

# "THE IMPACT OF CALCIUM AND VITAMIN D<sub>3</sub> SUPPLEMENTS IN OSTEOPOROSIS PROPHYLAXIS"

*Irina GRAMĂ, Student, Faculty of Medicine No.1, Nicolae Testemițanu State University of Medicine and Pharmacy, Chișinău, Republic of Moldova*

*Inga NEAMȚU, Student, Faculty of Medicine No.1, Nicolae Testemițanu State University of Medicine and Pharmacy, Chișinău, Republic of Moldova*

*Maria MUNTEANU, PhD student, Nicolae Testemițanu State University of Medicine and Pharmacy, Chișinău, Republic of Moldova*

*Scientific Coordinator: Luminița SUVEICĂ, PhD in Medical Sciences, Associate Professor at the Department of Family Medicine, Nicolae Testemițanu State University of Medicine and Pharmacy, Chișinău, Republic of Moldova.*

**INTRODUCTION:** Osteoporosis is a metabolic bone disorder characterized by a reduction in bone mineral density and alterations in bone micro-architecture, leading to an increased susceptibility to fractures. Globally, this condition affects a considerable number of individuals, and its incidence is continuously rising, especially due to the aging population. The prevention and treatment of osteoporosis require a complex approach, with calcium and vitamin D<sub>3</sub> supplements playing a central role in strategies aimed at supporting bone health.[1]

Osteoporosis is a complex condition resulting from an imbalance between bone formation and resorption processes. This multifactorial disease involves a variety of factors, including hormonal changes, genetic influences, and nutritional and lifestyle factors. Hormonal deficiencies, such as a decrease in estrogen and testosterone levels, play a key role in reducing bone mineral density, while genetic predispositions can influence an individual's risk of developing the disease. In addition, inadequate nutrition, particularly calcium and vitamin D deficiencies, along with a lack of physical activity, significantly contribute to bone fragility.

Understanding the pathophysiology of osteoporosis is crucial for developing effective prevention and treatment strategies, considering the complexity and diversity of the factors involved. A comprehensive approach that includes nutritional supplementation, regular physical exercise, and, when necessary, pharmacological treatments can significantly contribute to reducing the incidence and severity of osteoporosis. Thus, a thorough understanding of the underlying mechanisms of this condition is essential for protecting bone health and preventing associated complications.

**METHODS:** For this research, a literature review was conducted in order to understand and

*CONTEXT: Osteoporosis is a major health issue with a high prevalence among the elderly population. Preventive interventions, such as the administration of calcium and vitamin D<sub>3</sub> supplements, can help reduce the risk of fractures. This paper provide evidence that can stay at the basis of a further investigation on the role of calcium and vitamin D<sub>3</sub> supplements in the prevention and reduction of osteoporosis risk.*

*METHODS: The study was carried out in two stages: a literature review and a descriptive study, carried out by administering a questionnaire to 60 participants aged between 20 and 60 years. The questionnaire included questions about dietary habits, the consumption of calcium and vitamin D<sub>3</sub> supplements, physical activity levels, and personal or family history of bone-related conditions.*

*RESULTS: The largest age group of respondents was between 20-30 years old, representing 51.7% of all participants in the question, the rest 16.7% aged 41-50 years, 15% aged 31-40 years, 8.3% under 20 years and 8.4% aged 51-60. The majority of participants had completed higher education (63.3%) and were female (76.7%). Among all respondents, 20% had a family history of osteoporosis, and 90% were aware of the role of calcium and vitamin D<sub>3</sub> in the prevention of osteoporosis. However, only half of them used calcium supplements (54.3%) and vitamin D<sub>3</sub> (63.3%). Following the use of supplements, 40% of respondents reported an improvement in bone health, with no side effects reported. Regarding dietary habits and physical activity, the majority of respondents consume foods rich in calcium (95%) and vitamin D (98.3%), and 46.7% engage in regular physical exercise. Among all respondents, 83.1% consider calcium and vitamin D<sub>3</sub> supplements effective, and 93.3% would recommend taking calcium supplements to others for the prevention of osteoporosis.*

