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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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Содержание:

ANALYSIS OF RISK FACTORS AND THEIR IMPACT ON BONE HEALTH STATUS IN KAZAKH POPULATIONS

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Abstract.

Background: Osteoporosis is a serious public health problem worldwide, especially among the aging population. It is characterized by low bone mineral density (BMD), which leads to an increased risk of fractures. Despite the growing burden, data on the prevalence of osteoporosis and related risk factors in Kazakhstan are limited. The purpose of this study was to assess the state of BMD and identify key risk factors associated with osteoporosis among adults aged 45 years and older in the Abay region of Kazakhstan. **Methods:** The cross-sectional study was conducted from July 2023 to March 2024 with 367 women. Data collection included measurement of BMD using dual-energy X-ray absorptiometry (DXA), a standardized questionnaire adapted by the International Osteoporosis Foundation, and laboratory tests (vitamin D, calcium, and alkaline phosphatase levels). The participants were grouped by age and BMD status. Statistical analysis included the chi-square criterion or Fisher's exact criterion for categorical variables and the Mann–Whitney U–test or Kruskal-Wallis criterion for continuous variables. Logistic regression was used to study the relationship between low BMD and demographic factors, lifestyle, and nutrition. **Results:** Osteopenia and osteoporosis were detected in 25.3% and 21.0% of participants, respectively, and their prevalence was significantly higher among people aged 56-65 years ($p<0.004$). Regression analysis showed that low BMD was significantly associated with older age (AOR 1.034; p=0.025), weight (AOR 0.975; p=0.071), lower BMI (AOR 0.989; p=0.764). **Conclusions:** This study highlights the high prevalence of low BMD among middle-aged and older adults in the Abay region and underscores key modifiable risk factors, including older age, lower BMI, fracture history, and rheumatoid arthritis. These findings are essential for strengthening clinical diagnostic practices and guiding preventive strategies to reduce osteoporosis-related complications in the Kazakh population.

Key words. Bone mineral density (BMD), osteoporosis, dual-energy X-ray absorptiometry (DXA), dietary intake, risk factors.

Introduction.

Bone tissue formation is a dynamic process that encompasses both the generation of new bone and the resorption of old bone. Bone remodeling begins with the resorption of mineralized bone by osteoclasts, followed by the formation of osteoid by osteoblasts, which subsequently undergoes mineralization. Disruption of the balance between bone resorption and formation—particularly when resorption exceeds formation—leads to a reduction in bone mass and ultimately contributes to the development of osteoporosis [1]. Osteoporosis is characterized by reduced bone mass, disruption of bone microarchitecture, and decreased bone strength. According to the World Health Organization (WHO), approximately 200 million women worldwide are affected by osteoporosis [2]. The prevalence of this condition globally ranges from 19.7% to 40.4% [3]. Osteoporosis presents a significant challenge to healthcare systems, particularly affecting postmenopausal women due to the marked decrease in estrogen production. With demographic changes, the global population aged 60 and older is expected to nearly double from 12% (900 million individuals) in 2015 to 22% (2 billion) by 2050 [4]. In Kazakhstan, the population aged 50 and above is projected to increase by 35% by 2035, with those aged 70 and above increasing by 95% [5]. For women aged 50, the lifetime risk of sustaining an osteoporotic fracture is nearly 50%, with a mortality rate of approximately 20% within the first-year post-fracture [6].

An audit conducted across eight Eurasian countries on the osteoporosis burden and lifetime hip fracture risk in populations aged 50 and older found the highest incidence rates in Kazakhstan. The study reported a probable fracture risk of 12.6% for women in Kazakhstan. This data was compiled from available literature and surveys of national osteoporosis societies' representatives [7]. However, no prior studies have examined osteoporosis diagnosis using dual-energy X-ray absorptiometry (DXA) in populations in Kazakhstan, nor have risk factors contributing to osteoporosis prevalence in this demographic been explored.

