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Abstract: Osteoporosis is considered a serious public health problem, particularly affecting the postmenopausal period. In 2018, in the Republic of Kazakhstan the total and primary incidence was 10 and 3.7 cases per 100,000 adults, respectively. The objective is to study osteoporosis prevalence and indicate main factors affecting low bone mineral density by screening adult population of Abay region, Kazakhstan. The target group were 641 respondents aged between 18 and 65 years old, Kazakh population living in Abay region since birth. All participants filled out questionnaire and had a bone mineral density measurement by dual energy X-ray absorptiometry (DXA) between July 15, 2023 and February 29, 2024. Logistic regression analysis was conducted to assess the association between low bone mineral density and key demographic characteristics, aforementioned lifestyle factors and nutrition habits. We identified the prevalence of low bone density and osteoporosis at the level of 34.1% with the highest prevalence in the older population group (50+ years) - 48.3%. Regression analysis revealed a number of indicators associated with the likelihood of bone sparing. However, only 4 of these showed significance in the final multivariate model (R^2=22.4%). These included age (AOR 1.05), body mass index (AOR 0.92), fracture history (AOR 1.64), consumption of nuts and dried fruits were associated with lower prevalence of osteoporosis (AOR 0.48). Our study was the first in Kazakhstan that investigates the association of key demographic, behavior and anamnestic factors with low mineral density.

Keywords: bone mineral density; osteoporosis; dual energy X-ray absorptiometry; dietary patterns; aging

1. Introduction

What is osteoporosis? This definition was adopted by the World Health Organization (WHO) in 1994 and widely used until a revision in 2000 from the National Institutes of Health, which defined osteoporosis as a 'skeletal disorder characterised by compromised bone strength predisposing to an increased risk of fracture'.

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Osteoporosis is considered a serious public health problem, particularly affecting the postmenopausal period when there is a marked decrease in the production of the estrogen. The diagnosis of osteoporosis can be made on the basis of either fractures that have occurred without significant trauma or on the basis of low bone mineral density measured by dual energy X-ray absorptiometry (DXA), considered to be "gold standard" in the diagnosis of osteoporosis. An osteoporotic fracture can occur in almost any part of the skeleton, with the spine, hip, wrist, humerus and pelvis being the most commonly affected [1]. It is known that a 1.0SD decrease in bone mineral density (BMD) increases the risk of fracture by 2-2.5 times.

Decreased bone density is found in approximately 33% of women and 26% of men over 50 years of age. It is expected that by 2050, the elderly population (over 60 years of age) will overtake the population under 15 years of age [2]. On February 01, 2024 the population of Kazakhstan was 20,053,665 people, including 9,793,608 men and 10,260,057 women. The number of population of 60 years and older amounted to 2,616,515 people (13.2% of the total population), with 1,031,051 (39.4%) - men and 1,585,064 (60.6%) - women. It is projected that by 2035 the population over 50 years of age will grow by 35% and over 70 years of age by 95%. In Abay region of Kazakhstan there are 610,100 people, including the adult population of 421,501 people [3,4]. Osteoporosis is still quite rarely registered in the official statistics of Kazakhstan. In 2018, 1,245 cases of osteoporosis were registered in the Republic of Kazakhstan, with an expected number of 1.1 million patients. The total and primary incidence was 10 and 3.7 cases per 100,000 adults, respectively. The incidence was naturally predominant in women with 236 cases and 181 cases in men (per 100,000 population) and increased with age [5].

Osteoporosis has many causes including age, genetic factors, hormone therapy, some somatic diseases, prolonged bed rest, low physical activity and nutrition status [6]. Malnutrition and lack of sunlight may also be responsible for decreased bone mineralization. Adequate intake of selected nutrients rich in calcium, vitamin D, n-3polyunsaturated fatty acids (n-3 PUFAs), and protein-rich foods is essential for healthy bones [7].