*CONCLUSION: The results of this study confirm the importance of calcium and vitamin D<sub>3</sub> supplements in the prevention of osteoporosis. The study highlights the need for promoting better awareness about osteoporosis prevention and the necessity of developing national programs focused on preventing this condition. The implementation of preventive strategies could significantly contribute to improving the quality of life for patients.*

*Keywords: osteoporosis, bone health, calcium, vitamin D<sub>3</sub>, supplements*

elaborate the questionnaire staying at the basis of the cross-sectional study.

The main objective of the study was to analyze the effects of supplement use among the population. The questionnaire used to collect data was structured to provide comprehensive information about participants' dietary habits, medical history, lifestyle, along with details on the dosage and duration of supplement use.

The aim of the study is to provide evidence that can stay at the basis of a further investigation on analyzing the effect of Calcium and Vitamin D<sub>3</sub> supplements in the prevention of osteoporosis, with a particular focus on their role in supporting bone health and preventing the decline of bone mineral density. Possible further objective is to assess the combined impact of these supplements on reducing the risks of osteoporosis and bone fractures, as well as on the associated risk factors, while also considering the influence of an adequate diet and an active lifestyle. Research Objectives would be:

1. To evaluate the effects of Calcium and Vitamin D<sub>3</sub> supplements on bone mineral density.
2. To study the interaction between supplements and risk factors for osteoporosis, such as age, gender, diet, and physical activity.

3. To investigate the role of diet and an active lifestyle in enhancing the effectiveness of Calcium and Vitamin D3 supplements.

To assess the safety of long-term supplementation with Calcium and Vitamin D3, including identifying potential side effects.

Data collection stage: For this study, data collection was accomplished through a survey questionnaire, which was structured to answer relevant questions regarding the use of calcium and vitamin D3 supplements and their effects on bone health. The questionnaire was applied to people at high risk of osteoporosis (elderly people, especially postmenopausal women, people with a family history of osteoporosis and people with a sedentary lifestyle, poor nutrition). The participants were selected from urban and rural environments in the Republic Moldova, recruitment being carried out within the Family Health Centers from the Republic of Moldova. These people were identified through the recommendations of doctors, based on their medical history and lifestyle characteristics. The selection process took place between September 2024 and December 2024. The questionnaire consists of 5 sections and contains a total of 40 questions, of which 35 are closed and 5 are open. It also includes an introductory message describing the purpose of the research, details about the study organizers and the importance of participation.

Section 1 includes general participant data, which are essential for later analysis: participant's age, gender, education level (e.g., high school, higher education), occupation (to assess the impact of lifestyle on bone health), medical history (including family history of osteoporosis, bone conditions, or other conditions that may affect bone health). Section 2 aims to assess participants' knowledge and perception of osteoporosis and Calcium and Vitamin D3 supplements: knowledge about osteoporosis (what participants know about the prevention and treatment of osteoporosis); perceptions regarding the importance of supplements (e.g., whether participants consider supplements essential in preventing osteoporosis); sources of information about supplements (doctors, pharmacists, online sources, family, etc.); awareness of the benefits and risks of taking Calcium and Vitamin D3 supplements. Section 3 examines participants' behaviors regarding supplement use: types of supplements used (Calcium supplements, Vitamin D3, or combinations of these); daily dose of Calcium and Vitamin D3 administered; duration of use (how often per day, for how long supplements are used); participants' observations regarding changes in health after starting supplement use. Section 4 focuses on participants' diet and lifestyle, factors that may influence supplement effectiveness: eating habits (consumption of foods rich in Calcium and Vitamin D3, such as dairy products, leafy vegetables, fatty fish); level of physical activity (exercises that may support bone health, daily activity); other lifestyle habits (smoking, alcohol consumption, sleep); impact of diet on supplement effectiveness (e.g., interactions between supplements and certain foods); additional dietary supplements used in parallel (e.g., vitamins or minerals that support bone health). Section 5 explores the perceived impact of supplement use and their effectiveness: overall perception of the effectiveness of Calcium and Vitamin D3

supplements in preventing osteoporosis; perceived benefits (relief of joint pain, improved mobility, prevention of fractures); possible side effects observed; comparison of the effectiveness of supplements with other methods of osteoporosis prevention (e.g., physical exercises, medications prescribed by doctors); participants' recommendations regarding the use of supplements for osteoporosis prevention based on personal experience.