Bone mineral mass in adults is determined by the peak bone mass achieved during growth and the rate of bone loss over time. A balanced diet is essential for bone health, with evidence showing that a diet rich in calcium, phosphorus, protein, and vitamin D can improve bone health [8]. Additionally, regular physical activity supports bone density maintenance and reduces fracture risk, which increases with age-related bone mass and strength declines [9]. Insufficient nutrient intake and physical inactivity elevate the risk of osteoporosis and falls [10]. Clinical risk factors further enhance fracture risk assessment beyond DXA, including age, history of fragility fractures, family history of hip fractures, corticosteroid use, excessive alcohol consumption, smoking, and bone metabolism disorders [11]. The lack of comprehensive data on osteoporosis prevalence and risk factors in Kazakhstan hampers targeted prevention and treatment strategies. As preventive measures can reduce the risk of osteoporosis [12]. Osteoporosis diagnosis is confirmed based either on fractures occurring with minimal trauma or low bone mineral density (BMD) assessed via DXA, the "gold standard" in diagnostic imaging for this condition [13]. The operational definition of osteoporosis, endorsed by WHO, is a BMD T-score

of -2.5 or lower, assessed through DXA at the spine or hip [14].

Timely assessment of BMD via DXA and identification of bone health risk factors will assist in identifying the most impactful preventive strategies for reducing osteoporosis burden. This study aims to evaluate bone health and identify key risk factors contributing to reduced bone mineral density (BMD) among adults aged 45 years and older in the Abay region of Kazakhstan.

Materials and Methods.

Study Population:

Data were collected from July 2023 to March 2024 among 367 adults aged ≥45 years, all born and residing in the Abay region of Kazakhstan. Participants (367 women) were recruited at Semey Medical University Hospital and the "Toktamys" Medical Center. The mean age in the group with normal BMD was 55.00 ± 10.0 years and 57.5 ± 10.0 years in the group with low BMD (T/Z score < -1.0 SD).

Inclusion criteria were age ≥45 years and absence of congenital musculoskeletal disorders or prior DXA; exclusions included hip or lumbar surgery, inability to undergo DXA, residence outside Kazakhstan, or lack of consent. Participants were categorized into three age groups: 45–55 (perimenopausal), 56–65 (postmenopausal), and ≥66 years (elderly). The study complied with the Declaration of Helsinki, was approved by the Semey Medical University Ethics Committee (Protocol No. 7 dated 7 November, 2022), It was pre-registered on Clinicaltrials.gov on March 27, 2024 (ID NCT06344598).

Questionnaires:

Questionnaires were administered in person, with each participant assigned a personal ID. The instrument was adapted from the IOF (accessible at https://riskcheck.osteoporosis.foundation/form) osteoporosis risk questionnaire [15], translated into Kazakh and Russian, and piloted on 30 volunteers; repeated testing showed full agreement of responses, though only qualitative validation was performed. The questionnaire included demographic data and major osteoporosis risk factors (BMI, menopausal status and age at menopause, fracture history, height reduction, family history, smoking, alcohol intake, outdoor and household activity). Additional sections assessed chronic diseases (endocrine, rheumatic, oncological), medication use (hormone therapy, immunosuppressants, antacids, antidiabetics), and dietary intake of calcium, vitamin D, dairy products, and other nutrient-rich foods relevant to bone health.

DXA Procedure:

Bone mineral density (BMD) measurements were performed using DXA (Osteosys 2020, Seoul, Republic of Korea), with a focus on the lumbar spine (L1-L4) following the International Society for Clinical Densitometry (ISCD) guidelines from 2007. The bone region of interest was determined manually and sometimes automatically. Osteoporosis was defined by bone density thresholds: a T-score of ≤ -2.5 SD indicated osteoporosis; scores from -1.0 SD to -2.5 SD indicated low bone mass (osteopenia); scores above -1.0 SD indicated normal bone density. Z-scores were used to assess BMD in premenopausal women and men under the age of 50. Z-score of -2.0 or lower is de-fined as "below the expected range for age", Z-score above -2.0 is "within the expected range for age" [16]. A qualified radiologist interpreted the BMD results. Patients were classified into two groups based on the following criteria: those with normal BMD and those with low BMD.

