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# Studying the Factors Affecting Osteoporosis in Women with the Logistic Regression Analysis

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**Abstract:** The purpose of this investigation is to study the factors affecting osteoporosis in women with the logistic regression analysis in order to evaluate the effect of those risk factors. The age of women ranged between 40-70 years. A questionnaire was prepared for this study and the questions were directed to patients. The research was conducted on a total of 250 patients. As the dependent variable is in a categorical data type with two levels, binary logistic regression analysis was applied. According to the analysis results, such factors as age, weight, calcium amount of the individual, duration of the exercise, genetic factors, being in menopause and smoking have significant effect pushing individuals towards being osteoporotic. In order to prevent osteoporosis, a person should lose weight, increase weekly exercises, be careful about the calcium amount in her body and reduce smoking. particularly elder ones.

**Key words:** Osteoporosis · Risk Factors · Menopause · Smoking · Weight

## INTRODUCTION

Osteoporosis is the structural deficiency of bones and a systemic skeletal disorder characterized by an increase in bone fragility and susceptibility to fracture as a result of low bone mass and the deterioration of micro-architecture of bone tissue [1-5]. Osteoporosis is also defined as a skeletal disorder characterized by fatal loss which makes the person vulnerable to increased fracture risk regarding the bone strength [6, 7] and the two important factors constituting the bone strength are bone density and bone quality [8].World Health Organization (WHO) defined OP according to the dual Energy X-Ray Absorbsiometry (DEXA) measurement [4, 9]. Accordingly, if bone mineral density and bone mineral content is below 1 standard deviation for young adults, it is accepted as normal; BMD (Bone Mineral Density) between -1 and -2.5 SD (Standard Deviation) for young adults is called Osteoporosis and BMD being more than -2.5 SD (for young adults and presence of one or more than one fracture is called established osteoporosis [4, 10]. An increase in bone fragility in OP (Osteoporosis) causes an increase in morbidity and mortality [2, 4]. According to the criteria of WHO, women aged 50 and over are diagnosed with osteopenia between the ranges of 34-50% and osteoporosis between the ranges of 17-20%. Women aged 50 and over can face with a fracture caused by osteoporosis at a rate of 40% [11]. All over the world, one-third of the women aged between 60 and 70 and two-third of the women aged 80 and over is osteoporotic [12]. Osteoporosis-dependent fractures are mostly seen in vertebras, proximal femur and radius distal and around the shoulder in humerus. Shortening in stature which is seen in osteoporotic patients is an important clue for the diagnosis of the disorder. The reason is the compression fractures in vertebras. Patients may experience 10-15 cm of shortening in stature in comparison to the length in their youth. When osteoporotic fractures occur in vertebras, patients suffer from severe back pains. When the number of these

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fractures increases more in time, serious amount of shortening is seen in stature of those osteoporotic individuals and even thoracic kyphosis occurs [11]. Osteoporosis-dependent fractures increase mortality and they even cause pain, being dependent on someone else, failure to walk, depression and the obligation of living in nursing centers [8, 3-18].

**Classification of Osteoporosis:** A lot of classifications can be made in osteoporosis [19-23].

**By Age:**

- Juvenile: It is rare. It is generally observed in little children with a fast growth before puberty. There is no family history or known cause.
- Adult: It is rare. It is observed in premenopausal women and young men. It is impossible to find the primary cause.
- Senile: It is observed in people aged 75 and over. The osteoporosis-dependant fracture is hip fracture [21, 22 and 24].

**By localization:**

- General: Mass decrease is observed in all bones of the body [21].
- Local: There is always and underlying cause like immobilization [21]. The causes of local osteoporosis are: Fractures, Immobilization, Rheumatoid arthritis, Osteomyelitis, Primary and secondary tumors, Algodystrophy (Reflex sympathetic dystrophy), Muscular paralysis, Temporaryosteoporosis of hip, Tendon rupture or denervation, Sickle cell anemia, Alkaptonuria [23].