## RESULTS: LITERATURE REVIEW

According to findings in the literature review carried out in this research, some basic and relevant information are presented below.

Calcium is an essential mineral for the structure and health of bones, playing a crucial role in maintaining adequate bone density. An insufficient intake of calcium throughout life can increase the risk of osteoporosis, which is why calcium supplements are frequently used to prevent bone mass loss. Additionally, calcium contributes to the regulation of physiological processes involved in bone remodeling and to maintaining the structural integrity of bone tissue.[2]

Vitamin D3 plays an essential role in the proper absorption of calcium in the intestines and in maintaining an optimal level of calcium in the blood, significantly contributing to the prevention of osteoporosis. A deficiency in vitamin D3 can lead to reduced calcium absorption, but supplementation with this vitamin supports bone health by reducing the risk of bone loss and fractures.[3]

According to research, the combined use of calcium and vitamin D3 can have a beneficial synergistic effect, contributing to the prevention of osteoporosis by optimizing calcium absorption and maintaining bone density. This combination is particularly relevant for older individuals, who are at increased risk of fractures and bone mass loss.[4]

Identification and understanding of these factors are crucial for effective prevention and proper management of the disease, which is quite complex and caused by numerous risk factors, including the following:

1. Age  
As we age, bone density tends to decrease, thus increasing the likelihood of osteoporosis in elderly individuals.
  2. Gender  
Women are more prone to osteoporosis, especially after menopause, due to the reduction in estrogen levels, which is essential for maintaining bone health.
  3. Genetics  
A family history of osteoporosis may indicate an increased risk for this condition, suggesting a significant genetic component.
  4. Body Mass Index (BMI)  
Individuals with a low BMI have lower bone mass, making them more vulnerable to bone density loss.
1. Lifestyle
    - Diet: Inadequate intake of calcium and vitamin D can lead to insufficient bone mineralization.

- Lack of physical activity: Sedentarism can contribute to a decrease in bone density.
- Smoking and alcohol consumption: These habits can have a negative impact on bone health.

## Etiology

### 1. Hormonal Imbalances

**Estrogen:** Decreased estrogen levels, especially after menopause, are a major factor in the development of osteoporosis in women.

**Testosterone:** Men with low testosterone levels can also be affected by osteoporosis.

### 2. Medical Conditions

**Hyperthyroidism:** Excessive production of thyroid hormones can accelerate bone mass loss.

**Diabetes:** Individuals with type 1 diabetes have a higher risk of developing osteoporosis.

### 3. Medication Use

**Corticosteroids:** Long-term use of these medications is associated with secondary osteoporosis.

**Aromatase inhibitors and other hormonal treatments:** These therapies, used in cancer treatment, can affect bone density.[5]

Maintaining an adequate intake of calcium and vitamin D is crucial for bone health. Calcium is an essential component of the bone matrix, while vitamin D facilitates its intestinal absorption. A deficiency in these nutrients can lead to inefficient calcium absorption from the diet, which triggers a compensatory increase in parathyroid hormone (PTH) secretion. PTH stimulates bone resorption to release calcium into the bloodstream, which can weaken the bone structure over time.