Most people are asymptomatic with osteoporosis making epidemiologic studies particularly difficult. Osteoporosis can be prevented and treated. It is therefore important that risk factors are identified and continually updated to ensure that preventive care is as complete as possible.

Objective: to study osteoporosis prevalence and indicate main factors affecting low bone mineral density by screening adult population of Abay region, Kazakhstan.

2. Materials and Methods

2.1. Design

Study recruitment was conducted by random sampling method using random number tables and the register of the attached population. The target group is people aged 18-65 years living in Abay region of Kazakhstan since birth.

The study was approved by the Ethics Committee of Semey Medical University (SMU) (Protocol No.7 dated 07.11.2022). All the participants filled out questionnaires and had their BMD measured by DXA between July 15, 2023 and February 29, 2024. Each participant survey data was compared with bone density scans at the University Hospital of the SMU and "Toktamys" Medical Center. This study is pre-registered in the international clinical trials registry on the website Clinicaltrials.gov (ID NCT06344598).

2.2. Subjects

The subjects of the study were 846 Kazakh nationality residents of Abay region. Of these, 641 respondents (564 female and 77 male) were included in the sample according to the inclusion and exclusion criteria. Inclusion criteria included adults over 18 years old without congenital pathology of musculoskeletal system, living in Abay region since birth, without acute phase of somatic pathology. Exclusion criteria included age under 18 years and over 65 years, patients with congenital

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pathology of the musculoskeletal system, residents of other regions of Kazakhstan, unwilling to participate in the study and unable to sign informed consent independently.

The present study is the initial stage of a grant project and planned to be carried out in 2023-2025. The results presented in the study are the initial stage of the grant. This explains sampling bias towards women.

2.3. Bone measurements and the survey

The BMD were measured using DXA (Osteosys, 2020, Korea;) as a standardized method. Additionally, the bone density of lumbar was measured following the bone density examination guideline based on the recommendation of the 2007 International Society for Clinical Densitometry (ISCD) [8].

Osteoporosis is defined based on the following bone density levels: the T-scores and Z-scores: -2.5SD and below indicates the presence of osteoporosis, from -1.5SD to -2.5SD indicates low bone mass, a value equal to or exceeding -1.4SD is considered normal bone density [1]. The values of bone mineral density were interpreted by a qualified radiologist.

The questionnaires were developed in accordance with the international questionnaire [9] for the diagnosis of osteoporosis, available for free at IOF www.osteoporosis.foundation and supplemented with questions to obtain demographic information, including date of birth, place of birth and residence, and nationality [9]. Specific risk factors for osteoporosis requested in the questionnaire included height and body weight with BMI calculation, smoking and alcohol consumption history, use of hormone therapy, immunosuppressants, antacids, antidiabetic agents, previous fracture, family medical history, diet and physical activity. Patients were asked about the presence of chronic diseases affecting osteoporosis, including endocrine, rheumatic, and cancer pathology. Participants were also asked about current calcium, vitamin D intake. Nutrition questions included "how often/rarely consumed" foods rich in calcium and protein, such as milk and dairy products, red meat and meat products, fish and seafood, different types of nuts and dried fruits, and vegetables. Questions on physical activity included the time spent outdoors, physical activity during the day. People who agreed to participate in the study were surveyed in a paper format, signing an informed consent form and providing a contact telephone number.

2.4. Analysis Method

Study participants were divided into 2 groups according to age: participants younger than 50 years and older than 50 years. Statistics show that the mean age of natural menopause is 51 years in industrialized nations [10]. The prevalence of osteoporosis over the age of 50 years is 7% in men, lower than the 23% reported for women [11]. However, both males and females over the age of 50 years have trabecular bone loss throughout their later life. Therefore, there was no sex difference when dividing into two groups and amounted to 12% of men and 88% of women. Participation in the study of respondents under 50 years of age was dictated by scientific interest in the prevalence of osteoporosis in this group of the population of Abay region of Kazakhstan.