Laboratory Data:

Following the BMD assessment, each participant provided a fasting blood sample of 10 ml in the morning to measure levels of 25-hydroxyvitamin D, calcium, and alkaline phosphatase. Approximately 7 ml of blood was used for calcium and alkaline phosphatase analysis, while the remaining volume was used for vitamin D measurement. Blood samples were collected in tubes with coagulation activators and polymer gels. Samples were centrifuged at 2500–3000 rpm for 5 minutes to separate serum. Laboratory analyses were performed at the "Invivo" laboratory (license No. 19002293, issued February 1, 2019). The reference ranges for blood levels were as follows: calcium, 115-133 mmol/l; alkaline phosphatase, 156-369 U/l; and vitamin D, 30-100 ng/ml.

Statistical Analysis:

Frequencies were analyzed using Pearson's chi-square test or Fisher's exact test, with the latter applied for expected cell values of five or fewer. Due to non-normal distribution, confirmed via Kolmogorov–Smirnov test, continuous variables were analyzed using the Kruskal-Wallis tests. Due to non-normal distribution, confirmed via Kolmogorov–Smirnov test, comparisons between two groups (normal vs. low BMD) for continuous variables were conducted using the Mann–Whitney U test. Logistic regression analyses were conducted to evaluate the associations between osteopenia, osteoporosis, and key demographic characteristics, lifestyle factors, and dietary habits. Both unadjusted and adjusted odds ratios were calculated in the multivariate analyses. Statistical analyses were performed using IBM SPSS version 23.0, with differences deemed statistically significant at $p<0.05$.

Results.

The characteristics of the study population by age group are summarized in Table 1. Participants aged 45-55 years comprised 168 individuals, those aged 56-65 years included 143 individuals, and those aged 66 and older included 56 individuals. Data collection covered demographic information, health history, lifestyle factors, and dietary habits. The average age of menopause among all participants was 46.50±6.30 years, with statistically significant differences observed between age groups. The average body mass index (BMI) was 25.07±6.84 kg/m², with no significant variation across the age groups. Among participants aged 66 years and older, specific factors showed statistically significant prevalence, including fractures from minor injuries (50.0%), frequent falls (37.5%), and height reduction greater than 3 cm (33.9%), surpassing rates seen in the younger age groups. Additionally, physical activity levels and alcohol consumption were lower in individuals aged 66 and older than in those under 66. In participants aged 45-55 and 56-65, serum levels of vitamin D, and alkaline phosphatase were lower, and serum calcium levels were higher compared to the levels observed in the 66 and older group (Table 1). Of the 367

Table 1. *The Basic Characteristics of Participants and Comparison Across Age Groups.*