Physical exercise, especially resistance and weight-bearing activities, is essential for maintaining and increasing bone mass. These activities stimulate bone formation through mechanotransduction processes, which activate osteoblasts and strengthen the bone. In contrast, a lack of physical exercise or a sedentary lifestyle can contribute to bone mass loss, increasing the risk of osteoporosis and related fractures.[6]

A recently discovered marker in the osteo-metabolic field is irisin, which has a significant impact on bone health, energy metabolism, and weight control. Discovered in 2012 by Boström and his team at Harvard University, irisin is produced in muscles in response to physical activity and plays a key role in the conversion of white adipose tissue into brown adipose tissue, a process called "browning," which helps prevent fat accumulation and improves energy metabolism.

Research has shown that irisin directly influences bone metabolism by stimulating the activity of osteoblasts, the cells responsible for bone formation, which may contribute to increased bone density and help prevent osteoporosis. This highlights the complex connection between muscles, adipose tissue, and the skeletal system, as well as the importance of physical activity for overall health.

Irisin is a relatively small protein (112 amino acids) and acts as a "messenger" between different tissues, having significant effects on metabolism and bone health. Its production increases during physical exercise and helps regulate metabolism in muscles, adipose tissue, and bones. Although it is not a hormone, irisin functions similarly, influencing the physiological and metabolic processes of the body.

These findings suggest that irisin could become an essential part of osteoporosis prevention strategies, complementing other treatments such as calcium and vitamin D3 supplementation.[7]

## Cross-sectional study

The questionnaire staying at the basis of cross-sectional study was completed by the general population from various socio-demographic backgrounds. Based on the results obtained through the methods described in Chapter II, we were able to provide a general characterization of the study sample. According to the recorded data, we observed that the largest proportion of respondents' ages is between 20-30 years, with 51.70% and 31 responses.

After analyzing the survey results, it was found that the majority of the participants, 76.7% (46 individuals), are female, while only 23.3% (14 individuals) are male. This predominance of women among the respondents can be explained by the fact that osteoporosis is a condition that more frequently affects women, especially after menopause. This predisposition is linked to the decrease in estrogen levels, a hormone essential for maintaining bone density. Additionally, women tend to be more aware of and interested in measures for preventing osteoporosis, which justifies their larger participation in the study. In contrast, men represent a smaller percentage of the participants, which reflects general trends, as osteoporosis is less common among them. However, it is important to note that the incidence of osteoporosis in men is on the rise, especially at older ages. The distribution of participants is highly relevant to the research objectives, providing a solid foundation for drawing conclusions specific to the group most at risk, namely women.

In the survey, participants were asked whether they had been diagnosed with osteoporosis or osteopenia. The results, presented in the graph, show the following: 93.3% of respondents, representing 56 individuals, indicated that they had not been diagnosed with these conditions, while 6.7% of respondents, i.e., 4 individuals, confirmed having a diagnosis of osteoporosis or osteopenia.

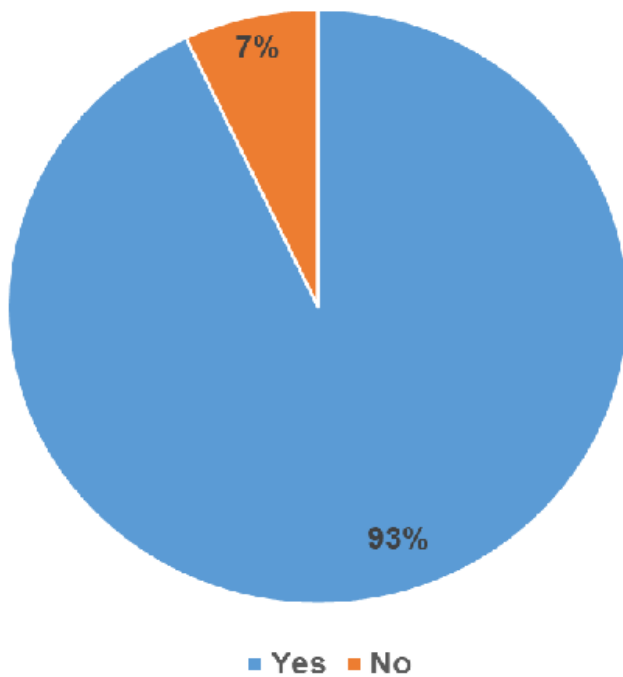
The results are represented in Graph No. 1.

