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The Impact of Practicing Exercise and Risk Factors Categorize in Osteoporotic Concerning Postmenopausal Women (Analytical study using binary logistic regression)

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Abstract

Background: Osteoporosis is an illness that may be categorized as a "silent pandemic" because of its worldwide incidence. The essential characteristics of osteoporosis are bone mass reduction and degeneration in bone tissue's micro-architecture. Postmenopausal osteoporosis (PMO) seems to be the most prevalent skeletal disorder.

Objective: To study investigates the influence of practicing exercise and physical activity as the most critical contributing factors of osteoporosis in postmenopausal women.

Patients and Methods: A cross-sectional survey was conducted at Baghdad Teaching Hospital from July 1, 2021, to December 31, 2021. Data were collected directly through interviews using a special questionnaire. One hundred and fifty postmenopausal women with osteoporosis participated in this study. A rheumatologist clinically diagnosed all participants using a bone density screening (DEXA).

Results: the current study's results indicate the prevalence of osteoporosis among postmenopausal women, with a higher percentage of 69.3% in the age group (≥50 years). 60.7% of all participants were overweight and obese according to body mass index (BMI). Calcium deficiency was found in 87.3% of the subjects, more than two third (76%) of them were not practicing exercises, and 86.7% suffered from vitamin D deficiency. Reclassifying the actual and wrong percentile demonstrates the accurate percentile (overall percentage = 78.7), 32 individuals were wrongly classified, and the probability of total error was reported at around 21.3%. The most important finding was that postmenopausal women with osteoporosis who exercised and participated in physical activity regularly were 13.7 times in better health than those who did not exercise.

Conclusion: Exercising and physical activity lower risk factors for postmenopausal women. It is becoming more necessary to reconsider the

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importance of performing exercises in maintaining and enhancing postmenopausal women's health.

Keywords: Risk Factors, Osteoporosis, Postmenopausal, Practicing Exercises.

Introduction

Osteoporosis is an illness that may be categorized as a "silent pandemic" because of its worldwide incidence [1]. The essential characteristics of osteoporosis are bone mass reduction and degeneration in bone tissue's micro-architecture [2]. Weakness in mechanical strength in the bone may be attributed to the deficiency of bone mineral density, increasing bone fragility and making it more vulnerable to fracture [2, 3]. Women at fifty years old are more susceptible to osteoporotic fractures than men, and their proportion ranges between 40 - 50% for women and 3 - 22% for men [4]. Worldwide, nearly two hundred million women have osteoporosis[5]. Osteoporosis affects 30% of postmenopausal women. [6] Postmenopausal osteoporosis (PMO) seems to be the most prevalent skeletal disorder, with declining estrogen levels that lead to an imbalance of calcium in the bones and increasing bone resorption; as a result of these reasons, postmenopausal women are more vulnerable to the dangers of osteoporosis than men [7, 8]. Many aspects of lifestyle affect low bone mineral density and osteoporosis in postmenopausal women, and several scientific studies have proved this; smoking, for instance, is a contributing factor for osteoporosis in postmenopausal women, while physical training is a bone mass protector [1]. The influence of long-term exercises and physical activity on bone mass has been widely investigated. Many cross-sectional studies revealed a positive relationship between physical training and bone mineral density [9-11]. Women's physical activity and exercise habits may change throughout their lifetime, and overall health, BMI, smoking status, and socioeconomic variables impact physical activity participation [5].

Patients and Methods

A cross-sectional study was conducted from July 1, 2021, through December 31, 2021, in the Baghdad teaching hospital at the bone density testing unit. One hundred fifty women with postmenopausal osteoporosis participated in this study and were referred to the DEXA unit for diagnosis of osteoporosis. Women with menstruation or who had communication difficulties were excluded. Data were collected directly through interviews using a special questionnaire designed for this research that included several questions related to sociodemographic characteristics, specific nutritional status, family history of osteoporosis, anthropometrics, lifestyle, and medication use (Age, BMI, occupation, educational levels, family history, smoking, dairy, and Milk Consumption, exposed to sunlight, Taking calcium and vitamin D supplement, soft drinks consumption, Animal protein consumption, suffering from calcium deficiency, suffering from calcium deficiency, using treatment of hyperthyroidism, use treatment of collagen disorder, use therapy of gastrointestinal problems, and suffering from chronic disease), as well as practicing exercises in

ORIGINAL RESEARCH
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nominal binary dichotomous scales (i.e., yes, or no).