Parameter	**Total (n=367)**	**45-55 years (n=168)**	**56-65 years (n=143)**	**66 and older (n=56)**	**Statistical criterion**	**p-value**
Female, n (%)	367 (100.0)	168(45.8)	143 (39.0)	56(15.2)	0.24	0.785
Weight (kg)	69.8±18.2	69.50 ±18.8	70.00±19.0	70.00 ±17.0	1.36	0.506
BMI(kg/m^2), median±IQR	25.07±6.84	25.60 ±7.33	24.97±6.60	24.64±6.60	3.68	0.158
Fractures, n (%)	113 (30.8)	43 (25.6)	42 (29.4)	28(50.0)	11.96	0.003
Frequent falls or fear of them, n (%)	109 (29.7)	38 (22.6)	50 (35.0)	21(37.5)	7.56	0.023
Decrease in height by more than 3cm, n (%)	69 (18.8)	21 (12.5)	29 (20.3)	19(33.9)	12.96	0.002
Somatic diseases, n (%)						
Hepatitis	4 (1.1)	3 (1.8)	1 (0.7)	0(0)	1.57	0.455
COPD	2 (0.6)	0 (0)	0 (0)	2(3.6)	11.16	0.004
Oncology	5(1.4)	3 (1.8)	1 (0.7)	1(1.8)	0.76	0.682
Diabetes	15 (4.1)	4 (2.4)	8 (5.6)	3(5.4)	2.30	0.316
Diseases of the thyroid and parathyroid	43 (11.7)	21 (12.5)	15 (10.5)	7(12.5)	0.34	0.843
Rheumatoid arthritis	54(14.7)	17(10.1)	27 (18.9)	10(17.9)	5.24	0.073
Medications, n (%)						
Antidiabetic	10(2.5)	3 (1.6)	4 (2.6)	3(4.6)	1.89	0.388
Antacids	1 (0.2)	1 (0.5)	0 (0.0)	0(0.0)	1.15	0.563
Immunosuppressants	7 (1.7)	3 (1.6)	4 (2.6)	0(0.0)	1.89	0.389
Glucocortiocosteroids	62 (15.2)	21 (11.1)	26 (17.0)	15(23.1)	6.05	0.049
Vitamin D	62 (15.2)	31 (16.3)	21 (13.7)	10(15.4)	0.443	0.801
Calcium	44 (10.8)	21 (11.1)	17 (11.1)	6(9.2)	0.194	0.907
Behavioral risk factors, n (%)						
Physical activity,	263 (71.7)	124 (73.8)	107 (74.8)	32(57.1)	6.89	0.032
Time spend outdoors	299 (81.5)	139 (82.7)	117 (81.8)	43 (76.8)	1.00	0.605
Family history of osteoporosis	53 (14.4)	29 (17.3)	20 (14.0)	4(7.1)	3.52	0.172
Fractures in parents	47 (12.8)	25 (14.9)	18 (12.6)	4 (7.1)	2.26	0.323
Alcohol (3 units or more)	5 (1.4)	1 (0.6)	4 (2.8)	0(0.0)	3.70	0.157
Smoking (20 cigarettes or more)	9 (2.5)	2 (1.2)	5 (3.5)	2(3.6)	2.06	0.356
Laboratory indicators (average)						
Calcium (mmol/l), median±IQR	2.38±0.13	2.38±0.11	2.38±0.14	2.32±0.16	0.66	0.72
Vitamin D(ng/ml), median±IQR	13.15±7.68	13.32±8.46	12.99±6.78	16.62±14.95	2.73	0.26
Alkaline phosphatase (U/l), median±IQR	90.15±31.50	93.15±33.60	86.90±22.2	98.00±45.90	2.18	0.34
Densitomery, n (%)						
	total	45-55 years	56-65 years	66 and older	15.41	<0.004
Healthy	197(53.7)	107(63.7)	66(46.2)	24(42.9)		
Osteopenia	93 (25.3)	38(22.6)	40(25.9)	14(32.1)		
Osteoporosis	77 (21.0)	23(13.7)	40(28.0)	14(25.0)		
Menopause, n=367						
Age, median±IQR	46.50±6.30	47.00±6.30	47.00±7.30	43.50±8.30	29.29	<0.001

participants, 25.3 % were diagnosed with osteopenia and 21.0% with osteoporosis.

In line with the study objectives, participants were classified into two groups based on their bone mineral density (BMD) test results: a normal BMD group and a low BMD group. The mean age in the normal BMD group was 55.00 ± 10.0 years, whereas in the low BMD group it was 57.5 ± 10.0 years. Comparative analysis between these groups revealed statistically significant differences in BMI (p<0.001), history of fractures (p=0.032). However, serum levels of calcium, vitamin D, and alkaline phosphatase did not show significant differences between the groups.

The results of the nutrition preference questionnaire for participants with normal and low BMD are presented in Table 3. As shown, 65.9% of respondents in the low BMD group and 57.9% in the normal BMD group reported consuming nuts and dried fruits "not every day," a difference that was statistically significant (p=0.033). According to our survey, 23.5 % of individuals with low BMD consumed eggs daily, compared to 39.1 % in the normal BMD group. Additionally, a greater number of respondents in the low BMD group reported consuming eggs "not every day" compared to the normal BMD group (64.7% vs. 50.8%, respectively), with statistically significant differences (p=0.006). The relationship between dietary habits and bone health in Kazakhstan could potentially be analyzed by focusing on individual nutrients rich in protein, n-3 polyunsaturated fatty acids (n-3PUFAs), and calcium, such as meat, seafood, dairy products, and vegetables. However, no statistically significant differences were found for these food items between the comparison groups.

