Calcium and vitamin D status in women of childbearing age in the rabat-Salé Kenitra region, Morocco

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Abstract: Vitamin D deficiency is a significant public health issue in Morocco, affecting a considerable portion of the population despite favorable climatic conditions and abundant sunlight. The objective of this study was to evaluate the prevalence of vitamin D and calcium deficiencies among women of childbearing age in the Rabat-Salé region. A cross-sectional study was conducted between 2009 and 2010, involving a sample of 432 women aged 20 to 49 years who were non-pregnant and residing in the Rabat-Salé region. The collected samples were analyzed for 25-hydroxyvitamin D (25-OHD) and calcium levels. The results revealed that 94% of women had a deficiency, with 59.7% experiencing severe deficiency and 35.07% having moderate deficiency. The median 25(OH)D level for the moderate group (12.52 μg/L) was higher than that of the severe group (7.20 μg/L). Additionally, more than 38.43% of women had hypocalcemia, with 16.86% suffering from severe hypocalcemia and 21.57% experiencing moderate hypocalcemia. These findings highlight the need for vitamin D supplementation and increased awareness of the importance of a diet rich in micronutrients, particularly among women in this region.

Keywords: 25-hydroxyvitamin D, Calcium deficiency, Moroccan women, Vitamin D deficiency.

1. Introduction

Vitamin D plays a crucial role in maintaining phosphocalcic homeostasis and preventing bone diseases. Its active form, 1,25-dihydroxyvitamin D, enhances intestinal absorption of calcium and phosphorus, reduces their urinary excretion, and mobilizes bone calcium [1]. Despite these fundamental functions, vitamin D deficiency is a global public health issue, particularly among women of childbearing age. This defiency is attributed to environmental, cultural, and biological factors, such as reduced sun exposure, diets low in vitamin D, and the increasing prevalence of obesity [2, 3].

In this context, several studies have highlighted the extent of this deficiency in specific populations. A survey conducted in the Lyon region in 2008 revealed that 50% of women aged 18 to 49 wearing covering clothing had serum vitamin D levels below 17 nmol/L, with only 1% having normal concentrations (≥ 75 nmol/L) [4]. The most frequently observed clinical signs among these patients included fatigue (50%), bone pain (29,2%), and muscle pain (26%) [4]. A recent study conducted in Casablanca in 2023 confirmed these finding, reporting that 69% of patients presented with vitamin D deficiency and similar clinical manifestations, such as bone and muscles pain [5].

The importance of vitamin D for both bone and general health, combined with the increasing prevalence of its deficiency, requires particular attention, especially for women living in cultural contexts where sun exposure is limited.

The objective of this study was to evaluate the prevalence of vitamin D and calcium deficiencies

among women of childbearing age in the Rabat-Salé region. This evaluation was conducted through an in-depth survey and clinical analyses of serum 25-hydroxyvitamin D (25OHD) and calcium levels in a sample of 432 women.

2. Methodology

2.1. Study Design

Our study design is a cross-sectional survey conducted between 2009 and 2010 to examine a sample of 432 (including 212 women for 25(OH) D sampling) non-pregnant women aged 20 to 49 years living in the Rabat-Salé region. The sampling process was based on a framework derived from the 2004 census and employed a multi-stage cluster sampling method.

Initially, 45 census areas were randomly selected. Within each area, a starting point was randomly determined using maps. From these points, households with at least one eligible women in the targeted age range were selected until 20 households were included. Finally, one eligible women per household was randomly selected to participate.

2.2. Data Collection

2.2.1. Anthropometric Measurements and Body Composition

With the help of trained personnel, data on sociodemographic characteristics, anthropometric measurements, and body composition analyses were collected through questionnaires administered during home visits. Subsequently, teams were dispatched from the Laboratory of Research and Medical Analyse of the fraternal of the Royal Gendarmerie (LRAM) to households to collect blood samples after an overnight fast.