**By Etiology:** Classification of osteoporosis by etiologyand definition of a secondary cause of osteoporosis will be able to enable a specific treatment of this special cause [3, 25].

- Primary: There is no underlying disease or cause [21, 26].
- Secondary: There may be many underlying diseases or causes such as endocrine causes, gastrointestinal disorders, connective tissue diseases, immobilization, malign diseases, drug utilization [21, 26].

**By Involved Bone Tissue:**

- Trabecular, b) Cortical [21-23, 26].

**Factors Afecting Osteoporosis In Women:** The more risk factors are for all postmenopausal women, the higher the fracture risk is. Most of the structural and genetic factors are the risk factors that cannot be changed. The most important factor in OP is peak bone mass and bone loss. These two factors are both related to genetic and environmental changes. Knowing the factors affecting osteoporosis frequently enables understanding the decrease in bone density and etiology of fracture composition. These risk factors can also be used in predetermination of the individuals in high risk group and of the patients who can benefit from the protective treatment before the composition of fracture [23, 27]. We can classify the factors affecting osteoporosis in many ways but in general as being a woman (women have less bone structure), aged over 50, eating low calcium foods, less physical activity, mobilization or exercise or amenorrhea. Physical activity has the protective effect on skeleton. Mechanical overload on bone stimulates bone formation. Short and slightly built people with osteoporotic individuals in the family have higher risk for osteoporosis in comparison to the portly and overweight people and body weight is among the important determinants of bone mass. Weight applies mechanical overload on skeleton and has a protective effect due to the estrogen storage of fatty tissue. Fracture risk reduces due to the protective effect of fat pad during falling [10]. Being light-skinned, hormonal levels (early menopause), not giving birth before, surgical menopause, high number of births, long time breast-feeding, using contraceptive pills, being on some medications for a long time or in high doses (corticosteroids, lithium, antacids, anticonvulsants, thyroid drugs), existence of some diseases (diabetes, hyperthyroidism, paralysis, some rheumatic diseases, malign diseases, Koah, lifestyle, dieting, smoking, overconsumption of alcoholic, cola and caffeinated drinks are the main factors affecting osteoporosis [11, 26-30]. The classification about the risk factors related to osteoporosis is stated in Table 1.

According to the agreement made in Canada in 2006, the risk factors affecting osteoporosis were classified as major and minor risk factors (Table 2). As most of the osteoporosis-dependant fractures result from falling, falling risk factors were evaluated [7, 10].

Table 1: Risk Factors Related to Osteoporosis [10, 27 and 29].

| | |
|---|---|
| Factors about lifestyle: | Intake of low level of calcium, vitamin D deficiency, vitamin A surplus, Aluminum (it exists in antacids), Immobilization, Weakness, High amount of caffeine intake, High amount of salt intake, Alcohol (3 or more drinks a day), Inadequate physical activity, smoking (active or passive), |
| Genetic disorders | Cystic fibrosis, Homocystinuria, Osteogenesisimperfecta, Ehlers-Danlos, Hypophosphatasia, Porphyria, Glycogen storage diseases, Idiopathic hypercalciuria, Riley-Day syndrome, Gaucher disease, Marfan syndrome, Hemochromatosis, Menkes syndrome |
| Hypogonadal conditions | Androgen insensitivity, Hyperprolactinemia, Athletic amenorrhea, Anorexia nervosa and bulimia, Panhypopituitarism, Premature ovarian failure, Turner and Klinefelter syndromes, Endocrine disordes, Cushing syndrome, Hyperparathyroidism, Thyrotoxicosis, Adrenal insufficiency, Diabetes mellitus |
| Gastrointestinal disorders: | GI surgery, Malabsorption, Primary biliary cirrhosis, Inflammatory bowel disease, Celiac disease, Pancreas disease, Gastric bypass |
| Hematological disorders: | Haemophilia, Multiple myeloma, Systemic mastocytosis, Leukemia and lymphomas, Sickle-cell anemia, Thalassemia, Rheumatic and autoimmune diseases, Ankylosing spondylitis, Lupus, Rheumatoid arthritis |
| Various conditions and diseases | Alcoholism, Emphysema, Multiple sclerosis, Amyloidosis, End stage renal disease, Muscular dystrophy, Chronic metabolic acidosis, Epilepsy, Bone disease after transplantation, Congestive heart failure, Idiopathic scoliosis, Sarcoidosis, Depression, previous fracture in adulthood |
| Medications | Anticoagulants (heparin), Cancer chemotherapy drugs, Gonadotropin releasing hormone agonists, Anticonvulsants, Cyclosporine A and tacrolimus, Lithium, Aromatase inhibitors, Stored medroxyprogesterone, Parenteral nutrition, Barbiturates, Glucocorticoid (=5 mg/day prednisoneor equivalent usage for =3 months) |

