BALNEO RESEARCH Balneo and PRM Research Journal
English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

Research article

Prevalence of osteoporosis and risk factors in different age categories in adult women

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Citation: Vizitiu E. , Costea A.I., Silişteanu S.C., - Prevalence of osteoporosis and risk factors in different age cat-egories in adult women
Balneo and PRM Research Journal
2023, *14(4): 627*

Academic Editor(s):
Constantin Munteanu

Reviewer Officer:
Viorela Bembea

Production Officer:
Camil Filimon

Received: 22.11.2023
Accepted: 04.12.2023
Published: 20.12.2023

Reviewers:
Mariana Rotariu
Cristina Popescu

Publisher's Note: Balneo and PRM Research Journal stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract: (1) Background: Analysis of risk factors and prevalence of osteoporosis in an elderly population suggests a study focused on identifying and evaluating factors contributing to osteoporosis among them. (2) Methods: The aim of this paper is to analyse and compare the prevalence levels of osteoporosis in different age groups in adult women, focusing on the identification and assessment of relevant risk factors. Hypothesis of the work: There are assumed to be significant correlations between adult women age groups and osteoporosis prevalence, and these correlations are influenced by a number of risk factors, including older age, BMI, family history of fractures, and BMD bone mineral density levels. (3) Results: There is a tendency to increase the average weight with age up to the age group of 70-79 years. Mean BMI values indicate significant variation in participants weight status, with relatively high values across all age groups. Mean T-score and Z-score values at femoral neck BMD indicate reduced bone mineral density, possibly associated with osteoporosis or osteopenia, especially in older age groups. (4) Conclusions: There is an increase in average weight with age, and BMI values are relatively high across all age groups, indicating the importance of monitoring and managing body weight to prevent complications associated with osteoporosis.

Keywords: osteoporosis, risk factors, elderly population

Introduction

Analysis of risk factors and prevalence of osteoporosis in an elderly population suggests a study focused on identifying and evaluating factors contributing to osteoporosis among them. This analysis could look at known or potential risk factors for developing osteoporosis and explore how widespread this condition is among this elderly population. Osteoporosis is a systemic condition characterized by loss of bone density and increased fragility of bones, making them susceptible to fractures [1]. According to WHO, bone mass density is assessed by DEXA examination (dual absorptiometry by X-ray), it is a rapid test that is performed at the level of the lumbar spine (vertebrae L1-L4) and at level of the hip joint [2]. Following the DEXA exam, 2 indicators are obtained that are taken into account in the diagnosis of osteoporosis, namely the Z-score that is obtained by referring to normal values for the same age and sex, but in current practice, the most used is the T score. If its value is less than -2.5, the diagnosis is osteoporosis. Osteopenia has a T-score between -2.5 and -1.0 [3,4]. The impact of this condition on health and quality of life is significant, as associated bone fractures can cause a number of complications and significantly limit the mobility and independence of affected individuals. People diagnosed with osteoporosis are more prone to bone fractures, especially at the level of the hip, spine and wrist.

Osteoporotic fractures [5] significantly increase morbidity and may impact mortality. Understanding the epidemiology of these fractures is crucial to develop effective strategies to reduce their impact on public health. World statistics show that in 1990 1.7 million people were diagnosed with hip fracture. It is assumed that in 2050 the number of people with this diagnosis will reach 6 million. Studies show that Taiwan's hip fracture rate was the highest in the world [6].

In Romania, menopause was found to occur 10 years faster than the internationally allowed limit, which increases the risk of osteoporosis. Studies show a high percentage of osteopenia with over 10% compared to the limits accepted abroad, which shows that during the bone formation period there was a poor diet [2]. Among the elderly population, osteoporosis is more common due to the natural aging process, when bone strength decreases, plus lack of education and social factors. Risk factors such as lack of physical activity, a diet low in calcium and vitamin D, oral glucocorticoid therapy due to rheumatologic disease [7],

family history, active smoking and excessive alcohol consumption, obesity, body mass index ≤ 19, immobilization, chronic diseases can influence the occurrence and progression of osteoporosis [8-10].

Therefore, identifying and understanding the risk factors associated with this condition is crucial for implementing preventive measures and management strategies that reduce the risk of fractures and improve the quality of life of the people affected by osteoporosis. Study [11] highlights discrepancies in addressing osteoporosis in the elderly population and the need for greater involvement of physicians in the education and treatment of these patients. Encouraging a proactive attitude on the part of affected people regarding treatment is crucial; especially in view of future demographic changes. The authors of this study [12] drew relevant conclusions on loss of bone mineral density (BMD) at an old age in both women and men, with a downward trend as they age. In particular, in men, a continuous decrease in BMD is observed, although it remains higher than that in women, and the rate of loss is slower. Consistent risk factors associated with bone loss in the elderly include female gender, thinning, and weight loss of 5% or more. At the same time, weight gain (by 5% or more) appears to offer protection against bone loss in both men and women. There are also modifiable risk factors, such as weight, estrogen consumption, and smoking. They that can influence bone health. The authors [13] also consider movement an extremely complex and varied process, the result of the intricate interaction between the organism and its environment. It involves activities carried out by multiple structures that make up joints, such as ligaments, tendons, muscles, as well as the intervention of the nervous system in controlling them. Thus, various pathologies can influence the Neuro-Myo-Arthro-Kinetic System (NMAK).