2.2.2. Blood Sampling

Blood samples were collected directly at the participants' homes by clinical technicians from the Laboratory of Research and Medical Analyses of the Fraternal of the Royal Gendarmerie (LRAM). Participants were required to observe overnight fasting before the sampling to ensure the accuracy of biochemical analyses. The collected samples, intended for the analysis of 25-hydroxyvitamin D (25-OHD) and calcium, were then transported under controlled conditions directly to the LRAM. Upon arrival, the samples were stored according to international preservation standards, ensuring their integrity and reliability for subsequent analyses.

2.2.3. 1- Vit D

Blood samples were collected from participants into silica-containing dry tubes without anticoagulants to evaluate serum concentrations of 25-hydroxyvitamin D (25(OH) D) and total calcium. After centrifugation at 4500 revolutions per minute (r/min) for 10minutes to separate the serum, the samples were frozen at -20°C in the laboratory (LRAM) and subsequently transported to the biology center of hospitals at Casablanca (CBH) for analysis. Serum 25(OH)D concentrations were measured using the Cobas e311 analyzer, employing an electrochemiluminescence immunoassay (ECLIA). Vitamin D status was categorized into three levels:
 Optimal (≥20 µg/L), moderate (10–20 µg/L), and severe (≤10 µg/L).

2.3. Calcium

Total calcium was quantified using the Cobas 6000 system, based on a spectrophotometric endpoint method. These techniques allowed for a precise evaluation of serum 25(OH)D and calcium levels in the studied population.

2.4. Ethical Considerations

The study protocol was approved by the Ethicl and Deontological Consultative Committee of the

Institute of Research for development (IRD) in July 2009, as well as by the Moroccan Ministry of Health (letter no. 623 dated March 16, 2009). Subsequently, the Ministry of the Interior granted the necessary authorizations through the Wilaya of Rabat-Salé (authorization no.1823 for Salé and no.1824 for Rabat, dated April 7, 2009).Free and informed consent was obtained from eligible women, with consent forms prepared in both Arabic and French to ensure optimal understanding

2.5. Statistical Analyses

The statistical analyses were carried out by Statistical Package for the Social Sciences (SPSS, version 26.0). Variables with a normal distribution were presented as mean ± standard deviation (SD), while those with a non-normal distribution were reported as median. The relationship between serum vitamin D levels and Calcium was assessed using Pearson correlation. With $R^2=0,005$, statistically considered, no significant correlation between the variable.

3. Results

3.1. Classifications of Vitamin D Levels

The Table 1 represents the mean and standard deviation (SD) of the different classifications of vitamin D levels (severe deficiency : <10 µg/L, moderate deficiency: 10-20 µg/L). The mean for severe vitamin D deficiency is 6,823 ug/L with a standard deviation of 1,995 ug/L. subsequently; the second classification (moderate deficiency) shows a mean of 13,065 ug/L and a standard deviation of 2,552 ug/L.

Table 1.
Mean and Standard Deviation of the classifications of vitamin D levels.

	<10	10.0-20	20-30
N	126	74	11
Min.	3,000	8,560	20,270
Max.	9,950	19,200	25,500
Mean	6,823	13,065	22,185
Variance (n-1)	3,981	6,513	2,603
SD (n-1)	1,995	2,552	1,613