Regression analysis of risk factors indicating a significant association with reduced BMD is shown in Table 4. The

Table 2. *Bone Mineral Density Categories.*

Parameter	Total (n=367)	Normal BMD (n=197)	Low BMD (n=170)	Statistical criterion	p-value
Female, n (%)	367(100.0)	197(53.7)	170(46.32)	3.948	0.47
BMI (kg/m2), median±IQR	24.82±6.37	26.40±6.80	23.23±5.95	12196.0	<0.001
Weight (kg)	69.25±17.4	73.00±17.5	65.50±17.3	12603.5	<0.001
Fractures after minor injuries and falls, n (%)	113(30.8)	51(25.9)	62(36.5)	4.79	0.032
Frequent falls or fear of them, n (%)	109(29.7)	56(28.4)	53(31.2)	0.33	0.569
Decrease in height by more than 3cm, n (%)	69(18.8)	37(18.8)	32(18.8)	1.20	0.992
Somatic diseases, n (%)					
Hepatitis	4(1.1)	3(1.5)	1(0.6)	0.73	0.390
COPD	2(0.5)	1(0.5)	1(0.6)	0.011	1.000
Oncology	5(1.4)	3(1.5)	2(1.2)	0.081	0.775
Diabetes	15(4.1)	8(4.1)	7(4.1)	0.001	0.978
Diseases of the thyroid and parathyroid	43(11.7)	25(12.7)	18(10.6)	0.390	0.532
Rheumatoid arthritis	54(14.7)	24(12.2)	30(17.6)	2.17	0.141
Medications, n (%)					
Antidiabetic	10(2.5)	7(3.1)	3(1.7)	0.801	0.371
Antacids	1(0.2)	0(0.0)	1(0.6)	1.28	0.257
Immunosuppressants	7(1.7)	5(2.2)	2(1.1)	0.677	0.411
Glucocortiocosteroids	62(15.2)	33(14.4)	29(16.2)	0.250	0.617
Vitamin D	62(15.2)	33(14.4)	29(16.2)	0.250	0.617
Calcium	44(1.8)	22(9.6)	22(12.3)	0.752	0.386
Behavioral risk factors, n (%)					
Physical activity	296(72.5)	167(72.9)	129(72.1)	0.037	0.847
Time spend outdoors	299(81.5)	159(80.7)	140(82.4)	0.163	0.686
Family history of osteoporosis	53(14.4)	30(15.2)	23(13.5)	0.213	0.644
Fractures in parents	47(12.8)	26(11.4)	21(12.4)	0.058	0.809
Alcohol (3 units or more)	5(1.4)	1(0.5)	4(2.4)	2.31	0.128
Smoking (20 cigarettes or more)	9(25.5)	3(1.5)	6(3.5)	1.536	0.215
Laboratory indicators					
Blood calcium (mmol/l), median±IQR	2.38±0.13	2.38±0.10	2.40±0.19	1564.50	0.74
Vitamin D(ng/ml), median±IQR	14.37±9.32	13.52±7.43	15.23±11.21	1594.5	0.62
Alkaline phosphatase (U/l), median±IQR	90.15±31.50	91.45±35.80	90.00±25.40	1594.5	0.27
Menopause, n=367					
Age, median±IQR	46.50±6.30	45.50±6.30	48.50±6.80	9248	0.063

regression analysis identified several indicators associated with the likelihood of bone preservation. Among them, the final multivariate model showed significance for age (AOR 1.034; 95% CI from 1.004 to 1.064; p=0.025), weight (AOR 0.975; 95% CI from 0.948 to 1.002; p=0.071), BMI (AOR 0.989; 95% CI from 0.917 to 1.065; p=0.764, eating nuts and dried fruits (AOR 0.769; 95% CI from 0.448 to 1.321; p=0.341), eating eggs(AOR 0.639; 95% CI from 0.384 to 1.063; p=0.084), eating carbonated drinks (AOR 0.867; 95% CI from 0.519 to 1.450; p=0.587), eating fast food (AOR 0.677; 95% CI from 0.406 to 1.130; p=0.135). In a model with alternating factors, it is shown that the probability of impoverishment increases with age, and if at least some milk is present in the diet, the probability of impoverishment decreases with increasing weight and BMI if there are enough nuts and eggs in the diet compared to their absence or deficiency. The presence of at least some fast food and soda in the diet increases the decrease in BMD (little or enough compared to their complete absence) (Table 4).