For example, in a recent study [14], the importance of using therapeutic swimming for postmenopausal women was emphasized. This approach focuses on maintaining an appropriate morphophysiological status in order to ensure stability and prevent fractures associated with osteoporosis. Recent studies have shown that by maintaining bone mass and maintaining adequate muscle tone, osteoporosis can be prevented [8,15,16] .It is also important to expose daily to the sun for a period of 5 to 15 minutes, with a frequency of 2-3 times a week, thus influencing the synthesis of vitamin D [17]. It is worth mentioning the role of balanced diet and supplements of magnesium, calcium and potassium [18-21]. Important for the prevention of osteoporosis is also the practice of physical activity (Antonescu, Higgs) as well as the importance of calcium intake, both dietary and medicinal, influencing bone mass, with the role of preventing fractures by falling [15,22,23].

Another element to consider is the alkaline diet that correlates with the patient's age, physical activity and protein intake, thus preventing muscle loss [24].

Studies by researchers [25-28] have shown that patients diagnosed with osteoporosis who performed a controlled and individualized exercise program had significant results compared to patients who did not exercise. These physical exercises also had a beneficial

role in patients diagnosed with osteoporosis and who had vertebral fracture, being influenced walking, balance, posture, and last but not least the quality of life [29,30].
And other studies [31-33] they show that moderately high physical activity is associated with a 45% reduction in the risk of hip fracture, given that over 90% of hip fractures are due to fall.
Other studies [34,35] it shows that people who exercised less than 1 hour per week had an 85% risk of hip fracture. An analysis from another 2016 study highlights the results over a 12-month period of a group of patients diagnosed with osteoporosis and vertebral fractures, which assessed the effects of exercise on functional mobility, balance, pain and quality of life [36].
Emotional support, cooperation between family members and medical personnel can help the patient understand risk factors and the importance of exercise [37].

2. Material and method

Objectives of the work: Identification and evaluation of risk factors associated with the development of osteoporosis; Determining the prevalence of osteoporosis within the age category of the population studied; Analysis of the impact of risk factors on the development and progression of osteoporosis; The need to develop aquatic programs for patients affected by osteoporosis.
The aim of this paper is to analyses and compares the prevalence levels of osteoporosis in different age groups in adult women, focusing on the identification and assessment of relevant risk factors.
Hypothesis of the work: There are assumed to be significant correlations between adult women's age groups and osteoporosis prevalence, and these correlations are influenced by a number of risk factors, including older age, BMI, family history of fractures, and BMD bone mineral density levels. In organizing and conducting the research, we included in the study a sample of 50 patients aged 50 to 79 years old who had undergone DEXA testing for osteoporosis.
This analysis was performed both in the C.F. Suceava Ambulatory and in the Interdisciplinary Research Centre for Motricity Sciences and Human Health, respecting ethical and deontological principles. Based on patient analyses, we used the FRAX Assessment Tool to estimate fracture risk. The longitudinal study started in September 2023 and will continue until December 2024.
The criteria for inclusion in the study were: patients diagnosed with osteoporosis by DEXA test, patients age between 50-79 years old, patients agreement to participate in the study, without neurological disorders or chronic diseases in acute stage.
The exclusion criteria were: age of patients <50 years old and >79 years old, patients who were uncooperative or had decompensated neurological or chronic conditions.
There are numerous investigations worldwide that analyze the influence of active and passive forms of leisure on the physical and mental health of different categories of the population [38]. Study [39] highlights certain health problems faced by adulthood, as well as awareness of practicing physical exercise in water and on land, in order to combat them, and following the study [40], the researchers found that pain, especially somatic pain, exerts a significant impact on quality of life, influencing individuals' overall health, emotional states, and physical conditions.
A recent study [41] confirmed that the aquatic environment offers a number of significant benefits compared to the terrestrial environment.
These advantages obtained through activities carried out in water are fundamental and manifest throughout the body, impacting motor, functional and aesthetic ability.

3. Results

Table 1. Statistical calculation - age category 50-59

Statistical indicators	Age	Weight	Height	BMI	BMD femoral neck		BMD lumbar spine		
					Scor T	Scor Z	Scor T	Scor Z	BMD g/cm3
X	55.65	73.94	157.53	29.52	-1.17	-0.68	-2.76	-1.54	0.75
α	2.22	16.75	6.50	4.87	1.13	1.01	0.28	0.46	0.11
Cv%	3.99	22.65	4.13	16.50	-96.51	-148.37	-10.10	-30.11	14.75

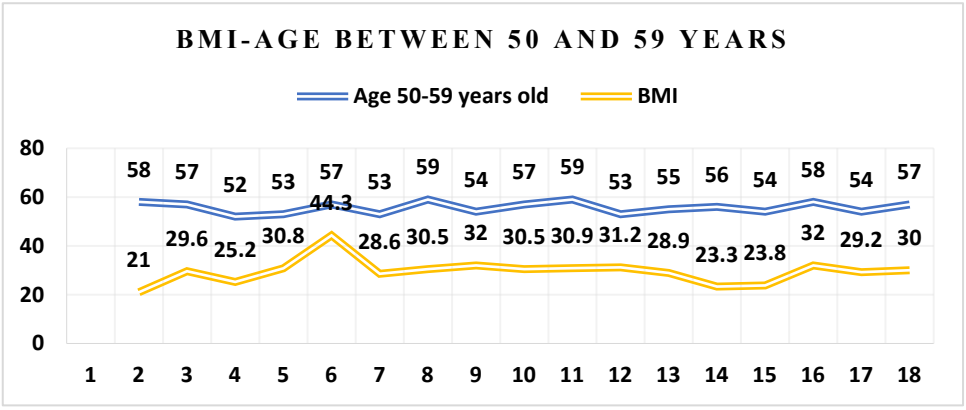

Figure 1. Graphical representation of BMI

The average BMI is about 29.52, with a standard deviation of about 4.87. In this regard, there is a significant variation in the weight status of participants.