Statistical Analysis

The dependent variable used in this questionnaire is categorical data; therefore, Binary Logistic Regression was used to analyze the results [12-14] using Statistical Package for the Social Sciences (SPSS) version 22. The data were presented as numbers and percentages. P-values less than or equal to 0.05 were considered statistically significant.

Results

Descriptive Statistics of Studied Risk Factors

The results obtained from Table (1) show that the highest percentage was found in a woman in the age group ≥ 50 years with 104 (69.3%), and most of the participants, 91 (60.7%), were overweight and obese; the majority of the study sample had a job and represented 103(68.7%). What is interesting in this data is that more than half of the women who were enrolled in this study have a higher level of education and constituting 86(57.3%).

Table (1): Sociodemographic characteristics of the study sample

Items	Groups	No.	%	C.S.
Age Groups Years	< 50 yrs.	46	30.7	P=0.000 HS.
	≥ 50 yrs.	104	69.3	
BMI	Underweight & Normal weight	59	39.3	P=0.011 S
	Overweight & Obesity	91	60.7	
Occupation	None working	47	31.3	P=0.000 HS
	Working	103	68.7	
Educational levels	Illiterate and Low Educated	64	42.7	P=0.086 NS
	High Education	86	57.3	

* HS: Highly Significant; S: Significant; NS: Non-Significant; Testing based on the Binomial test;C.S.:Comarsion Significant

Table (2) presents an overview of the distribution of the sample study according to risk factors; as illustrated in this table, Patients with no family history of osteoporosis made up the largest proportion of the study population 103 (68.7%); in terms of smoking, only fifteen patients were smokers, while the majority of 135 (90%) had never smoked. Approximately more than two-thirds of the survey sample, 114 (76%), stated that they were not performing any exercise or engaging in physical activity.

Table (2): The distribution of the sample study according to risk factors for the postmenopausal osteoporotic women

Risk Factors	Groups	No.	%	C.S.
Family history of osteoporosis	Yes	47	31.3	P=0.000 HS.
	No	103	68.7	
Smoking	Yes	15	10	P=0.000 HS.
	No	135	90	
Dairy and milk consumption	Yes	103	68.7	P=0.000 HS.
	No	47	31.3	
Are you exposed to sunlight	Yes	53	35.3	P=0.000 HS.
	No	97	64.7	
Are you taking calcium and vitamin D supplements?	Yes	65	43.3	P=0.000

ORIGINAL RESEARCH
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	No	85	56.7	HS.
Animal protein consumption	Yes	101	32.7	P=0.000 HS.
	No	49	67.3	
Soft drinks consumption	Yes	47	31.3	P=0.000 HS.
	No	103	68.7	
Are you doing exercise	Yes	36	24	P=0.000 HS.
	No	114	76	
Are you suffering from calcium deficiency	Yes	131	87.3	P=0.000 HS.
	No	19	12.7	
Are you suffering from Vit D deficiency	Yes	130	86.7	P=0.000 HS.
	No	20	13.3	
Use treatment for hyperthyroidism	Yes	21	14	P=0.000 HS.
	No	129	86	
Use treatment of bone marrow disorders	Yes	21	14	P=0.000 HS.
	No	129	86	
Use treatment for collagen disorder	Yes	9	6	P=0.000 HS.
	No	141	94	
Use treatment of gastrointestinal problems	Yes	57	38	P=0.004 HS.
	No	93	62	
Are you suffering from chronic disease?	Yes	66	44	P=0.165 NS
	No	84	56	

* HS: Highly Significant; S: Significant; NS: Non-Significant; Testing based on the Binomial test; C.S.:Comarsion Significant.

Data Analysis using Logistic Regression Includes the iteration's number of derivatives regarding the maximum likelihood function– MLF for obtaining the lowest value of the double negative logarithm of MLF. For getting optimal estimates of the parameter's model used.