Discussion.

In our study, groups of participants aged 45 and older were recruited to study risk factors affecting bone health at a younger age. The development of osteoporosis is influenced by a wide range of factors, which in a broad sense can be divided into unmodifiable and modifiable risk factors [17]. Osteoporosis has important clinical significance due to its role as a leading factor predisposing to osteoporotic fractures [18]. The lifetime risk of osteoporotic fracture is approximately 50% for women by the age of 50 [12]. Fractures are the most severe consequence of osteoporosis and lead to a significant economic burden [19]. In our study, 113 out of 367 people (30.8%) reported that they had a history of fractures.

Long G et al. report that early menopause (<40 years) is a predictor of low BMD and osteoporotic fractures, which is associated with a shorter reproductive period and low exposure to estrogens [20]. It is known that the average age of menopause is 50 years and older [21]. In our study, the average age of

Table 3. *Nutritional intake in the normal and low BMD groups.*

Parameter	Total (n=367)	Normal BMD (n=197)	Low BMD (n=170)	Statistical criterion	p-value
Consumption of milk and dairy products, n (%)				8.031	0.018
consume every day	149(40.6)	85(43.1)	64(37.6)		
consume not every day	193 (52.6)	93 (47.2)	100(58.8)		
not consume	25 (6.8)	19 (6.9)	6(3.5)		
Vegetables and greens, n (%)				0.033	0.984
consume every day	103(28.1)	56(28.4)	47(27.6)		
consume not every day	198 (54)	106 (53.8)	92 (54.1)		
not consume,	66 (18)	35 (17,8)	31 (18.2)		
Meat products (red meat), n (%)				4.000	0.135
consume every day	325(88.6)	180(91.4)	145(85.3)		
consume not every day	44 (10.8)	20 (8.7)	24 (13.4)		
not consume	1 (0.3)	0 (0.0)	1 (0.6)		
Fish and seafood, n (%)				0.394	0.821
consume every day	40(10.9)	22(11.2)	18(10.6)		
consume not every day	296 (80.7)	160 (81.2)	136 (80.0)		
not consume	31 (8.4)	15 (7.6)	16 (9.4)		
Nuts and dried fruits, n (%)				6.795	0.033
consume every day	101(27.5)	65(33.0)	36(21.2)		
consume not every day	226 (61.6)	114 (57.9)	112 (65.9)		
not consume	40 (10.9)	18 (9.1)	22 (12.9)		
Eggs, n (%)				10.246	0.006
consume every day	117(31.9)	77(39.1)	40(23.5)		
consume not every day	210 (57.2)	100 (50.8)	110 (64.7)		
not consume	40 (10.9)	20 (10.2)	20 (11.8)		
Carbonated drinks, n (%)				5.091	0.078
consume every day	36(9.8)	15(7.6)	21(12.4)		
consume not every day	181 (49.3)	92(46.7)	89 (52.4)		
not consume	150 (40.9)	90 (45.7)	60 (35.3)		
Fast food, n (%)				9.409	0.009
consume every day	8(2.2)	5(2.5)	3(1.8)		
consume not every day	165 (45.0)	74 (37.6)	91 (53.5)		
not consume	194 (52.9)	118(59.9)	76(44.7)		

Table 4. *Regression analysis of risk factors indicating a significant association with decreased BMD.*

Parameter	Univariate (OR)			Multivariate (AOR)*		
Models	**OR**	**95% CI**	**p**	**AOR**	**95% CI**	**p**
Age	1.034	1.004; 1.064	0.025	1.034	1.004; 1.064	0.025
weight	0.975	0.948; 1.002	0.071	0.975	0.948; 1.002	0.071
BMI	0.989	0.917; 1.065	0.764	0.989	0.917; 1.065	0.764
Eating nuts and dried fruits	0.769	0.448; 1.321	0.341	0.769	0.448; 1.321	0.341
Eating eggs	0639	0.384; 1.063	0.084	0.639	0.384; 1.063	0.084
Eating carbonated drinks	0.867	0.519; 1.450	0.587	0.867	0.519; 1.450	0.587
Eating fast food	0.677	0.406; 1.130	0.135	0.677	0.406; 1.130	0.135
*- multivariate model adjusts for confounders						

menopause for women aged 45 to 55 years was 46.1, for those aged 56 to 65 years it was 46.5, and for those aged 66 and older it was 44.3 years ($p<0.001$). Of the 367 study participants, 21.0% were diagnosed with osteoporosis, and 25.3% with osteopenia.