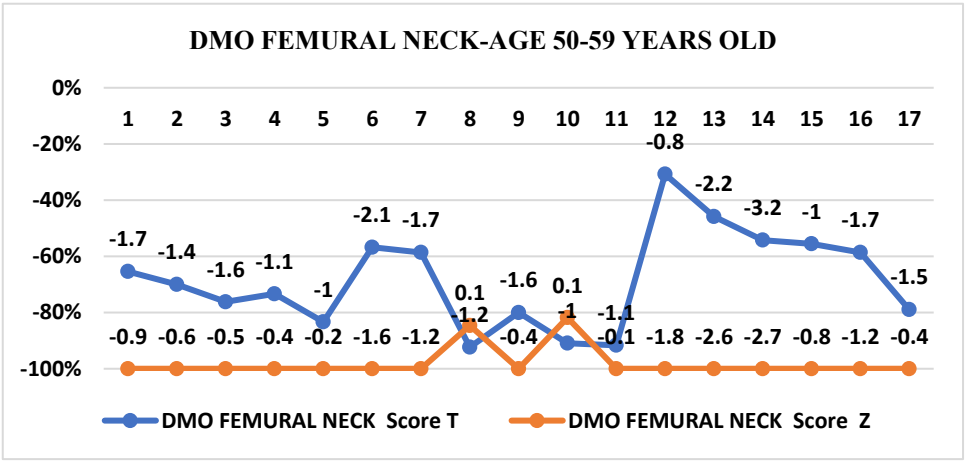

Figure 2.Graphic representation BMD femoral neck

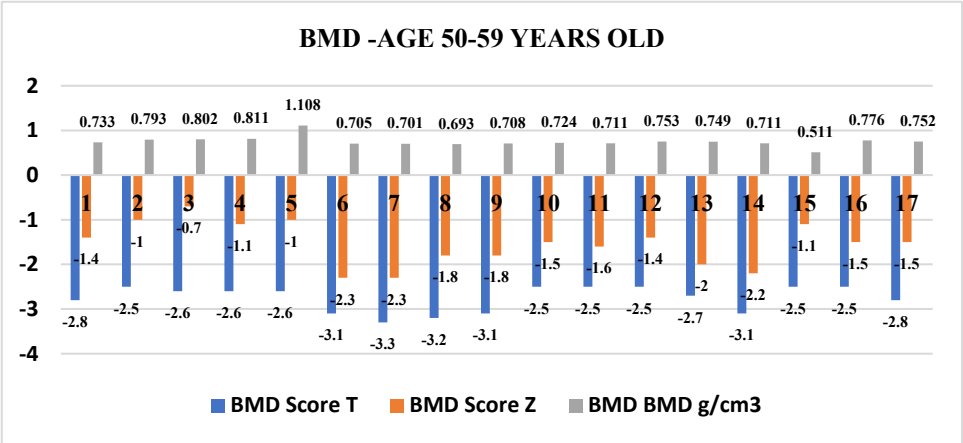

Figure 3. BMD graphic representation

The T-score for femoral neck BMD averages about -2.76, with a standard deviation of about 0.28, while the Z-score is about -1.54, with a standard deviation of about 0.46. These scores suggest reduced bone mineral density, indicating the possible presence of osteoporosis or osteopenia among participants.

Table 2. Statistical calculation - age category 60-69

Statistical indicators	Age	Weight	Height	BMI	BMD femoral neck		BMD lumbar spine		
					Scor T	Scor Z	Scor T	Scor Z	BMD g/cm3
X	65.18	70.18	157.68	28.14	-1.99	-0.75	-2.81	-1.30	0.76
α	2.46	14.53	6.64	4.85	0.67	0.61	0.61	0.91	0.13
Cv%	3.78	20.70	4.21	17.23	-33.75	-81.08	-21.71	-69.73	16.44

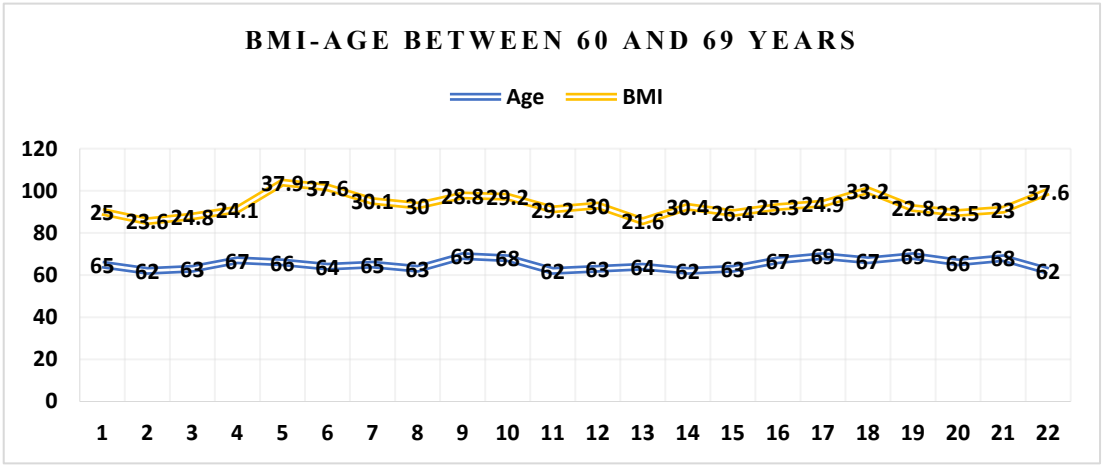

Figure 4. Graphical representation of BMI

BMI (mean = 28.14, standard deviation = 4.85, variability coefficient = 17.23%): The average body mass index (BMI) is about 28, which indicates a relatively high value. Standard deviation and coefficient of variability suggest a significant variation in BMI among individuals in this dataset.