Table (3): Iteration's number of derivatives regarding the Maximum Likelihood Function

Risk Factors	Iteration: Step 1			
	1	2	3	4
-2 Log likelihood	136.36	130.83	130.474	130.472
Constant	0.743	1.205	1.413	1.437
Age Groups	-0.731	-1.188	-1.380	-1.401
BMI	1.049	1.544	1.710	1.727
Occupation	0.125	0.056	-0.001	-0.008
Education level	-0.203	-0.271	-0.291	-0.294
Family history of Osteoporosis	-0.017	-0.021	-0.030	-0.032
Smoking	-0.184	-0.309	-0.356	-0.361
Dairy and milk consumption	-0.048	-0.113	-0.141	-0.144
Are you exposed to sunlight	-1.086	-1.599	-1.777	-1.795
Are you taking calcium and vitamin D supplements?	0.343	0.541	0.607	0.613
Animal protein consumption	-0.265	-0.394	-0.433	-0.437
Soft drinks consumption	-0.267	-0.400	-0.471	-0.481
Are you suffer from calcium deficiency	-0.170	-0.289	-0.350	-0.358
Are you suffer from Vit D deficiency	0.207	0.269	0.293	0.296
Use treatment for hyperthyroidism	-0.411	-0.579	-0.635	-0.640
Use treatment of marrow disorders	-0.146	-0.174	-0.174	-0.174

ORIGINAL RESEARCH
Published: 25 December 2023
Doi: 10.26505/DJM.25027710709

Use treatment for collagen disorder	-0.497	-0.602	-0.618	-0.618
Use treatment of gastrointestinal problems	0.114	0.145	0.144	0.143
Are you suffer from chronic disease	-0.150	-0.261	-0.312	-0.318
Method: Enter				
Constant is included in the model.				
Initial -2 Log-Likelihood: 165.324				
Estimation terminated at iteration number 4 because log-likelihood decreased by less than .010 percent.				

In the fourth column iteration of the derivative of negative double MLF, we get its lowest value, which is equal to 130.472 (i.e., -2 log-likelihood). We stop at this iteration because the variation in the parameters (P1, P2,.., Pk) becomes lower than 0.010; the change in the evaluated parameters became very slow after the second iteration, as we can see from column 2. So, it can be said that the values of the parameters in iterations columns 3 and 4 are similar, with apparent differences. We stopped at the fourth iteration and considered its parameters as the best result that could be obtained for the parameters since negative double MLF gets the lowest value at that iteration. Column 3 summarizes the optimal model's parameters obtained in the fourth iteration. This table includes the constant value and the standard errors of the parameter's estimates of the studied function (i.e., Performing Exercises).

Table (4): Represents an optimal estimate of the parameter's model and some related output

Risk Factors	$\widehat{B}$	**S.E.**	**Wald**	**df**	**Sig.**	**Exp ($\widehat{B}$)**	**95% CI. Exp ($\widehat{B}$)**	
							L.b.	**U.b.**
Age Groups	-1.40	0.66	4.55	1	0.03	0.25	0.07	0.89
BMI	1.73	0.55	9.99	1	0.00	5.62	1.93	16.4
Occupation	-0.01	0.51	0.00	1	0.99	0.99	0.36	2.70
Education level	-0.29	0.50	0.35	1	0.55	0.75	0.28	1.97
Family history of Osteoporosis	-0.03	0.51	0.00	1	0.95	0.97	0.36	2.63
Smoking	-0.36	0.72	0.25	1	0.61	0.70	0.17	2.83
Dairy and milk consumption	-0.14	0.58	0.06	1	0.80	0.87	0.28	2.68
Are you exposed to sunlight	-1.80	0.51	12.4	1	0.00	0.17	0.06	0.45
Taking Ca. and vitamin D supplement	0.61	0.50	1.48	1	0.22	1.85	0.69	4.96
Animal protein consumption	-0.44	0.53	0.69	1	0.41	0.65	0.23	1.81
Soft drinks consumption	-0.48	0.57	0.72	1	0.40	0.62	0.20	1.87
Suffer from calcium deficiency	-0.36	0.74	0.24	1	0.63	0.70	0.17	2.96
Suffer from Vit. D deficiency	0.30	0.68	0.19	1	0.67	1.34	0.35	5.13
Use treatment for hyperthyroidism	-0.64	0.65	0.96	1	0.33	0.53	0.15	1.90
Use treatment of marrow disorders	-0.17	0.69	0.06	1	0.80	0.84	0.22	3.22
Use treatment for collagen disorder	-0.62	0.92	0.45	1	0.50	0.54	0.09	3.27
Use treatment of gastrointestinal problems	0.14	0.51	0.08	1	0.78	1.15	0.43	3.13
Suffer from chronic disease	-0.32	0.53	0.36	1	0.55	0.73	0.26	2.05
Constant	1.44	1.43	1.01	1	0.32	4.21	-	-

* HS: Highly Significant; S: Significant; NS: Non-Significant; Testing based on the Binary Logistic parameters estimate's model test.