Figure 1 presents the vitamin D levels in two groups : <10 µg/L (severe deficiency), and 10.0-20 µg/L (moderate deficiency). The median vitamin D level was higher in individuals with moderate deficiency, at 12,52µg/L, compared to 7,20 µg/L in those with severe deficiency.
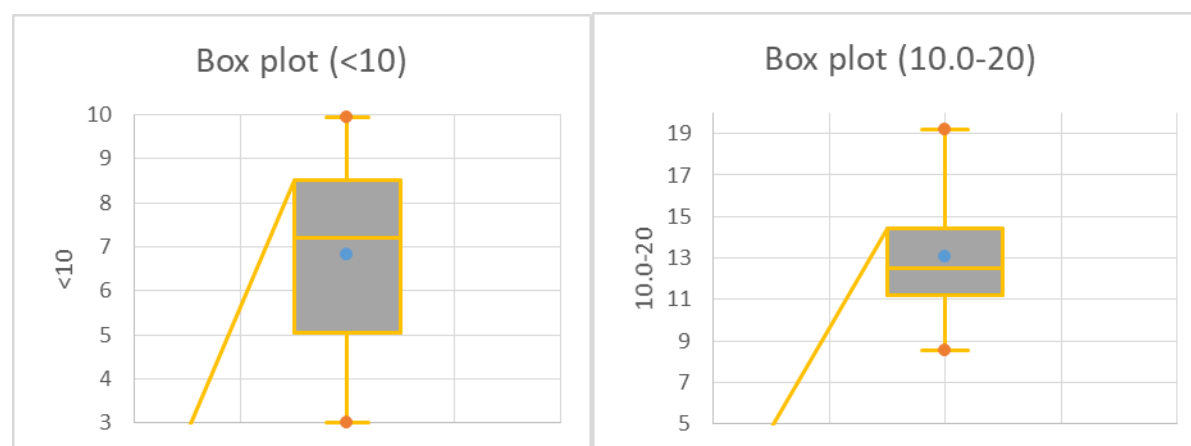

Figure 1.
Median of vitamin D levels in all participant categories.

3.2. Prevalence of Vitamin D Deficiency in Moroccan Women

This table above shows the prevalence of vitamin D deficiency among Moroccan women according to classifications (severe deficiency and moderate deficiency). Specifically, 59.715% of women suffer from severe deficiency, while 35.071% have moderate deficiency (Table 2).

Table 2.
Prevalence of vitamin D deficiency in Moroccan women.

Classification	Effective (n)	Prevalence (%)
<10	126	59.715
10.0-20	74	35.071
20-30	11	5.213

3.3. Classification of Calcium Levels

The Table 3 presents the mean and standard deviation (SD) for the different classifications of calcium levels: severe deficiency (<80.15 mg/L), moderate deficiency (80.15-84.16 mg/L), and optimal (84.16 − 104.20 mg/L). The mean calcium level for severe deficiency is 74.482 mg/L with a standard deviation of 5.006 mg/L. Similarly, the second classification, moderate deficiency, has a mean of 82.844 mg/L and a standard deviation of 2.552 mg/L.

Table 3.
Mean and SD of classifications of calcium levels.

	80.15-84.16	<80.15	84.16-104.20
N	261	261	261
Min.	63,330	51,670	85,030
Max.	88,400	79,980	144,560
Mean	82,844	74,482	93,907
Variance (n-1	6,510	25,064	84,443
SD (n-1)	2,552	5,006	9,189