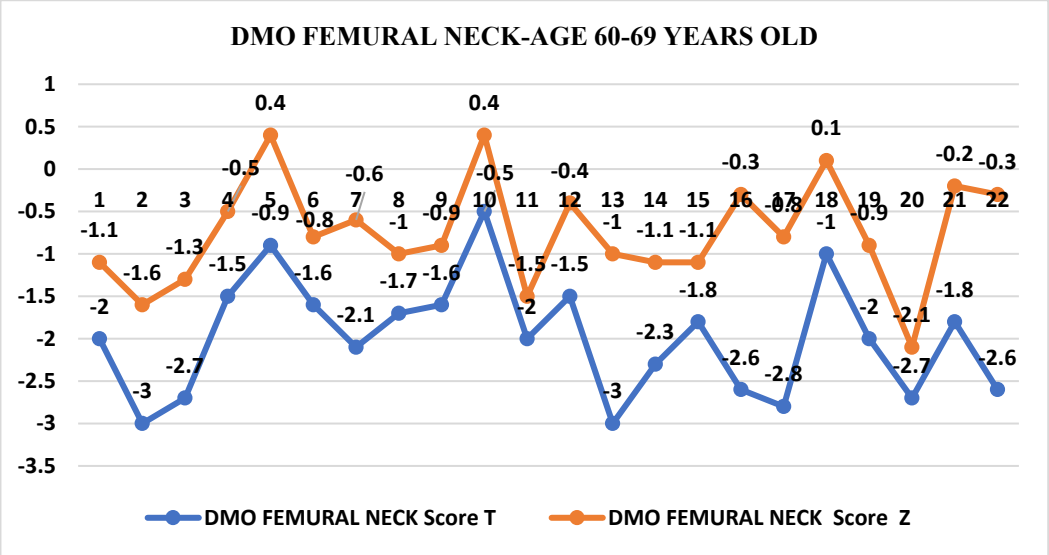

Figure 5. Graphic representation BMD femoral neck

Femoral neck BMD (mean = -1.99, standard deviation = 0.67, variability coefficient = -33.75%): The T-score for femoral neck bone mineral density is on average -1.99, and the standard deviation is relatively small, indicating a concentration of values around this statistical average.

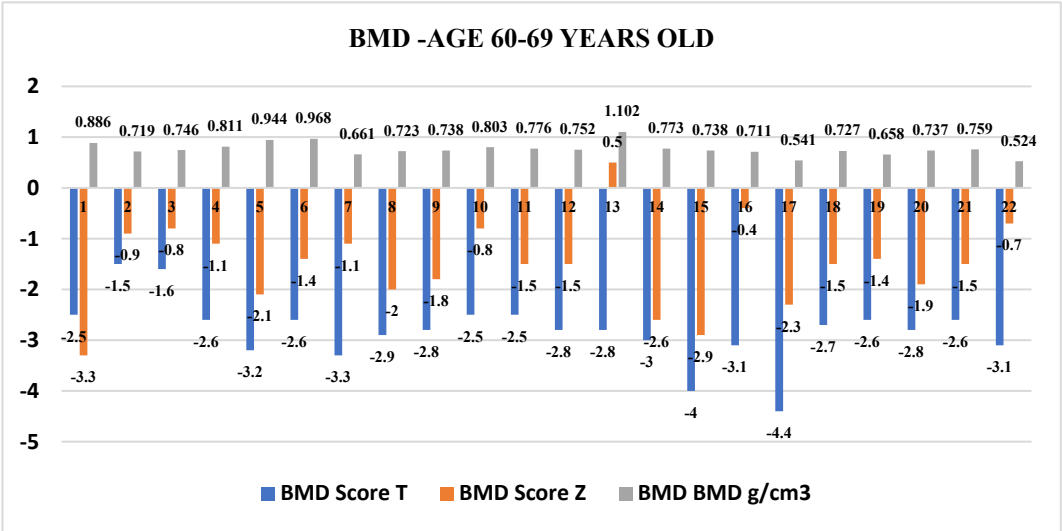

Figure 6. BMD graphic representation

BMD (mean = -2.81, standard deviation = 0.61, coefficient of variability = -21.71%): Bone mineral density (BMD) averages -2.81, and standard deviation indicates a relatively small dispersion of data around this mean.

Table 3. Statistical calculation - age category 70-79

Statistical indicators	Age	Weight	Height	BMI	BMD femoral neck		BMD lumbar spine		
					Score T	Score Z	Score T	Score Z	BMD g/cm3
X	72.73	68.45	155.55	28.35	-1.56	-0.29	-2.84	-0.75	0.74
α	2.49	9.92	7.48	3.94	0.90	0.43	0.36	0.76	0.07
Cv%	3.42	14.49	4.81	13.90	-57.28	-147.64	-12.78	-101.58	8.94