ORIGINAL RESEARCH
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Risk Factors entered in step1: (Age Groups, BMI, ……, Suffer from chronic disease)

Table (4) findings obtained an optimal estimate of the parameter's model, as well as (Wald) statistic for each of the model parameters and the number of degrees of freedom and the significance of the parameters, which we will explain later. As for thoroughly testing the model's sufficiency and its quality (fit) of (Goodness), we use the statistics F and R2 in linear regression, while in the case of the logistical model, the ratio of the greatest likelihood (Log-Likelihood Ratio) that follows the distribution of ($Chi-Square\ \chi^2$):

$$\chi^2 = 2\,[\,log\ {}_eL_O - log_e\ L_1]$$

Where :

L_1: The value of MLF that content (i) factors.

L_o: The value of MLF that content (i-1) factors.

Then χ^2= 34.852 with 18 df and P=0.00986 (i.e. < 0.01).

This confirms the significance of the fully compatible model of entered variables in the full model method.

Table (5): Represents a Contingency Table for Hosmer and Lemeshow Test

Contingency Table for Hosmer and Lemeshow Test					
Step 1	**Practicing Movement Exercises No**		**Practicing Movement Exercises Yes**		**Total**
	Observed	Expected	Observed	Expected	
1	15	14.514	0	0.486	15
2	15	14.095	0	0.905	15
3	14	13.878	1	1.122	15
4	12	13.436	3	1.564	15
5	14	13.023	1	1.977	15
6	10	12.054	5	2.946	15
7	10	10.818	5	4.182	15
8	12	9.475	3	5.525	15
9	6	8.191	9	6.809	15
10	6	4.516	9	10.484	15

Table (5) summarize a non-parametric test of the fitted model, as it is based on a calculation of Chi-Square due to differences between (Observed) values and their (Expected) values. It has been suggested that a test by (Lemeshow and Hosmer) using χ^2distribution to reveal deviations in the Logistic model. The statistic of this test is a part of (Observed) not based on the theoretical model, and the other (Expected) is calculated from the logistics model estimates. The χ^2statistic of fitness in a contingency table is calculated from Table (5). From the intersection of the sums of the dependent binary (y) variable with the sums of the estimated probabilities, a table is created by the (H) statistic, which follows the χ^2distribution to test the significance of the differences between the observed and expected frequencies when the segmentation method is fixed with constant points within the range [0, 1], where any number of split points can be selected, and the split points are often with m = 10, in this case, the group that

ORIGINAL RESEARCH
Published: 25 December 2023
Doi: 10.26505/DJM.25027710709

includes the pairs' [Yi pˆ(Xi)] within group K according to the following:

$$JK = [\text{i: } (k-1)/m \leq P(Xi) \leq K/m]$$

The H-statistic = 9.328 with df =8, then accept the null hypothesis since P=0.315 (i.e.,>0.05).Hence preceding results realized a high level of contingency which seems clearly in Table (4) among actual and expected values, which a signed by yes, and of having no practicing movement exercised, and that was a high contingency in Table (5) for a column of a marked by yes due to [0, 1] regarding of (no, and yes) exercised respectively.

Table (6): Reclassification of actual and wrongly percentile

Classification Table					
	Observed		Predicted		
			Are you doing exercise?		Percentage Correct
			No	Yes	
Step 1	Are you doing exercise	No	108	6	94.7
		Yes	26	10	27.8
	Overall Percentage		((((78.7))))		
The cut value is .500					

Table (6) represents the classification of the accurate percentile (Overall percentage = 78.7), 32 individuals were wrongly classified, and the probability of total error was around 21.3%.

Interpretation of Parameter's Model and Conclusions

Table (4) observed that (Bˆ) denoted the model coefficients in Log-Odds form, which give by the model equation:

$$\log\left(\frac{\hat{p}}{1-\hat{p}}\right) = 1.44 - 1.4F1 + 1.73F2 - 0.01F3 - 0.29F4 - \cdots - 0.32F18$$

(Age Groups: *F*1, BMI: *F*2, Occupation: *F*3, ……., Suffer from chronic disease: *F*18)

Where pˆ denotes the probability of obtaining the answer of having no exercise for new observation. These estimates explain the relationship between studied risk factors and the dependent variable (i.e., The Performing Exercises) by (Logit) units. The second column represents the standard error of (Bˆ). The third column represents the Wald statistic for testing the significance of parameters. The column of Exp (Bˆ), which represents the Odd Ratios, which clarify the exponential function value of the regression coefficient that explains the weighted percent criteria [The probability of occurrence event p(y) to probability of not occurrence event 1-p(y)], as well as the last column, represents 95% confidence interval of the parameters estimates.