Table 2: Major and Minor Risk Factors [10].

| MAJOR RISK FACTORS 1 | MINOR RISK FACTORS |
|---|---|
| Aged over 65 | Rheumatoid arthritis |
| Compression fracture in vertebra | Clinical hypothyroidism in the past |
| Fragility fracture over the age 40 | Usage of chronic anticonvulsant |
| Osteoporotic fracture history in the family (particularly in mother with low-impact hip fracture) | Calcium deficient nutrition |
| Systemic glucocorticoid usage for more than 3 months | Smoking |
| Malabsorption syndrome | Excessive alcohol intake |
| Primary hyperparathyroidism | Overconsumption of caffeine |
| Inclination to falling | Low body weight (<57 kg) |
| Osteopenia diagnosed with X-ray | Weight loss more than 10% of the body weight at the age of 25 |
| Hypogonadism | Chronic heparin treatment |

## MATERIALS AND METHODS

The purpose of this study is to Study The Factors Affecting Osteoporosis in Women With The Logistic Regression Analysis. The scope of the study is the factors affecting women aged between 40 and 70 to be osteoporotic and the questionnaire was used as method. However, as the dependent variable is in a categorical data type with two levels, binary logistic regression analysis was applied.

## RESULTS

In this study, the factors affecting women aged between 40 and 70 to be osteoporotic were analyzed. A questionnaire was prepared for this study and the below mentioned questions were directed to the subjects. The research was conducted on a total of 250 patients.

The analysis results were evaluated by using the questions in the above table. Whether the subjects are osteoporotic was chosen as the dependent variable. Other variables in the questionnaire were regarded as explanatory variables.

As the dependent variable is in a categorical data type with two levels, binary logistic regression analysis was applied.

Omnibus test results that were carried out regarding the significance of the model for beta coefficients are indicated in the table above. As the significance values of test statistics are $0.00<0.05$, it is concluded that at least one beta coefficient is significant. In conclusion, it can be uttered that the created logistic regression model is significant.

Hosmer-Lemeshow goodness of fit test results are indicated in the table above. As the significance value of Hosmer Lemeshow test statistics is $0.983>0.05$, the model was stated to have goodness of fit.

Table 3: Some questions related to the variables

| Questions | Data Type |
|---|---|
| Are you osteoporotic? | 0=No 1=Yes |
| Age | Quantitative |
| Weight | Quantitative |
| Do you have osteoporosis history in the family? | 0=No 1=Yes |
| Amount of calcium (mg) 800-1200 | Quantitative |
| Weekly exercise duration | Quantitative |
| Have you gone through the menopause? | 0=No 1=Yes |
| Do you smoke? | 0=No 1=Yes |

Tablo 4: Logistic regression analysis

| | | Chi-square | df | Sig. |
|---|---|---|---|---|
| Analysis Model | Step | 29,681 | 7 | ,018 |
| | Block | 29,681 | 7 | ,018 |
| | Model | 29,681 | 7 | ,018 |