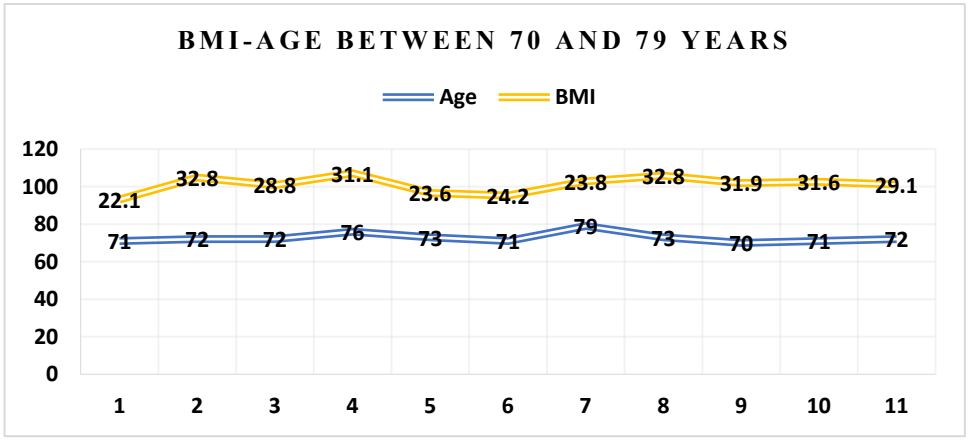

Figure 7. Graphical representation of BMI

BMI (mean = 28.35, standard deviation = 3.94, variability coefficient = 13.90%): The average body mass index (BMI) is about 28, which indicates a relatively high value. Standard deviation and variability coefficient indicate a significant variation in BMI among individuals in this dataset.

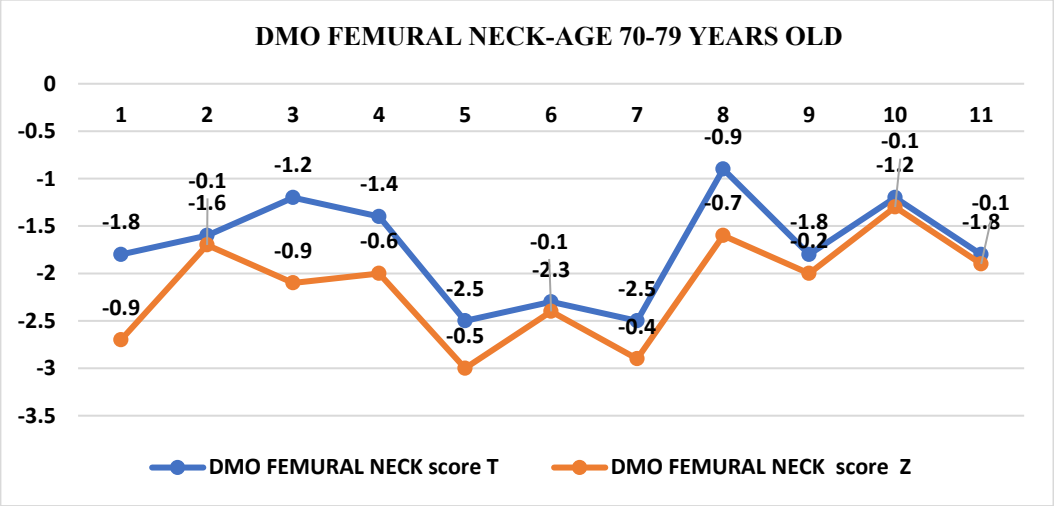

Figure 8. Graphic representation BMD femoral neck

Femoral neck BMD (mean = -1.56, standard deviation = 0.90, variability coefficient = -57.28%): The T-score for femoral spine bone mineral density averages -1.56, and standard deviation indicates a relatively large dispersion of data around this mean.

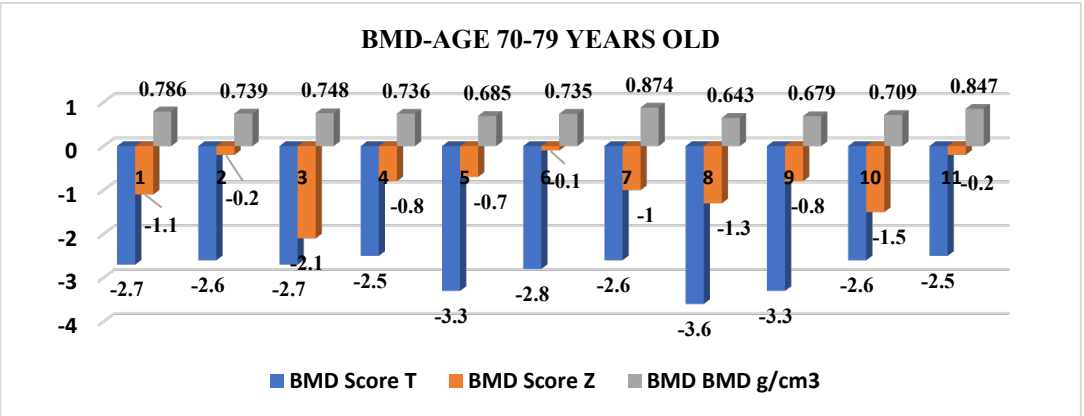

Figure 9. BMD graphic representation

BMD (mean = -2.84, standard deviation = 0.36, coefficient of variability = -12.78%): Bone mineral density (BMD) averages -2.84, and standard deviation suggests a relatively small dispersion of data around this mean.

In order to find out the probabilities of fractures over a period of 10 years, for the analysis proposed for the study, the FRAX instrument was used. It takes into account several factors, such as: age, sex, family history of fractures, body mass index (BMI), alcohol consumption and BMD values (bone mineral density) at the level of the femoral neck.

In this regard, we will give as an example a 65-year-old patient, BMI 25.0, BMD-with a T-score of -0.5. A minor reduced bone density can be observed.