The frequencies were compared using either Pearson's chi-square test or Fisher's exact test (applied when expected cell values were five or less). Continuous variables were compared using Mann-Whitney U-test due to their non-normal distribution confirmed by Shapiro-Wilk test. Logistic regression analyses were conducted to assess the association between osteopenia and osteoporosis and key demographic characteristics, aforementioned lifestyle factors and eating habits. In multivariate analyses, the unadjusted and adjusted odds ratios were presented. The analyses were performed using IBM SPSS version 22 (IBM Corp.)

3. Results

The final sample amounted to 461 respondents. The number of women was 564 (88.0%), men - 77(12.0%). No differences in sex distribution between age groups were found.

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The mean BMI was 24.2(7.05) kg/m². In patients younger than 50 years of age, the mean BMI was 23.2 (6.12) kg/m², and in patients 50 years and older, the mean BMI was 25.3 (7.5) kg/m². According to the results of the questionnaire, 29(4.5%) respondents indicated that they smoke cigarettes, 11(1.7%) people indicated an unhealthy habit in the form of alcoholic beverage intake. Use of hormonal therapy in history (past or present) was indicated by 74(11.5%) people. Fractures after minor injuries and falls were complained by respondents from the age group over 50 years - 112 (33.8%) people out of 158 people who responded positively. BMD measurements in all people of our sample showed the following results: 20.2% low bone mass, 13.9% osteoporosis and 65.9% had normal BMD. The highest BMD reduction was observed in the group 50 years and older (Tables 1 and 2). The results of nutrition preference questionnaire in the two age groups are presented in Table 3.

Table 1. General characteristics of osteoporosis risk factors.

Parameter	All respondents (n=641)	Less than 50 years (n=310)	50 years and more (n=331)	Statistical criterion	p-value
Female	564 (88.0%)	266 (85.8%)	298 (90.0%)	χ^2 =2.7	0.1
Male	77 (12.0%)	44 (14.2%)	33 (10.0%)		
Densitometry				χ^2 =67.94	<0.001
Healthy bone	422 (65.9%)	251 (81.2%)	171 (51.7%)		
Low bone mass	129 (20.2%)	43 (13.9%)	86 (26.0%)		
Osteoporosis	89 (13.9%)	15 (4.9%)	74 (22.4%)		
Fractures after minor injuries and falls	158 (24.6%)	46 (14.8%)	112 (33.8%)	χ^2 =31.11	<0.001
Frequent falls or fear of falling	140 (21.8%)	35 (11.3%)	105 (31.7%)	χ^2 =39.15	<0.001
After the age of 40, have you lost more than 3 cm in height	94 (14.7%)	23 (7.4%)	71 (21.5%)	χ^2 =25.18	<0.001
Chronic diseases	158 (24.6%)	48 (15.5%)	110 (33.2%)	χ^2 =27.15	<0.001
Hepatitis	7 (1.1%)	4 (1.3%)	3 (0.9%)		0,72*
Chronic obstructive pulmonary disease (COPD)	3 (0.5%)	1 (0.3%)	2 (0.6%)		1.0*
Cancer	9 (1.4%)	4 (1.3%)	5 (1.5%)		1.0*
Diabetes	15 (2.5%)	4 (1.3%)	12 (3.6%)		0.08*
Thyroid or parathyroid gland disorders	60 (9.4%)	22 (7.1%)	38 (11.5%)	χ^2 =3.63	0.06
Rheumatoid arthritis	74 (11.5%)	18 (5.8%)	56 (16.9%)	19.36	<0.001
Drug therapy					
Antidiabetic	10 (1.6%)	2 (0.6%)	8 (2.4%)		0.11*
Antacids	2 (0.3%)	1 (0.3%)	1 (0.3%)		1.0*
Immunosuppressants	7 (1.1%)	0	7 (2.1%)		0.02*
Glucocorticoids	74 (11.5%)	20 (6.5%)	54 (16.3%)	χ^2 =15.25	<0.001
Vitamin D	94 (14.7%)	40 (12.9%)	54 (16.3%)	χ^2 =1.49	0.22
Calcium	59 (9.2%)	22 (7.1%)	37 (11.2%)	χ^2 =3.19	0.07

Table 2. Osteoporosis development behavioural risk factors.