The median of tree levels calcium (severe deficiency : <80.15 mg/L, moderate deficiency: 80.15-84.16 mg/L, and optimal level : 84.16-104.20 mg/L) presented as a box plot shown in Figure 2. The median calcium level was lower in individuals with severe deficiency, at 75.12mg/L, compared to 83.25 m/L in those with moderate deficiency, and 90.47 mg/L in those who had an optimal level.
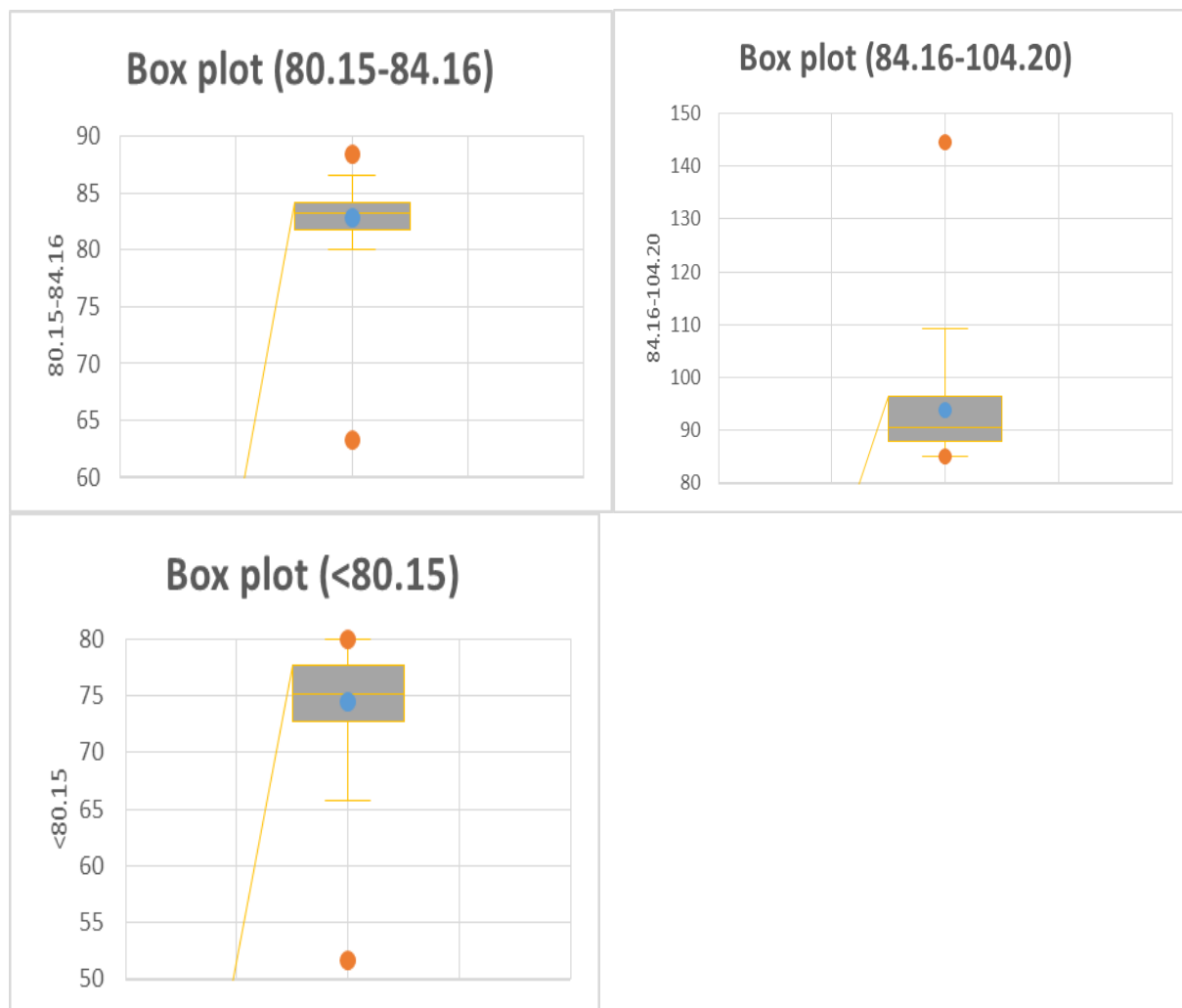
Figure 2.
Median calcium levels in all subject groups.

3.4. Prevalence of Calcium Deficiency in Moroccan Women

The data presented, as shown in the table above, illustrates the prevalence of calcium deficiency among Moroccan women, categorized into severe deficiency, moderate deficiency, and optimal levels. Specifically, 16.865% of women experience severe deficiency, while 21.577% have moderate deficiency of calcium (Table 4).

Table 4.
Prevalence of calcium deficiency in Moroccan women.