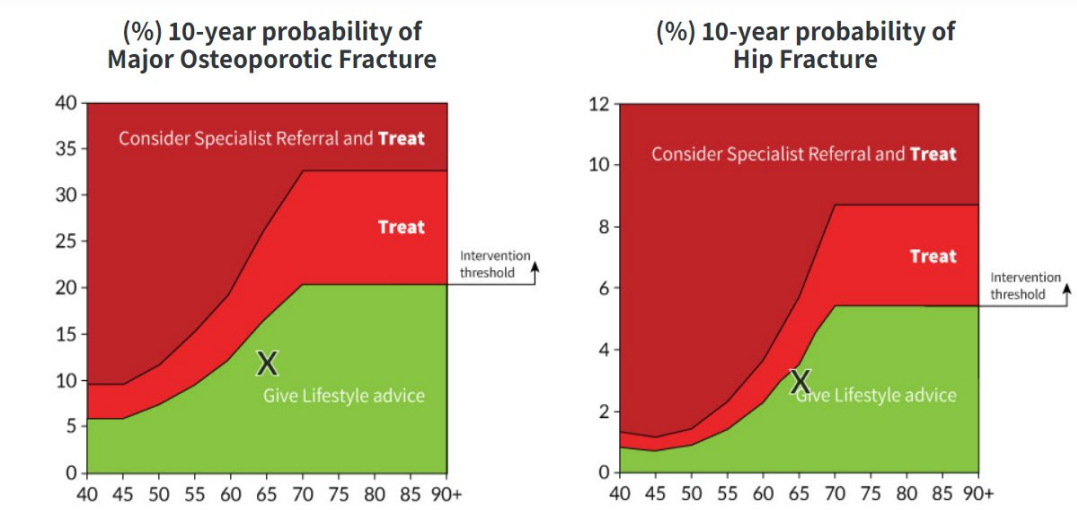

Figure 10. Model de (%)10-years probability of major Osteoporotic Fracture and (%)-years probability of hip Fracture (https://frax.shef.ac.uk/FRAX/tool.aspx?lang=ro)

Table 4. Difference in statistical indicators on age categories

					BMD Femoral neck		BMD lumbar spine		
Average age category	Age	Weight	Height	BMI	Score T	Score Z	Score T	Score Z	g/cm3
X-age 50-59 years old	55.65	73.94	157.53	29.52	-1.52	-0.89	-2.76	-1.54	0.75
X-age 60-69 years old	65.18	70.18	157.68	28.14	-1.99	-0.75	-2.81	-1.50	0.76
The difference	9.53	3.76	0.15	1.38	-0.46	-0.14	-0.05	-0.04	0.01
X-age 70-79 years old	72.73	68.45	155.55	28.35	-1.73	-0.42	-2.84	-0.89	0.74
The difference	7.55	1.73	2.14	0.21	-0.26	-0.34	-0.02	-0.61	0.02

In terms of weight and BMI, there is a tendency to increase average weight with age to the age group 70-79 years, where the average weight is highest.

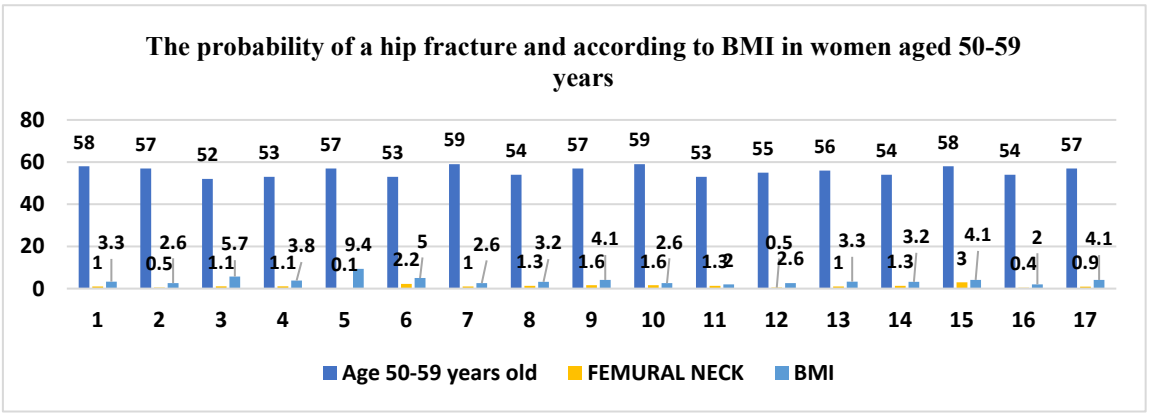

Figure 11. BMI graphic representation and hip invoice

The coefficient of variation for the femoral neck is about 57.25%. This coefficient is quite large, indicating a significant variation between femoral neck measurements. The coefficient of variation for BMI is about 45.88%. This coefficient suggests a moderate variation in BMI values in the sample of the age group 50-59 years.