These data suggest that the majority of respondents do not have osteoporosis or osteopenia, which may indicate a higher level of interest in prevention within this group. However, a small proportion of participants are already dealing with osteoporosis or osteopenia, signaling the need for broader education about the risks and preventive measures.

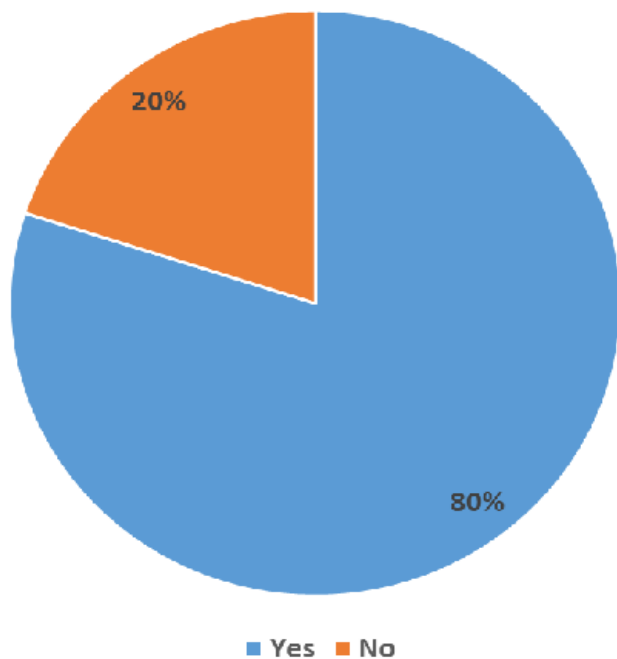
The results highlight the importance of preventive measures, such as calcium and vitamin D3 supplementation, to prevent the development or worsening



Graph No. 1. Diagnosis of respondents with osteoporosis or osteopenia.



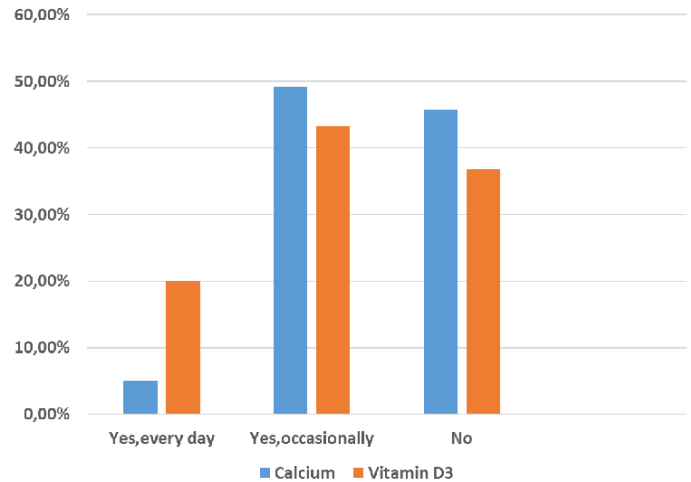
Graph No. 2. Family History of Osteoporosis



of osteoporosis and osteopenia, especially for individuals at higher risk. At the same time, this information can serve as a foundation for analyzing prevention behaviors and awareness levels within the scope of this study.

In the following chart, I aimed to analyze the family history of osteoporosis. Respondents were asked if there were any cases of osteoporosis in their family, and the results obtained are as follows: 80% of participants (48 people) answered negatively, indicating the absence of a family history of osteoporosis, while 20% of participants (12 peo-

Graph No. 3. Use of Calcium and Vitamin D3 Supplements by Respondents.



ple) confirmed the presence of osteoporosis cases within their family. The results are shown in Graph No.2.

