of the disease, and it was seen that, as the age for menopause increased, the risk of getting the disease diminished; in addition, as the age of individuals increased, the risk of osteoporosis was determined to increase 1.134 times. We also established less likelihood of osteoporosis risk in those experiencing a normal menopause than those who are iatrogenic, in those using contraceptive than non-users, in those using estrogen dewing post-menopause then non-users in those with renal disorders than those without and in those engaged in sedentary and inactive daily activities during childhood those engaged in heavy labors. During adulthood, any significant difference was not observed for daily activity. In addition, it was determined that those using antidiabetic drugs had less osteoporosis risk than non-users.

In eye color, those with green eye were taken as reference, and it was determined that the light-brown eyed ones had 34.213 times more osteoporosis risk with respect to the green eyed ones, and that the brown eyed ones were close to the significance level for the disease risk. Nevertheless, no significant relationship was observed to exist between the blue and green eyed ones. The place of settlement during adulthood was observed to have a risk, and that those living in rural areas had 4.715 times more osteoporosis risk than those living in urban areas; on the other hand, no significant difference was found between the persons living in towns and those in city centers for the risk to get the disease. Those persons consuming vegetables and carbohydrates inadequately had considerably less risk of getting the disease, but those consuming adequate protein were found to carry less risk with respect to those not consuming. In the study, it was observed that those subjects taking inadequate fat had 5.418 times more risk of the disease. The classification of all individuals by final model has been performed as 80.1% (281/351). Furthermore, the specificity value of the model was 67% (84/126) while the sensitivity values of the model was 88% (197/225). The distribution of residual values standardized for final model was found exponential distribution by using Kolmogorow-Smirnow test (p=0.193) (**Figure 1).** A ROC curve is presented in **Figure 2,** according to the values of the probability for individuals taking into account 23 risk variables for final model. This ROC curve was found successful to predict the patients. The area under the curve was area ± SEM = 0.88 ± 0.018 and was found statistically significant.

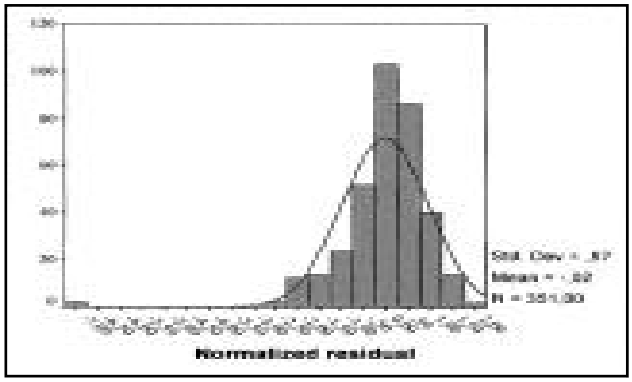

Figure 1 - The distribution of residual values for final model.

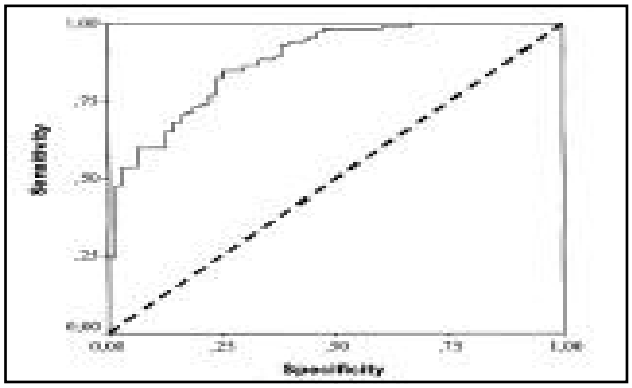

Figure 2 - Receiver operating characteristic curve for final model.

Discussion. Multivariate statistical methods are very important for the analysis and interpretation of medical studies, especially to identify the causes and the effects of a certain disease. Osteoporosis, which is known to be a disease of modern societies, is due to the fragility of bone structure. Osteoporosis is a major health problem, especially among women. The basic factors that determine a women's susceptibility to low bone are the peak bone mass, which is achieved during adolescence and early adulthood, and the bone loss associated with menopause and increasing age. Many behavioral factors are believed to be a determinants of bone mass and bone mineral density. Large European epidemiological studies demonstrated noticeable variations in hip fracture incidence, vertebral fracture prevalence and bone mass values, not only among countries, but also have reported parallel variations in both genders, with a higher fracture risk in northern countries and a lower risk in the Mediterranean area.[14,19] These results suggest that,