The highest prevalence of low BMD was observed in people over 50 years of age, which is consistent with the results of numerous studies that report that people over 50 years of age are five times more likely to develop osteoporosis than the general population [22,23]. Our survey of respondents showed that fractures, frequent falls, and decreased height tended to increase with age and were statistically significant in three age groups (Table 1). In this study, it was found that the probability of depletion of BMD decreases with increasing weight and BMI (AOR: 0.989; p=0.764). Another study reported that an increased BMI may be beneficial for the development of BMD, while an excessively high BMI may be harmful to bone health in women. The authors attribute this phenomenon to race, age, and the postmenopausal period [24]. Therefore, efforts aimed

at slowing the development of osteoporosis should be aimed at maintaining a normal BMI.

The survey illustrated that somatic diseases and medications reducing bone metabolism did not differ between the groups with low BMD and normal BMD. We believe that individuals over 45 years of age have comorbid somatic pathology and therefore consume a variety of medications, including those that reduce bone formation. Endocrine and rheumatologic disorders, chronic obstructive pulmonary disease (COPD), hepatitis, and malignant neoplasms are all potential causes of secondary osteoporosis [25]. Epidemiological studies indicate that approximately 60–80% of patients with rheumatoid arthritis (RA) have comorbid osteoporosis. According to population-based studies, the prevalence of osteoporosis is twice as high with RA compared to healthy individuals. However, it is important to note that no definitive conclusions can be drawn as to whether RA directly contributes to the development of osteoporosis, or whether the relationship is bidirectional or influenced by other factors [26]. Some studies have demonstrated that bone loss occurred in certain patients even before the diagnosis of RA, and BMD appears to be primarily associated with demographic factors [27]. In our study, regression analysis did not reveal a positive correlation between chronic pathologies and low BMD levels. It is estimated that fractures induced by glucocorticoids occur in 30–50% of patients undergoing long-term glucocorticoid therapy [28]. In our study, the group with low BMD included 170 individuals out of 367 participants (46,3%). Therefore, understanding the mechanisms of osteoporosis development with comorbid pathology at the age of 45 and older will help in early diagnosis and treatment of osteoporosis [9]. The role of nutrients and foods in bone metabolism and fracture risk has been discussed for many years [29,30]. Dietary recommendations are based on observational studies, which may contain unaccounted-for concomitant factors [31]. Our comparative analysis of the diet of residents of the Abay district showed that people with low BMD rarely or do not consume eggs (p=0.006), nuts and dried fruits (p=0.033). However, regression analysis reveal a correlation between dietary factors and low BMD levels (Table 3). Univariate analysis revealed statistically significant differences in the consumption of eggs and nuts/dried fruits between the groups with normal and low BMD. However, in the multivariate analysis, these dietary factors were not significant, likely due to the influence of confounding variables. The low BMD group was older, and older individuals traditionally consume fewer eggs and nuts, which explains the discrepancy between the univariate and multivariate analyses. Vitamin D plays a well-known role in maintaining calcium homeostasis related to bone health [32]. In bone tissue, vitamin D promotes the mobilization of calcium and phosphorus, indirectly affecting the differentiation of osteoclasts, which proliferate and stimulate bone resorption [33]. In addition, vitamin D deficiency, in addition to reducing calcium absorption, increases the level of parathyroid hormone, which, in turn, leads to calcium resorption from bones and a decrease in bone mass [34]. The main sources of vitamin D are exposure to sunlight and diet, and sufficient amounts of vitamin D are found only in a limited number of foods - insufficient exposure to the sun poses a serious public health problem [35]. A study conducted in the western region of Kazakhstan in 2019 examined the effect of ultraviolet radiation on vitamin D levels. The authors identified widespread vitamin D deficiency and concluded that this disease is most common in regions with limited exposure to sunlight [36]. The eastern region of Kazakhstan, where our study was conducted, is also an area with a prolonged period of limited sunlight exposure, which can lead to a decrease in vitamin D levels. In the course of our study, we determined the content of calcium, vitamin D and alkaline phosphatase in blood serum in the autumn-winter period. The vitamin D content in blood serum was below normal values (14.37±9.32 ng/ml), but we did not find a significant correlation between vitamin D levels and bone density in the two groups with normal and low BMD (Table 2). The eastern region of Kazakhstan, where our study was conducted, is also an area with a prolonged period of limited sunlight exposure, which can lead to a decrease in vitamin D levels. Deng et al. It has been reported that postmenopausal Chinese women with serum vitamin D levels below 30 ng/ml had lower bone density in the femoral neck, but this correlation was not observed in the lumbar spine [37]. The results of other studies [34,38] also indicate that the level of vitamin D in blood serum is not associated with BMD in postmenopausal women, which is consistent with the results of our study and confirms the absence of a link between vitamin D and BMD. Parde et al. Age has been reported to significantly correlate with alkaline phosphatase and calcium levels in the group of postmenopausal women [39]. In our study, the levels of calcium and alkaline phosphatase were assessed in both groups with normal and low BMD, and no significant correlation was found between the two groups.