Parameter	All respondents (n=641)	Less than 50 years (n=310)	50 years and more (n=331)	Statistical criterion	p-value
Physical activity	463 (72.2%)	225 (72.6%)	238 (71.9%)	χ^2 =0.04[a]	0.85
Being outdoors	529 (82.5%)	262 (84.5%)	267 (80.7%)	χ^2 =1.65	0.19
Family history of *osteoporosis*	87 (13.6%)	39 (12.6%)	48 (14.5%)	χ^2 =0.51	0.48

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Parents' history of fractures	87 (13.6%)	45 (14.5%)	42 (12.7%)	χ^2 =0.46	0.50
Alcohol 3 or more units/day	11 (1.7%)	3 (1.0%)	8 (2.4%)		0.23*
Current Smoking	29 (4.5%)	15 (4.8%)	14 (4.2%)	χ^2 =0.14	0.71
Weight, kg	67.0 (20.0)	63.0 (16.5)	70.0 (18.0)	U=39371.0**	<0.001
Height, sm	162.0 (10.5)	163.0 (10.3)	160.0 (9.0)	U=43943.5**	0.002
BMI, kg/m^2	24.2 (7.05)	23.2 (6.12)	25.3 (7.5)	U=43272.0**	0.001
**- nonparametric criteria - Mann-Whitney U-test a - χ^2Pearson's					

Table 3. Results of patients survey on nutrition.

Parameter/ frequency of use	All respondents (n=641)	Less than 50 years (n=310)	50 years and more (n=331)	Statistical criterion	p-value
Consumption of milk and dairy products				χ^2 =0.48	0.79
none	45 (7.0%)	24 (7.7%)	21 (6.3%)		
rarely	326 (50.9%)	156 (50.3%)	170 (51.4%)		
often	270 (42.1%)	130 (41.9%)	140 (42.3%)		
Vegetables and greens				χ^2 =7.42	0.02
none	143 (22.3%)	79 (25.5%)	64 (19.3%)		
rarely	340 (53.0%)	168 (54.2%)	172 (52.0%)		
often	158 (24.6%)	63 (20.3%)	95 (28.7%)		
Meat products (red meat)				χ^2 =6.47	0.04
none	8 (1.2%)	7 (2.3%)	1 (0.3%)		
rarely	64 (10.0%)	26 (8.4%)	38 (11.5%)		
often	569 (88.8%)	277 (89.4%)	292 (88.2%)		
Fish and seafood				χ^2 =0.53	0.29
none	60 (9.4%)	33 (10.6%)	27 (8.2)		
rarely	524 (81.7%)	254 (81.9%)	270 (81.6%)		
often	57 (8.9%)	23 (7.4%)	34 (10.3%)		
Nuts and dried fruits				χ^2 =2.47	0.29
none	63 (9.8%)	26 (8.4%)	37 (11.2%)		
rarely	414 (64.6%)	209 (67.4%)	205 (61.9%)		
often	164 (25.6%)	75 (24.2%)	89 (26.9%)		
Eggs				χ^2 =1.78	0.41
none	57 (8.9%)	25 (8.1%)	32 (9.7%)		
rarely	372 (58.0%)	175 (56.5%)	197 (59.5%)		
often	212 (33.1%)	110 (35.5%)	102 (30.8%)		
Soda				χ^2 =51.99	<0.001
none	203 (31.7%)	62 (20.0%)	141 (42.6%)		
rarely	327 (51.0%)	168 (54.2%)	159 (48.0%)		
often	111 (17.3%)	80 (25.8%)	31 (9.4%)		
Fast food				χ^2 =76.30	<0.001
none	253 (39.5%)	72 (23.2%)	181 (54.7%)		
rarely	348 (54.3%)	204 (65.8%)	144 (43.5%)		
often	40 (6.2%)	34 (11.0%)	6 (1.8%)		

Regression analysis revealed a number of indicators associated with the likelihood of bone sparing. However, only 4 of these showed significance in the final multivariate model (R^2=22.4%).