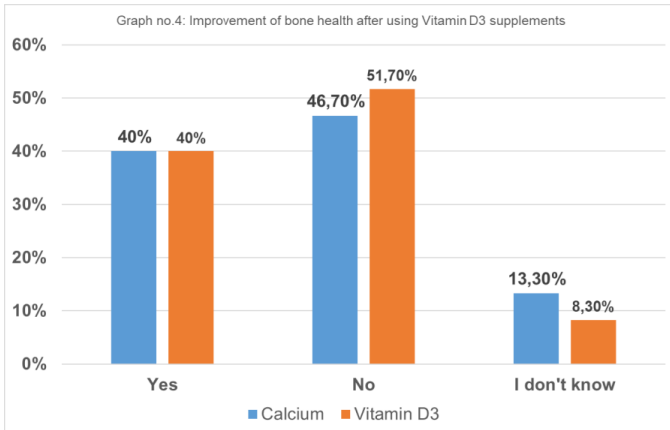
These data show that the vast majority of the surveyed individuals do not have a family history associated with osteoporosis, which could indicate a lower genetic risk for this condition. However, the 20% who reported a family history of osteoporosis suggest a group that might be more predisposed to developing the condition due to hereditary factors. The fact that family history is an important risk factor for osteoporosis is well known, as bone density and metabolic processes of bones may have a genetic component. For this reason, careful monitoring and implementation of preventive measures, such as calcium and vitamin D3 supplementation, are essential for individuals in the at-risk group. These results provide a clearer picture of the study group's characteristics and highlight the role of risk factors.

Following the analysis of the use of calcium and vitamin D3 supplements within a group of respondents, the results show a significant trend in consumption behavior. Approximately 49.2% of participants report not using calcium supplements, while 45.8% use them occasionally, and a smaller percentage take them daily. Regarding vitamin D3, 43.3% of respondents do not use this supplement, while 36.7% use it occasionally, and only 20% take it daily. These data are represented in Graph No.3.

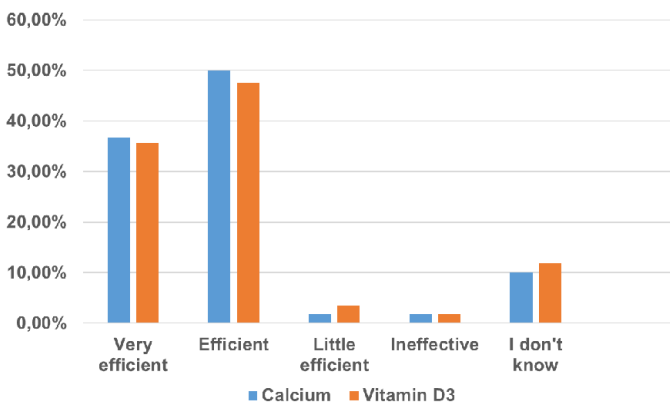
These data highlight a moderate use of dietary supplements, indicating that a significant portion of the population prefers occasional use or avoids supplements altogether, possibly due to a perceived lack of necessity or other factors such as education regarding their benefits. This behavior can influence the levels of essential nutrients in the population, emphasizing the need for educational campaigns on supplementation, especially for vitamin D3, considering its crucial role in bone health and the immune system.

1. The results regarding the perception of bone health improvement after using calcium and vitamin D3 supplements show a division of opinions among respondents. For vitamin D3 supplements, only 40% of respondents observed an improvement in bone health, while 8.3% → 16