Table 5: Hosmer and Lemeshow Test

| Chi-square | df | Sig. |
|---|---|---|
| 1,939 | 8 | ,983 |

Table 6: The logistic regression model and coefficients of determination

| | -2 Log Likelihood | Cox & Snell R Square | Nagelkerke R Square |
|---|---|---|---|
| Value | 344,868 | ,683 | ,715 |

Table 7: Classification ratios regarding the logistic regression model

| | | | Prediction Value | | |
|---|---|---|---|---|---|
| | | | Are you osteoporotic? | | |
| Observed | | | No | Yes | True % |
| Real Value | Are you osteoporotic? | No | 118 | 15 | 88,72 |
| | | Yes | 13 | 104 | 88,89 |
| | Total % | | | | 88,80 |

Log-likelihood value regarding the logistic regression model and coefficients of determination are indicated in the table above. Concerning Cox Snell and Nagelkerke coefficients of determination, it can be concluded that the variable of being osteoporotic can be well explained by explanatory variables. As the coefficients of determinant are much higher than 0.50.

Classification ratios regarding the logistic regression model is indicated in the table above. According to the results obtained, true classification ratio of the model was calculated as 88.80%. As per this value, it was established that the classification power of the model is considerably high.

Parameter prediction results belonging to the coefficients for explanatory variables are indicated in the table above. According to the result of logistic regression analysis and concerning the significance values of test statistics, all explanatory variables have effect on the subjects to be osteoporotic ($p<0.05$). Quantitative evaluations can be carried outconcerning explanatory variables by extracting the square root of beta coefficients. Accordingly, below inferences can be made about logistic regression model:

- When the ages of individuals increase 1 unit, the risk of being osteoporotic increases 8 times approximately.
- When the weight of individuals increases 1 unit, the risk increases 5 times.
- When the calcium amount of individuals increases 1 unit, the risk of being osteoporotic decreases by 60% approximately.
- The risk of being osteoporotic for the individuals with osteoporotic people in the family is nearly 6 times higher than the ones without osteoporotic people in the family.
- When the weekly exercise duration of the individuals increases 1 hour on average, the risk of being osteoporotic decreases by 65% approximately.
- The risk of being osteoporotic for the individuals who have gone through menopause is approximately 6 times higher than the ones who haven't.
- The risk of being osteoporotic for the smokers is approximately 2 times higher than the non-smokers.

## DISCUSSION

Osteoporosis is observed in women 5 times more than in men. Such factors as low bone mass and mineral content in women and estrogendeficiency-dependent bone losses increase osteoporosis, therefore being a woman is an important risk factor in terms of osteoporosis [4, 31].

Great contribution was made in determining the individuals prone to osteoporosis as defined according to the DEXA measurements [7]. The purpose of this study is to evaluate the factors affecting osteoporosis. In this study, the relation of the risk factors that are directly related to the personal characteristics with OP was researched and various results were obtained.

In literature, there are few number of studies which study the relation of risk factors with DEXA levels. The current studies are in specific disease groups (like renal failure) [32]. In the research, such factors as whether they are osteoporosis, age, weight, whether osteoporosis exist in the family, the amount of calcium (mg) (800-1200) and weekly exercise time, whether the person has gone

through menopause and smokes were evaluated. The analysis results were evaluated by using those questions. Whether the subjects are osteoporotic was chosen as the dependent variable. Other variables in the questionnaire were regarded as explanatory variables. As the dependent variable is in a categorical data type with two levels, binary logistic regression analysis was applied.