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These included age (AOR 1.05; 95% CI 1.04 to 1.06; p <0.001), body mass index (AOR 0.92; 95% CI 0.88 to 0.95; p <0.001), fracture history (AOR 1.64; 95% CI 1. 07 - 2.53; p <0.001), consumption of nuts and dried fruits were associated with lower prevalence of osteoporosis (AOR 0.48; 95% CI 0.27- 0.85; p <0.012) (Table 4).

Table 4. Regression analysis for risk factors indicating a significant association with osteoporosis.

Parameter	OR	95% CI	p	AOR	95% CI	p
Age	**1.05**	**1.04; 1.06**	<0.001	**1.05**	**1.04; 1.06**	**<0.001**
Sex				-	-	-
Male	0.77	0.45; 1.29	0.32			
Female	ref					
Weight (kg)	0.98	0.97; 0.99	0.005	-	-	-
Height	0.97	0.95; 0.99	0.003	-	-	-
BMI	**0.95**	**0.92; 0.98**	**0.002**	**0.92**	**0.88; 0.95**	**<0.001**
Chronic diseases	**1.56**	**1.08; 2.26**	**0.019**	0.87	0.48; 1.57	0.64
Rheumatoid arthritis	**2.13**	**1.31; 3.47**	**0.002**	1.71	0.85; 3.48	0.14
Glucocorticoids (GC) consumption	**1.66**	**1.01; 2.71**	**0.04**	1.02	0.52; 1.99	0.95
History of fractures	**2.25**	**1.56; 3.26**	**<0.001**	**1.64**	**1.07; 2.53**	**0.02**
Frequent falls or fear of falling	**1.69**	**1.15; 2.48**	**0.008**	0.98	0.61; 1.57	0.92
Decrease in height	**1.79**	**1.15; 2.79**	**0.010**	1.10	0.66; 1.84	0.71
Insufficient physical activity	0.92	0.64; 1.33	0.669	-	-	-
Alcohol consumption	**3.47**	**1.01; 11.98**	**0.049**	3.25	0.88; 12.03	0.08
Lack of outdoor time	0.82	0.52; 1.27	0.363	-	-	-
Lack of vitamin D consumption	0.95	0.60; 1.50	0.82	-	-	-
Lack of calcium consumption	0.73	0.42; 1.26	0.27	-	-	-
Cigarettes	1.39	0.5; 2.96	0.40	-	-	-
Dairy products	1.29	0.66; 2.52	0.50	-	-	-
Greens	1.21	0.82; 1.81	0.35	-	-	-
Meat	1.56	0.31; 7.78	0.59	-	-	-
Fish	0.88	0.51; 1.53	0.66	-	-	-
Consumption of nuts and dried fruits	**0.46**	**0.27; 0.78**	**0.004**	**0.48**	**0.27; 0.85**	**0.012**
Eggs	0.69	0.39; 1.19	0.18	-	-	-
Soda	0.99	0.70; 1.41	0.97	-	-	-
Fast food	0.89	0.64; 1.25	0.51	-	-	-

4. Discussion

To the best of our knowledge, our study was the first in Kazakhstan that investigates the association of key demographic, behavior and anamnestic factors with low mineral density. We identified the prevalence of low bone density at the level of 34.1% with the highest prevalence in the older population group (50+ years) - 48.3%. Beside age, the low bone density was directly associated with history of fractures. BMI and eating nuts and dried fruits were inversely associated with low bone density.