**Graph No. 4. Improvement in Bone Health After Using Vitamin D3 Supplements**



**Graph No. 5. Evaluation of the effectiveness of calcium and vitamin D3 supplements in osteoporosis prevention**



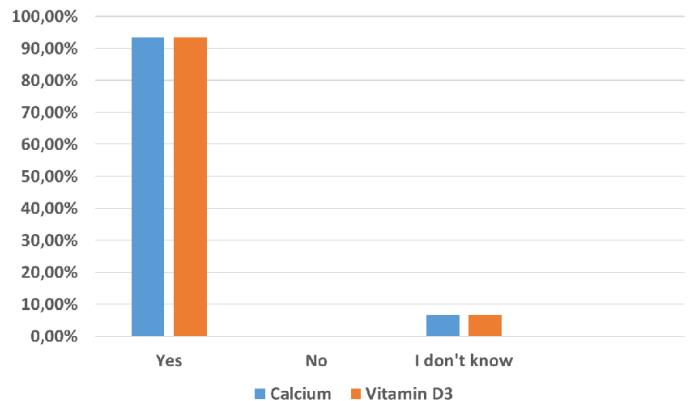
did not notice any benefits, and the majority (51.7%) were uncertain ("Don't know"). Similarly, for calcium supplements, 40% of participants reported benefits, but 13.3% stated they did not observe any improvements, while 46.7% could not assess the effects. These data are represented in Graph No. 4.

These findings suggest that a significant proportion of the population is unsure about the effects of supplementation on bone health. The results may reflect either a lack of proper monitoring of bone health status or a variable effectiveness of supplements depending on dosage, duration of use, or other pre-existing health conditions. These findings emphasize the need for further studies and education on the correct use and monitoring of supplement effects.

The results regarding the perception of the effectiveness of calcium and vitamin D3 supplements in preventing osteoporosis show varied opinions among respondents. For calcium supplements, 36.7% believe they are effective, and 10% rate them as very effective. However, half of the participants (50%) are unable to assess the effectiveness of these supplements, which may indicate a lack of information or a failure to monitor the results of consumption.

These findings suggest that there is a need for increased education and awareness regarding the benefits of calcium supplementation in osteoporosis prevention, as well as a greater emphasis on monitoring the outcomes of sup-

**Graph No. 6. Recommendation of calcium and vitamin D3 supplements**



plement use to evaluate their effectiveness.

On the other hand, the effectiveness of vitamin D3 supplements is considered effective by 35.6% of respondents and very effective by 11.9%. However, 47.5% of respondents are unable to provide a clear opinion on their effectiveness. The results are represented in Graph No. 5.

These results highlight the need for further education and research on the impact of vitamin D3 supplementation in preventing osteoporosis. The significant proportion of respondents who cannot assess its effectiveness indicates that more awareness and guidance are required to help individuals understand how these supplements can contribute to bone health and osteoporosis prevention.

These data suggest that, although a significant portion of the population recognizes the potential of calcium and vitamin D3 supplements in preventing osteoporosis, a large proportion remains uncertain, emphasizing the need for educational and awareness campaigns. Increasing awareness about the benefits of these supplements and their correct usage could help reduce the incidence of osteoporosis in the population.

The analysis of participants' responses to the question, "Would you recommend calcium and vitamin D3 supplements to others?" shows that the overwhelming majority of respondents (93.3%) consider calcium and vitamin D3 supplements essential for preventing osteoporosis, recommending them to others. This opinion reflects a high level of awareness regarding the role of these nutrients in maintaining bone health and preventing the loss of bone mineral density. However, the minority responses expressing uncertainty or reluctance underscore the importance of further education and proper information regarding the use of these supplements to ensure effective prevention and responsible use.

The responses are represented in Graph No. 6.

## CONCLUSION

The study highlights there are possible association between calcium and vitamin D3 supplements and prevention of osteoporosis, particularly among populations at risk of this condition. The data obtained from the questionnaire applied to the general population, coming from various socio-demographic backgrounds, provide

a clear picture of the awareness and behaviors related to osteoporosis prevention, especially concerning the use of these supplements.

Although a significant proportion of participants recognizes the potential benefits of calcium and vitamin D3 in maintaining bone health, there is still a need for further education and awareness campaigns to ensure that the broader population fully understands the importance of these supplements. The study also emphasizes the necessity of tailored preventive measures, particularly for individuals with risk factors such as age, gender, family history, and lifestyle habits.

The findings of this research underscore the role of calcium and vitamin D3 in supporting bone health and preventing osteoporosis, contributing to the development of more effective public health strategies for osteoporosis prevention.