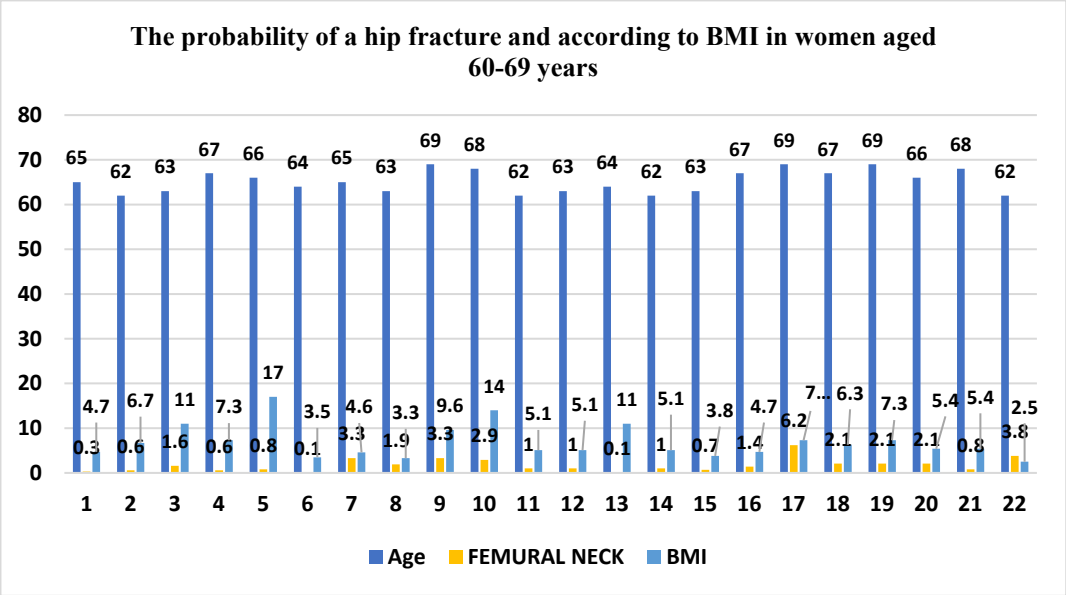

Figure 12. BMI graphic representation and hip invoice

The coefficient of variation for the femoral neck is about 83.85%. This coefficient is quite large, indicating a significant variation between femoral neck measurements. The coefficient of variation for BMI is about 51.79%. This coefficient suggests a moderate variation in BMI values in the sample of the age group 60-69 years.

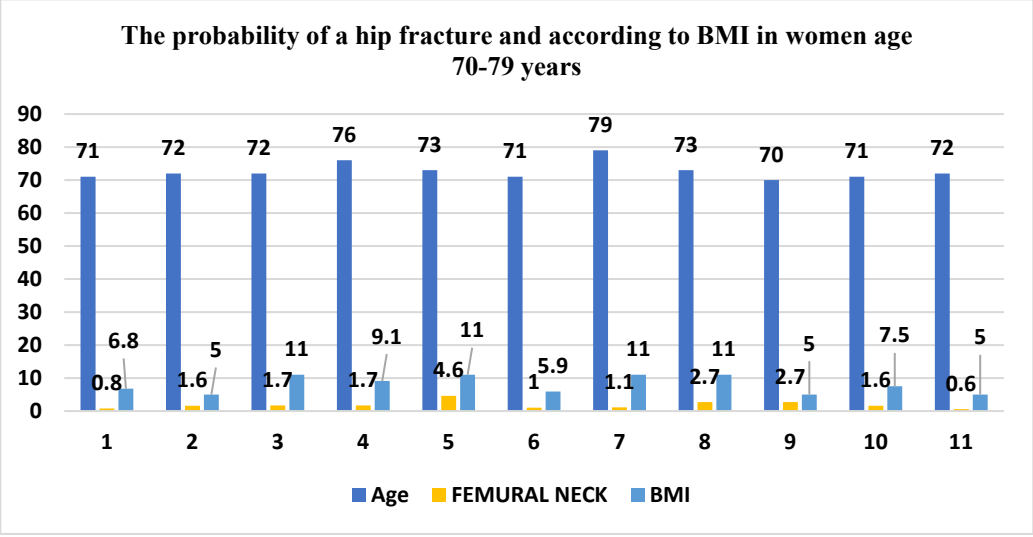

Figure 13.BMI graphic representation and hip invoice

The coefficient of variation for the femoral neck is about 59.77%. This high coefficient indicates a very large dispersion of data. There are significant variations between femoral neck measurements, and there are important differences between individuals. The coefficient of variation for BMI is about 31.49%. This coefficient indicates a moderate variation in BMI measurements compared to femoral neck measurements. However, BMI data is quite varied in this age group 70-79 years.