Furthermore, according to the Table (6) of the reclassification reality of diagnosed predicted impact of studied risk factors concerning the women who did not practice exercises versus those who practiced them, through an overall percent of two primary and off-diagonal predicted classes is given by (72.2: 5.3).

That result led to the conclusion that menopausal women with osteoporosis doing movement exercises had better health

ORIGINAL RESEARCH
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conditions (about 13.7 times) than those who were not.

Discussion

Osteoporosis in postmenopausal women remains a health issue; Females are five times more likely than males to develop osteoporosis. Low bone density and mineral content in women, as well as estrogen insufficiency-dependent bone loss, all contribute to osteoporosis. As a result, being a woman is a significant risk factor for osteoporosis [15,16].In Iraq, no epidemiological data are available about the magnitude of the problem. In our study, the osteoporosis prevalence in postmenopausal women over 50 years (39.3%) was almost compatible with the other studies showing a prevalence of 34.8%[17]. A higher body mass index (BMI) positively correlates with a higher bone mineral density(BMD)[18].

On the other hand, a overweight or obese postmenopausal woman's fat significantly determines their physical performance [19]. Our study revealed that 60.7 % of the study sample were overweight and obese; these two contradictory factors affect the physical fitness of women with osteoporosis. According to the results of this study, it has been found that 31.3% of postmenopausal osteoporotic women are associated with family history as a highly significant and independent risk factor. This finding support previous research by Julie Robitaille et al.(2008), which showed that (36.5%) of women have a family history of osteoporosis and an increasing number of affected relatives increases the risk for osteoporosis[20]. There is no doubt that smoking is a bad habit; it is harmful to health. Several studies have shown changes in the micro-architecture of the trabecular bone due to smoking, which lowers the bone's resistance to friction and mechanical stress[21]. Osteoporosis is almost twice as common among women who smoke [22]. Our results show a statistically significant association between smoking and osteoporosis (P=0.000).Compared to women exposed to sunlight, women who are not exposed to sunlight are at a higher risk of osteoporosis[23]; this is consistent with our earlier findings, which showed that 64.7% of women who participated were not exposed to sunlight. Another risk factor regarding its effect on postmenopausal women is the consumption of soft drinks. The results from our study confirm the association between soft drinks and osteoporosis. Previous studies have reached similar results, which show that osteoporotic women sometimes consume soft drinks instead of water and fresh juice[24]. Calcium/phosphorus ratios and acid-base balances of the body are affected when phosphoric acid intake is excessive; this can lead to osteoporosis, fractures, and decreased bone density[25]. A modest relationship exists between diet and Bone Mineral Density[26]. Inadequate calcium intake can cause calcium deficiency.

Furthermore, there may be difficulty absorbing calcium in ionic forms. Various calcium salts, including calcium carbonate and lactate, can have difficulty absorbing because they combine with phytic acid and precipitate[27]. The impact of physical activity and exercise on bone mass has been studied in several cross-sectional studies[28, 29]. It has been noted in these studies that bone mass and exercise levels are positively correlated. It is also important to note that the

ORIGINAL RESEARCH
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association is based on lifetime exercise and does not suggest that exercising would be beneficial in preventing or reversing osteoporosis in previously sedentary individuals. This research aimed to investigate the effect of practicing exercise on postmenopausal osteoporotic women and to predict how it will affect them. In response to the question in this survey, are you doing exercises? The overall (76%) response to this question was negative. To anticipate the effects of physical exercise on those who exercise regularly and those who do not, it was necessary to determine the impact of physical activity on postmenopausal women's health. Binary logistic regression analysis was used to predict the effectiveness of exercise on these patients, and the results showed that women who exercised regularly were 13 times healthier than women who did not exercise. To our knowledge, this finding has not been reported in any previous research. It is the first research to indicate the effect of exercises on health of postmenopausal women with osteoporosis.