Our study has important clinical significance. We found a high prevalence of osteoporosis among the population of the Abay region of Kazakhstan, which is 43.9%. The strategy of many countries, including Kazakhstan, regarding the prevention of osteoporotic fractures is mainly focused on postmenopausal women. In Kazakhstan, our study fills the gap in knowledge in the field of osteoporosis prevention. With limited budgets of medical organizations, knowledge of the factors will allow you to identify the key ones that can be influenced in order to give more specific recommendations on nutrition and lifestyle. Age groups are also important, the presence of factors for each age group requires a separate conversation with people of different ages. This study is limited by the fact that the sample included women living in the sharply continental climate of the eastern part of Kazakhstan, so the results may not be applicable to the whole of Kazakhstan and require further study. The sample was not very large and consisted of three age groups, so it was not homogeneous in age. In addition, no preliminary calculation of the sample size was carried out, which may limit statistical reliability and should be taken into account when interpreting the results. In the elderly, bone mineral density (BMD) may have been overestimated due to degenerative alterations, as only lumbar dual-energy X-ray absorptiometry (DXA) was employed. The survey of the respondents revealed the presence of somatic pathology, so it could affect the results of densitometry. It should be borne in mind that the risk factors were assessed

by the participants themselves, and the data may be inaccurate due to omissions or forgetfulness. In addition, data collection was prospective, and some data was retrospective, which led to certain limitations. Although many studies have been conducted on osteoporosis and osteopenia, this study may be important and new in terms of studying risk factors in middle-aged people for timely diagnosis of osteoporosis. Prevention of osteoporosis should be aimed at controlling risk factors such as body mass index, diet, as well as timely diagnosis and treatment of somatic pathology.

Conclusion.

This study highlights the high prevalence of low BMD among middle-aged and older adults in the Abay region and underscores key modifiable risk factors, including older age, lower BMI, eating nuts and dried fruits, eggs, carbonated drinks, fast food. These findings are essential for strengthening clinical diagnostic practices and guiding preventive strategies to reduce osteoporosis-related complications in the Kazakh population.

Author Contributions.

MM: Writing – original draft, Conceptualization, Formal analysis, Methodology, Visualization. GB: Writing – review & editing, Formal analysis, Methodology. GK: Writing – review & editing, Formal analysis, Methodology. MP: Writing – review & editing, Formal analysis, Methodology, Validation. AM: Conceptualization, Formal analysis

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Institutional Review Board Statement.

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Semey Medical University (Protocol No. 7 dated 7 November 2022).

Informed Consent Statement.

Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest.

The authors declare no conflict of interest.

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