Epidemiologically, osteoporosis predominantly occurs in postmenopausal and premenopausal women, as well as in men over 50 years of age. Risk factors affect different ages and are not definitive, thus the incidence and risk factors of osteoporosis in the Kazakh population, in order to assess their

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impact on BMD was studied. Risk factors were identified by a unified questionnaire and included age, anamnestic, nutritional factors, vitamin D, calcium and medication consumption.

Several studies have evaluated the risk of osteoporosis in postmenopausal women aged 45 years and older and the positive association between osteoporosis and age >45 years [12–14]. In one study, osteoporosis was found in 12% of women aged 40-49 years, 21.8% of women aged 50-59 years, and 45.7% of women aged >60 years [12]. In another observational study, the prevalence of osteoporosis was significantly lower in those aged 40-50 years than in those aged 50 years and older, by a factor of about 20-40 [13]. The mean age of women was 59.5±8.6 years, and the mean age of menopause onset was 49.0±3.4 years [14].

Our study was a screening study with respondents younger than 50 years and older than 50 years. It was found that with increasing age by 1 year, the risk of osteoporosis increased by 5% (Table 4). We also found that 65.9% of the Kazakh population had normal BMD in the lumbar spine, 20.2% had low BMD, and 13.9% had osteoporosis (Table 1). The highest prevalence of reduced BMD was in individuals over 50 years of age, which is consistent with the findings of numerous studies that individuals over 50 years of age are 5 times more likely to have osteoporosis than the other population [15,16].

When measuring the lumbar spine (LS) in Turkish women, the incidence of normal BMD (31.4%), osteopenia (48.2%), and osteoporosis (20.5%) was higher compared to the study of the other Turkish researcher İpek A et al. [17]. In a study by Thambiah SC et al. [18] in the age range of 55-59 years in Thai women, the prevalence of osteoporosis in LS was 22.6%.

In China, the age-standardized prevalence of osteoporosis at the spine or hip was 6.46% and 29.13% for men and women aged 50years and older, respectively [19]. In the same study, the authors found that the prevalence of osteoporosis at each site increased with age in the range of 5 years, which may be comparable to our study only partially. In the Kazakh study sample, BMD significantly decreased for each year of body aging. We found no studies on the association of increased risk of osteoporosis with increasing age for each 12 months. A total of 158 individuals had chronic diseases, including 110 individuals (33.2%) in the age group older than 50 years. Pathologies such as thyroid and parathyroid gland diseases (11.5%, $p<0.001$) and rheumatoid arthritis (16.9%, $p<0.001$) were statistically significant, and accordingly, GC intake (16.3%, $p<0.001$) were the factors that increased the risk of osteoporosis in the group of 50 years and older.

According to the Framingham study [20] those individuals who generally followed a diet based on fruits, vegetables, milk and cereals had significantly higher BMD than those whose diet was characterized by high consumption of salty snacks, pizza, soda or high consumption of meat, bread and potatoes. Seafood is known to be rich in n-3PUFAs such as, eicosapentaenoic acid and docosahexaenoic acid, they inhibit the production of inflammatory cytokines, enhance calcium absorption and reduce urinary calcium excretion and regulate bone health [7]. Epidemiologic studies have shown that fish consumption and n-3PUFAs were significantly associated with BMD, fractures, and osteoporosis risk in postmenopausal women or elderly men in an Asian population. However, n-3PUFAs or fish consumption was not found to be associated with BMD or fractures in elderly men and women in Western populations [21].

The relationship of diet to bone health of Kazakh population can be analyzed by focusing on selected nutrients such meat, seafood, dairy products, nuts, and vegetables. According to our survey, 81.7% of the population rarely eats seafood and 64.6% rarely eat nuts, while 53.0% of respondents said they do not eat greens often, regardless of age. Soda and fast food are more consumed by those under 50 years of age compared to the group over 50 years of age, 54.2% ($p<0.001$) and 65.8% ($p<0.001$) respectively being statistically significant (Table 3).