Conclusions

In the current study, the statistical method of logistic regression was used to analyze factors influencing osteoporotic women and the impact of practicing exercises. Based on the results of the analysis, it appears that age, weight, calcium intake, physical activity, and vitamin D deficiency have significant effects on osteoporosis. In light of the results of the analysis, it appears that a majority of women are obese, a factor that could contribute to a higher risk for osteoporosis.

Recommendations

Osteoporosis prevention and treatment can be achieved by practicing a variety of exercises that enhance the health of postmenopausal women. Exercise improves metabolism and energy production, in addition to reducing stress and improving sleep quality. Exercise programs should include moderate to intense activities, such as weight lifting, walking, running, jumping, and climbing. Exercise for at least 30 minutes a day on most days of the week. It is also important to encourage women who suffer from obesity to follow a healthy diet aimed at losing weight and reaching and maintaining an ideal healthy weight, and monitoring the amount of minerals and vitamins like calcium and vitamin D in the body, by eating foods rich in that to reduce the risk of osteoporosis.

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Ethical clearance: The participants were informed of the research objectives and its importance, and verbal consent was obtained from the participants to answer the questionnaire prepared for this purpose.

Conflict of interest: Nil

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تأثير ممارسة التمارين الرياضية وعوامل الخطر المصنفة في هشاشة العظام لدى النساء بعد انقطاع الطمث (دراسة تحليلية باستخدام الانحدار اللوجستي الثنائي)

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الملخص

خلفية الدراسة: هشاشة العظام هو مرض يمكن تصنيفه على أنه "جائحة صامتة" بسبب انتشاره في جميع أنحاء العالم. الخصائص الأساسية لهشاشة العظام هي انخفاض كتلة العظام وتدهور البنية الدقيقة للأنسجة العظمية. يبدو أن هشاشة العظام بعد سن اليأس (PMO) هي أكثر اضطرابات الهيكل العظمي انتشارًا.

اهداف الدراسة: لتأثير ممارسة التمارين الرياضية والنشاط البدني كأهم العوامل المساهمة في الإصابة بهشاشة العظام لدى النساء بعد سن اليأس.

المرضى والطرائق: تم إجراء مسح مقطعي في مستشفى بغداد التعليمي في الفترة من 1 تموز (يوليو) 2021 إلى 31 كانون الأول (ديسمبر) 2021. وتم جمع البيانات مباشرة من خلال المقابلات باستخدام استبيان خاص. شاركت في هذه الدراسة مائة وخمسون امرأة في سن الياس ومصابات بهشاشة العظام. جميع المشاركات في البحث تم تشخيص اصابتهم بهشاشة العظام من قبل اخصائيي امراض المفاصل والروماتيزم سريريًا و باستخدام فحص كثافة العظام (DEXA).

النتائج: تشير نتائج الدراسة الحالية إلى انتشار مرض هشاشة العظام بين النساء بعد سن اليأس ، حيث بلغت النسبة أعلى من 69.3% في الفئة العمرية (≤50 سنة). كان 60.7% من جميع المشاركات يعانين من زيادة الوزن والسمنة وفقًا لمؤشر كتلة الجسم (BMI) . وقد وجد ان نقص الكالسيوم لدى 87.3% من المشاركات ، وأكثر من ثلثيهم (76%) لا يمارسن التمارين الرياضية، و86.7% يعانين من نقص في فيتامين دال . توضح إعادة تصنيف النسبة المئوية الفعلية والخاطئة النسبة المئوية الدقيقة (النسبة المئوية الإجمالية = 78.7)، وقد تم تصنيف 32 فردًا بشكل خاطئ، وتم الإبلاغ عن احتمال الخطأ الإجمالي بحوالي 21.3٪. وكانت النتيجة الأكثر أهمية هي أن النساء بعد سن اليأس والمصابات بهشاشة العظام والاتي مارسن التمارين الرياضية و النشاط البدني وشاركن فيه بانتظام كن يتمتعن بصحة أفضل بمقدار 13.7 مرة من اللواتي لم يمارسن التمارين الرياضة.

الاستنتاجات: ممارسة الرياضة والنشاط البدني يقللان من عوامل الخطر لدى النساء بعد سن اليأس. لقد أصبح من الضروري إعادة النظر في أهمية أداء التمارين الرياضية في الحفاظ على صحة المرأة بعد سن اليأس وتعزيزها.

الكلمات المفتاحية: عوامل الخطر،هشاشة العظام ، سن اليأس، ممارسة التمارين

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