Classification	Effective (n)	Prevalence (%)
<80.15	77	16.865
80.15–84.16	93	21.577
84.16–104.20	261	61.556

3.5. Relationship between Serum Levels of 25-Hydroxyvitamin D(25OHD) and Calcium Levels

The Figure 3 illustrates a linear regression analysis between calcium (Ca) levels and vitamin D(vit D) levels (μg/L). The coefficient of determination ($R^2 = 0.005$) indicates that the proportion of calcium

variance explained by vitamin D is extremely low (0.5%). this suggests that there is no significant correlation between calcium and vitamin D levels.
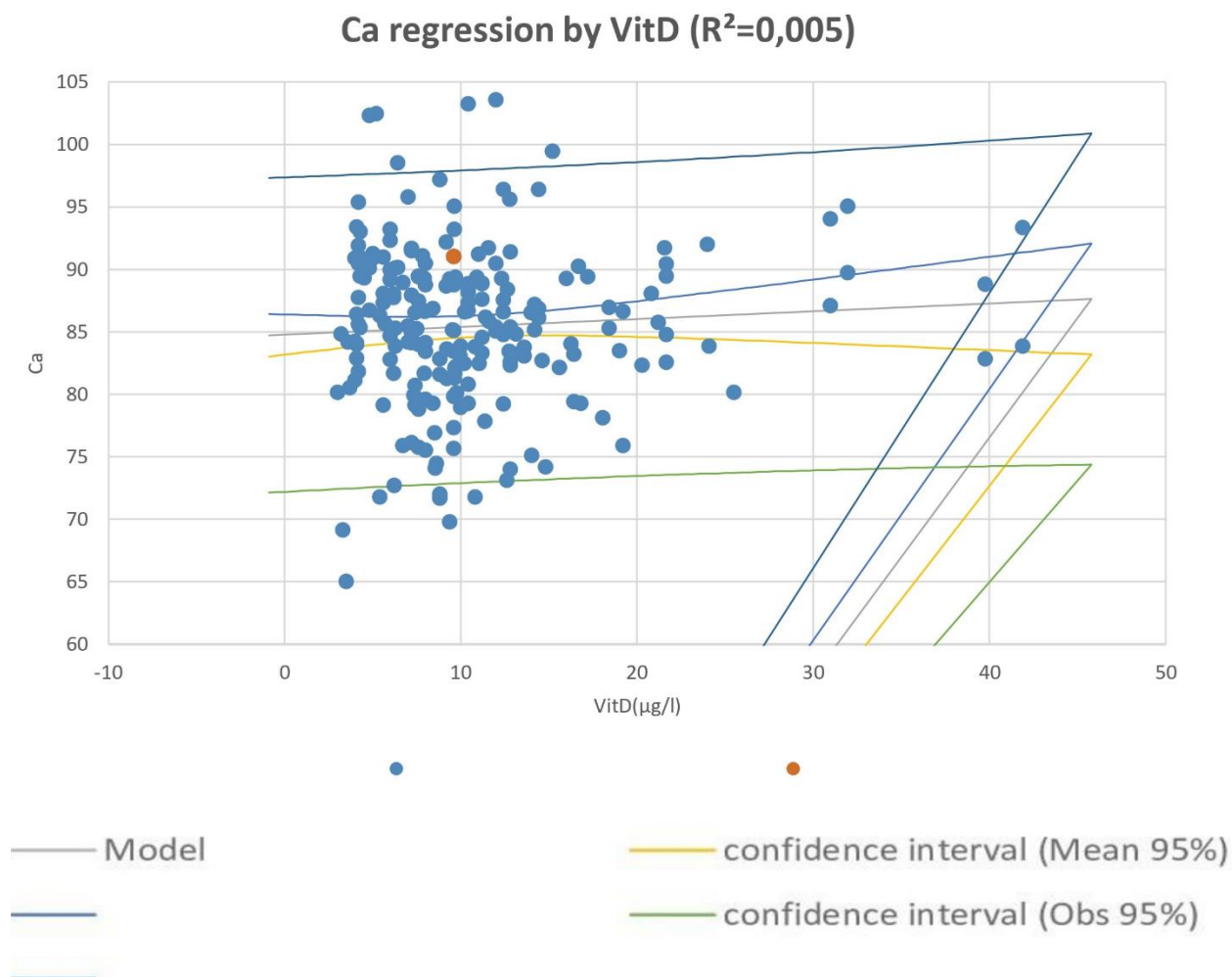