**1. Demographics of Respondents:** The majority of study participants are young adults (aged between 20 and 30, representing 51.7% of total respondents), indicating that osteoporosis prevention is an area of interest among young adults, despite the fact that the condition is more commonly associated with older ages. Additionally, women represent a significant proportion of respondents (76.7%), reflecting their higher susceptibility to osteoporosis, especially during post-menopausal years. These results highlight the need for targeted educational campaigns for this vulnerable demographic group.

**2. Prevalence of Osteoporosis and Osteopenia:** The survey results show that most respondents (93.3%) have not been diagnosed with osteoporosis or osteopenia, suggesting an awareness of the importance of prevention. However, a small percentage (6.7%) of participants are already dealing with these conditions, highlighting the need for additional preventive measures, especially for those already in higher-risk groups.

**3. Family History of Osteoporosis:** Nearly 80% of respondents do not have a family history of osteoporosis, suggesting a lower incidence of hereditary factors among this group. However, 20% of participants reported having cases of osteoporosis in their family, underlining the importance of monitoring and implementing more rigorous preventive measures for individuals with a family history of the condition.

**4. Use of Calcium and Vitamin D3 Supplements:** The results show moderate use of calcium and vitamin D3 supplements, with about 49.2% of respondents not using calcium supplements and 43.3% not using vitamin D3. These findings suggest a lack of awareness regarding the benefits of these supplements. Furthermore, only a small proportion (20% for vitamin D3 and 13.3% for calcium) take them daily. This behavior suggests that a significant part of the population either does not perceive the need for supplementation or lacks education on their benefits for bone health.

**5. Perception of Supplement Effectiveness:** Data indicate that only 40% of respondents consider calcium and vitamin D3 supplements effective in improving bone

health, while a large proportion (46.7% for calcium and 51.7% for vitamin D3) could not assess their effects. This underscores the need for further education regarding the monitoring and evaluation of the effectiveness of calcium and vitamin D3 supplements, to help users assess their real benefits.

**6. Supplement Recommendations:** The majority of respondents (93.3%) consider calcium and vitamin D3 supplements essential for osteoporosis prevention and recommend them to others. This result could suggest an increased awareness of the role of these supplements in bone health, as well as the need for additional information to support their correct and responsible use.

### References

1. [Cosman F, de Beur SJ, LeBoff MS, et al. \(2014\). "Clinician's Guide to Prevention and Treatment of Osteoporosis." \*Osteoporosis International\*, 25\(10\), 2359-2381.](#)
2. [National Institutes of Health \(NIH\), Office of Dietary Supplements. Calcium - Fact Sheet for Health Professionals. Available at: <https://ods.od.nih.gov/factsheets/Calcium-HealthProfessional/>](#)
3. [Christakos, S., et al. \(2016\). Vitamin D: Metabolism, Molecular Mechanism of Action, and Pleiotropic Effects. \*Physiological Reviews\*, 96\(1\), 365-408.](#)
4. [Gallagher, J. C., et al. \(2015\). "Calcium and vitamin D supplementation: effects on bone mineral density and fracture risk." \*Journal of Clinical Endocrinology & Metabolism\*, 100\(4\), 1130-1136.](#)
5. [Masi, L., & MacDonald, A. \(2017\). "Osteoporosis: Pathophysiology and Management." \*Osteoporosis International\*, 28\(2\), 423-434.](#)
6. [Weaver CM, Gordon CM, Janz KF, et al. The National Osteoporosis Foundation's position statement on peak bone mass development and lifestyle factors: a systematic review and implementation recommendations. \*Osteoporos Int\*. 2016;27\(4\):1281-1386.](#)
7. [Boström, P., Wu, J., Jedrychowski, M. P., Korde, A., Ye, L., Lo, J. C., ... & Spiegelman, B. M. \(2012\). A PGC1- \$\alpha\$ -dependent myokine that drives brown-fat-like development of white fat and thermogenesis. \*Nature\*, 481\(7382\), 463-468.](#)