Following our study, it has been concluded that when the ages of individuals increase 1 unit, the risk of being osteoporotic increases 8 times approximately; when the weight of individuals increases 1 unit, the risk increases 5 times; when the calcium amount of individuals increases 1 unit, the risk of being osteoporotic decreases by 60% approximately;the risk of being osteoporotic for the individuals with osteoporotic people in the family is nearly 6 times higher than the ones without osteoporotic people in the family;when the weekly exercise duration of the individuals increases 1 hour on average, the risk of being osteoporotic decreases by 65% approximately; the risk of being osteoporotic for the individuals who have gone through menopause is approximately 6 times higher than the ones who haven't; and the risk of being osteoporotic for the smokers is approximately 2 times higher than the non-smokers.

In current studies containing the risk factors for osteoporosis in literature, it is stated that body mass index has positive effect on bone density, mechanical pressure on bones reduces in case of falling, the estrogen amount due to the deficiency of fat tissue in those people is insufficient in maintaining bone density and osteoporosis risk increases [4, 33]. In a study carried out by Umay *et al.* [4] regarding the effect of osteoporosis risk factors on bone mineral density, it has been concluded that being fat or thin and illiterate, high numbers of pregnancy, insufficient Ca intake and cognitive dysfunctions have effect both on total lumbar and femur neck T scores; excessive consumption of tea and coffee, smoking, at least one comorbidity and additional medication has effect only on femur neck T scores [4]. Our study and the one carried out by Umay *et al.* [4] have similar results. In the only study where the relation between BMI and DEXA levels is evaluated, Ersoyet all. have stated that osteopenia and OP are observed more in correlation to the decrease in BMI in dialysis patients [32]. In another study, the relation between the number of pregnancy and osteoporosis was studied and it has been found out that Ca need of body increases in correlation to the increase in number of pregnancy and accordingly long lactation period leads to osteoporosis [34].

In some studies, excessive intake and abuse of tea/coffee and smoking have been stated as risk factors for OP [35]. It has been determined that tea and coffee intake increases Ca excretion with diuretic effect [36].and smoking negatively affects bone density by causing an increase in blood cortisol levels [7]. This result proves our finding that the risk of being osteoporotic for the smokers is approximately 2 times higher than the non-smokers.

In other studies, it has been stated that additional medication is effective on femur neck T scores and particularly this disease and drug groups have an effect on hip BMI and also some drugs used accelerate OP development and have negative effect on BMI [4, 37-39].

In a study where the relation of dementia, depression and anxiety conditions of patients with balance is studied, it has been put forth that cognitive dysfunction assessed with MMT is related to both static and dynamic balance scores and presence of depression is only related to static balance score, anxiety is not related to balance. In studies of literature where MMT scores of healthy individuals and OP patients are compared, it has been manifested that existing dementia can be an effective factor on bone density [37].

We are of the opinion that the deficiency of our study is that the effects of depression factor, being illiterate factor and drug usage factor on osteoporosis haven't been evaluated in detail.

Some personal characteristics increasing the probability of osteoporosis development and defined as a risk factor may be utilized in determining the individuals prone to osteoporosis [40]. This questionnaire which was carried out in a survey manner has no economic burden at all. In conclusion, it can be uttered that a broad spectrum study of risk factors is required in order to identify the cases with bone loss risk.

## CONCLUSION

In this study, the factors affecting women aged between 40 and 70 to be osteoporotic were analyzed with the technique of logistic regression analysis. According to the analysis results, such factors as age, weight, the amount of calcium, exercise duration, genetic factors, whether the person has gone through menopause and smoking have significant effect on individuals to be osteoporotic.

According to the analysis results, the older and the heavier individuals are, the higher risk for osteoporosis is in question. Concerning the individuals with osteoporotic people in the family, genetic factors increase the risk of

osteoporosis. When the calcium level of individuals reduces, the risk for osteoporosis increases. The more individuals do weekly exercise, the less risk for osteoporosis is. Going through menopause and increase in smoking raise the risk for osteoporosis.

In conclusion, In order to reduce the risk for osteoporosis are losing weight, increasing weekly exercise duration, paying attention to the calcium level in the body and reducing smoking, particularly the individuals being older and going through menopause should be more careful.

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