It is known that protein-rich foods from different sources can have different effects on bone health as they vary in protein content, amino acid composition, and digestibility [22]. The relationship between BMD and protein foods was analyzed in 2015, where the authors found that the processed foods and red meat protein food clusters were related to lower bone mineral density [23]. The authors believe this is due to the higher saturated fat content of red meat compared to other sources of animal protein. In another study, it was also found that a diet high in fish and olive oil consumption and low

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in red meat consumption was positively associated with LS BMD [24]. The explanation for the effect of protein benefit on bone formation in a balanced diet, in terms of acid-forming potential, is that acid/base balance is important to avoid urinary calcium loss with acid-forming foods such as processed meat [25].

The Kazakh is known for its preference for red meat and meat products and that was found in the study. In our study, 88.8 % (p=0.04) of respondents consume meat without age differentiations. Possibly, this factor affects the prevalence of osteoporosis in Kazakh population, however, no correlation was found (Table 4).

Thus, based on our data and the few studies regarding red meat consumption [24,25] and the risk of osteoporosis, we suggest that the study of the various factors affecting bone health should take into account the ethnic and geographic population.

Other non-dietary factors also influence bone metabolism. First of all, motor activity is essential for skeletal muscles: physical activity helps to maintain or build skeletal muscle volume and strength, and constant and individually dosed physical activity strengthens bone at any age. Other epidemiologic studies have shown that a 10% increase in peak bone mass at the population level reduces the risk of fracture in later life by 50% [26,27].

During the survey the questionnaires were formulated according to the IOF recommendations, which was “Do you engage in physical activity for more than 30 minutes per day (housework, gardening, walking, running)” [9]. In our study, 72.2% of the respondents gave a positive answer, and individuals in both groups were equally likely to have physical activity. However, we found no correlation with this risk factor.

Fracture history in our study had a positive correlation with the risk of osteoporosis. Previous publications have noted that the risk of subsequent fracture is approximately 4 times greater in women with 1 previous fracture [28]. We found a similar association between prior fracture and osteoporosis of 1.64 ($p < 0.001$).

There are now sufficient publications on the effect of BMI on bone metabolism in postmenopausal women and a significant association between BMI and BMD at the lumbar and femur has been shown [29]. We observed the effect of BMI on the development of osteoporosis by regression analysis. We found that lower BMI increased the risk of osteoporosis by 8% ($p < 0.001$).

This study is limited by the fact that the sample included women and men living in the sharply continental climate of eastern Kazakhstan and with the history of the Semipalatinsk nuclear test site [30], so the results may not be generalizable to all of Central Asia and require further study. In addition, data collection was prospective and some data was retrospective, therefore have inherent limitations. Of note, three variables were used as the main outcome variable: osteoporosis, osteopenia and normal BMD measured at the lumbar spine. Based on the findings that the risk of osteoporosis increases with increasing age by 5%, further research should be continued on a larger sample with DXA measurements in two anatomical zones, including the femoral neck, and aimed at creating an algorithm for predicting osteoporotic fractures in women and men living in Kazakhstan.

The main strength of our study is studying the overall prevalence of osteoporosis in the adult population of different ages, united by one geographical area of Kazakhstan. Consequently, screening enabled us to study risk factors across age ranges. The correlations identified might help in diagnosing osteoporosis in high-risk patients earlier, even before menopause. This knowledge will also help clinicians to take appropriate treatment measures and recommend lifestyle and medication adjustments.

5. Conclusions

Thus, our study aimed to identify risk factors will help to predict the development of osteoporosis, which is important for clinicians. For a public health, it is valuable to know about any new risk factors in order to evaluate these factors and build differentiated preventive policies for osteoporosis at different ages.

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