besides genetic characteristics, lifestyle and environmental factors play a pivotal role in influencing fracture risk.[20] In an attempt to guide the bone densitometry measurements, several international epidemiological surveys in different parts of the world have extensively analyzed potential osteoporosis risk factors, including demographic and social information, personal medical history, maternal and paternal history of bone fracture after the age of 50 years, smoking habit, alcoholic beverage consumption, calcium intake and present and past physical activities.[21-24] Conclusions obtained from these studies were controversial according to various ethnic groups. Therefore, extrapolation of these findings to our population and implementation in our routine clinical evaluation is not necessarily valid. In particular, factors such as menstrual, obstetric and lactation history, and their long term effect on BMD in postmenopausal period have not been intensively analyzed or described in a multiparous women population. Previous international publications on these issues suggest that premenopausal amenorrhea[25] is a potential risk factor for low postmenopausal BMD, as well as loss of maternal minerals during pregnancy and lactation.[4,5,26-28] There is a few study carried out in our country and especially in our region on osteoporosis risk factors. Due to this reason we have add different risk factors, which differ from the above-mentioned factors.

Epidemiological evidences suggest that lifestyle factors such as consumption of alcohol, tobacco, coffee, and tea have effects on bone density. Health behaviors like smoking, alcohol consumption and caffeine intake affect large numbers of people and are therefore potentially important from a public health perspective even if the effect on fracture risk is modest.[29] The evidence concerning smoking in relation to BMD is equivocal. Several studies have reported an inverse association[30,31] that has been attributed to the estrogen reducing effect of smoking, but several others have not.[32-34] The same uncertainty applies to alcohol intake, which has been reported to be inversely associated[30,31,35,36] or unrelated[32-34] to BMD. The association of BMD on the other hand, with coffee or caffeine containing beverages [for example tea] has been explored in fewer studies; some of them have reported an inverse relations[36,37] but others did not support the existence of an association.[33] Moreover, tea that also contains caffeine appears to be associated with a decrease in hip fracture risk, perhaps related to the presence of estrogenic flavinoids.[38] Although mechanisms of association between education and osteoporosis remain partly unexplained, most of the risk factors examined have shown distinct trends according to educational level. Although educational level may be an imperfect measure for socio-economic status, many studies have clearly established that this marker acts as a good predictor not only for most chronic diseases[39-41] but also for many related risk factors.[42,43] Varenna et al[44] evaluated 6,160 postmenopausal women referred for their first densitometric evaluation and they found that age at menarche, past exposure to oral contraceptives, prevalence of chronic diseases, physical activity, overweight, and smoking showed significant trends according to years of education. Also, as they had a cohort of postmenopausal women as the study group, they could show differences in the prevalence of osteoporosis among educational classes and the protective role played by increases in formal education. Magnus et al[45] undertook a random sample of 1,514 Norwegian women and men to investigate knowledge of osteoporosis and attitudes towards methods for preventing this disease, and they concluded that in both men and women, increased knowledge of osteoporosis was correlated to a high level of education. In several studies, authors have found that reproductive history has an inverse relation to bone density.[3-6,46-53] The bone density is adversely affected by both high rate of live birth and long period of breast-feeding, common in the region where this study was carried out. In our previous study,the lower birth rate and short period of breast-feeding was found with the group having university or high school degree and may suggest that both birth rate and the breast-feeding period may be associated with educational level. Furthermore, the calcium intake in the group with highest educational level was also found to be considerably higher than that of the other groups. The higher BMD values found in the group of highest educational level, may be attributed to the sufficient amount of calcium intake.[54]

In another study, we detected significantly lower essential element, like magnesium, copper and zinc in postmenopausal osteoporotic women than that of postmenopausal healthy women.[55] Due to this findings, diet habit should also be kept in mind. In another study, which was recently published, we also found significant relationship between the numbers of teeth and bone mineral density.[18] We detected significant low BMD in patients who have no teeth in contrast to patients who have more than 10 teeth. Dietary intake of calcium, vitamin D, dairy products, protein, and sodium, as well as supplemental calcium have been evaluated to be association with peak BMD or its loss, with no consensus.[18,56-58] This study suggests that low levels of dietary calcium intake, physical activity, education, and longer duration of menopause are independent predictors of the risk of low bone density in the our population. Adequate dietary calcium intake in combination with maintaining a daily physical activity, increasing educational level,

decreasing birth rate, and duration of breast-feeding may contribute to healthy bones and play a role in practical prevention of osteoporosis in Southeast Anatolia. In addition, the findings of the present study indicates the use of multivariate statistical method as a multiple logistic regression in osteoporosis that could be influenced by many variables is better than univariate statistical evaluation.

In conclusion, univariate analysis should also be calculated. Sometimes, due to multicollinearity problem, important variables are dropped out from the final model. However, univariate analysis identify those important variables.

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