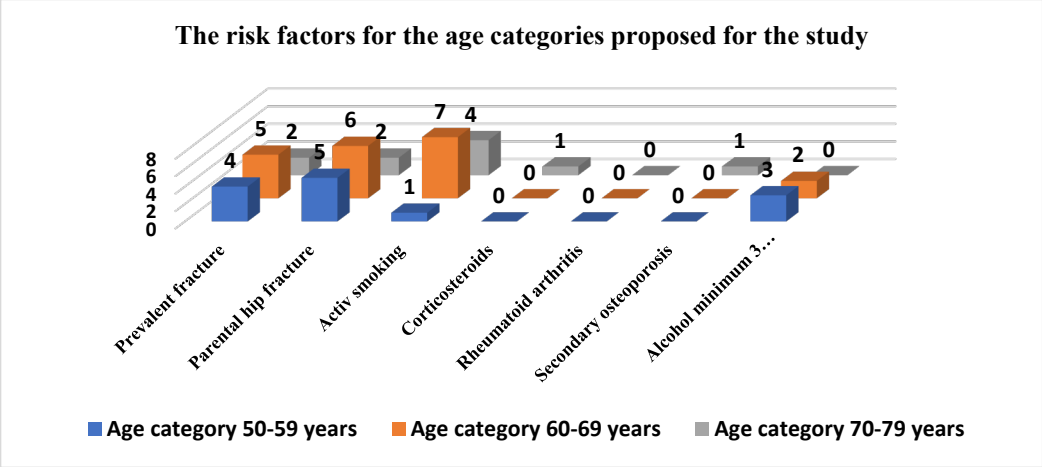

Figure 14. Graphical representation regarding risk factors in the age categories

It is observed that the number of people with prevalent fractures is higher in the age group 60-69 years (5) and lowest in the age group 70-79 years (2). Parenteral hip fractures are more prevalent in the 60–69 age group (6) and less prevalent in the 70–79 age group (2). Active smoking appears to be present in relatively similar proportions in the 50–59 years (5) and 60–69 years (6) age groups, but decreases in the 70–79 age group (2). Glucocorticoid consumption appears to increase with age, being smaller in the 50–59 age group (1), increasing in the 60–69 age group (7), and then decreasing in the 70–79 age group (4). Rheumatoid arthritis is more present in the 70-79 age group (1), while it is not reported in the other age groups. Secondary osteoporosis appears to be present to a small extent in the 70-79 age groups (1). Minimum alcohol consumption of 3 units per day is reported to a similar extent in the age groups 50–59 years (3) and 60–69 years (2), but is not reported in the age group 70–79 years (0).

Discussion: Fractures of the proximal humerus, forearm, and wrist account for about one-third of all osteoporotic fractures in the elderly. A study [42] looked at several risk factors for fractures in men and women ≥60 in Dubbo, Australia. Statistical data from this study suggest that older men and women largely have common risk factors for upper limb fractures, and that FNBMD is the primary risk factor. In another country (China), osteoporosis has seen an increase in prevalence over the past 12 years, affecting over a third of people over the age of 50. It is noted that this condition becomes more common with age and has been identified with a higher prevalence among women compared to that of men. Consequently, prevention and control measures are becoming increasingly important, given this growing trend of the spread of osteoporosis [43].

In the specialized literature it is shown that practicing regular physical exercise, individualized according to age, pathology, physical ability, is important in maintaining bone health, in increasing bone mineral density in the lumbar spine and femoral neck in elderly people, in increasing the quality of physical and mental life [1, 44-47]. It is important the onset of menopause that causes changes in the balance between bone formation and resorption, especially in conditions of estrogen deficiency [48-51].

Thus, in women there is an increased loss of bone density and mineral content at this level, which leads to an increased risk of fracture [49,52], and increased fragility [53]. In these conditions, taking into account the rapid growth of the aging population, osteoporosis is considered a public health problem, being the main cause of bone fracture in the elderly population, but especially in postmenopausal women, [54,55] affecting the quality of life of patients with this diagnosis and involving economic, social and therapeutic costs [4]. Osteoporosis can cause pain, restricted ROM and impact the ADL-scores in a negative way [53].

There are studies that highlight the beneficial effect of practicing individualized physical exercise (in patients with osteoporosis), for bone health, for increasing joint mobility and quality of life, [54,56] contributing to better absorption of calcium [46,57,58] and promoting bone formation [59], but also the secretion of sex hormones [60,61]. After a certain age, lifestyle should be phocused on increasing physical activity levels, quitting smoking, limiting alcohol consumption, preventing the risk of falls and ensuring an adequate diet, taking calcium and vitamin D supplements [62,63]. Thus, WHO recommended the practice of physical exercise for the prevention and treatment of non-drug osteoporosis [61, 62].
One study undeline the negative correlation between fat mass and bonemass, in spite of the load on the bones [63-65].
This study highlights that obesity and sarcopenia are present in elderly people from New Zeeland, with high risk of falling. Preserving muscle and bone mass, enhancing physichal abilities in elderly are primary objectives, as stressed by the high presence of osteoporosis in goups SS (sarcopenic phenotype) and SO (sarcopenic obese phenotype) [66].

5. Conclusions

There is a tendency to increased average weight with age to the age group 70-79 years. Mean BMI values indicate a significant variation in participants' weight status, with relatively high values across all age groups. Mean values for T-score and Z-score at femoral neck BMD indicate reduced bone mineral density, possibly associated with osteoporosis or osteopenia, especially in older age groups.

There is an increase in average weight with age, and BMI values are relatively high in all age groups, indicating the importance of monitoring and managing body weight to prevent complications associated with osteoporosis.

The development of exercise programs on land and water may be essential for managing and improving the quality of life of people affected by osteoporosis, given the significant variations observed in the analyzed data.

The use of tools such as FRAX to assess the likelihood of long-term fracture emphasizes the importance of assessing multiple risk factors in determining individual fracture risk.

The coefficients of variation suggest significant variations in age, femoral neck, and BMI measurements, providing insight into the dispersion and concentration of the data. The use of the T-score underestimates the importance of age in contributing to risk. For example, the significance of osteoporosis in a 50-year-old woman differs from that of a woman with the same BMD (and T-score) who is 70. The relative risk is higher in the younger woman, although the absolute risk is lower, at least in the short term [67].

Author Contributions: "Conceptualization, V.E.; methodology, V.E.; software, V.E.; validation, V.E.; formal analysis,V.E.; investigation, C.A.I.; resources, C.A.I.; data curation, C.A.I.; writing—original draft preparation, C.A.I.; Writing—review and editing, S.S.C.; visualization, S.S.C..; supervision, S.S.C; project administration, V.E.; funding acquisition, C.A.I.

The author has read and agreed to the published version of the manuscript."

Institutional Review Board Statement: "The study was conducted according to the guidelines of the Declaration of Helsinki, and ap-proved by the Institutional Review Board (or Ethics Committee) of „Stefan cel mare" University of Suceava (123/31.03.2023).".

Informed Consent Statement: All investigated peoples agreed to participate in the study.

Acknowledgments: The author of this work thanks the students of the Faculty of Physical Education and Sports from Suceava, for their involvement in the research carried out.

Conflicts of Interest: "The author declares no conflict of interest."

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