Figure 3.
Relationship between serum levels of 25-hydroxyvitamin D(25OHD) and calcium levels.

4. Discussion

Vitamin D play an essential role in several physiological functions, in addition to its involvement in the metabolism of calcium and phosphorus. However, few studies have examined the frequency of its deficiency among young women living in areas with high sun exposure. Regardless of the threshold used, vitamin D deficiency is widespread, exceeding our initial estimates. In our sample, we observed that more than 94% of women suffer from a vitamin D deficiency, among which 59.7% have a severe deficiency, with a 25(OH)D level below 10 µg/L, and 35.07% have a moderate deficiency, with a 25(OH)D level between 10 µg/L and 20 µg/L .the median 25(OH)D level for the moderate group (12.52 µg/L) is higher than that of the servere group (7.20 µg/L). This finding is similar to that of a cross-sectional study conducted in Marrakech, which revealed that 78.1% of women aged 18 to 45 years had a vitamin D level lower than 25nmol/L (9µg/L**),** while 21.9% had insufficiency [6]. Another study, a prospective prevalence survey conducted in Casablanca on a sample of 73 veiled women, showed that 69% of women suffered from vitamin D deficiency, and 31% had insufficiency [5]. In Rabat, a study

involving 415 women aged 24 to 77 years showed that 91% of participants had insufficient vitamin D levels (<30 ng/mL) [7]. A prevalence survey conducted in the Lyon region among 96 women aged 18 to 49 years wearing covering clothing revealed that 99% of women had vitamin D levels between 53 and 75nmol/L (19.21µg/L and 27.18 µg/L) [4]. A prospective epidemiological study conducted in the north of France, including 290 subjects aged 18 to 65 years, found that 92.3% of participants had a 25(OH)D level below 30 ng/mL, 75.1% below 20 ng/mL, and 27.9% below 10 ng/mL [8]. A study conducted on 102 gymnasts, followed for two seasons (2016-2017 and 2017-2018), showed that 45% of the measurements had a value below 30ng/mL, which is considered a vitamin D insufficiency, with significant seasonal variations [9]. A cross-sectional study conducted in Tunis with 258 women revealed that the average 25(OH)D levels were 7.88ng/mL, with a 95% confidence interval ranging from 7.06 to 8.7ng/mL [10].

Finally, our study revealed that more than 38.43% of women have hypocalcemia, with 16.86% suffering from severe hypocalcemia (calcium level below 80.15mg/L) and 21.57% having moderate hypocalcemia, with calcium levels between 80.15 and 84.16 mg/L. A retrospective analytical study conducted at the Ibn Rochd University Hospital Center between 2014 and 2023, involving 601 patients, showed that 79.7% of women had normal calcemia , while the prevalence of hypocalcemia was 17.63% and hypercalcemia was 2.66% [11].

5. Conclusion

Morocco is facing a public health issue related to deficiencies in certain micronutrients, particularly vitamin D, despite abundant sunlight and its rich food resources. Women in Rabat-Salé region suffer from vitamin D deficiency, leading to complications such as rickets, osteomalacia, hypertension, and metabolic syndrome… This highlights the importance of vitamin D supplementation and raising awareness among the population about the significance of a balanced, healthy diet rich in micronutrients.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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References

[1]   E. Tissandié, Y. Guéguen, J.-M. A. Lobaccaro, J. Aigueperse, and M. Souidi, "Vitamin D: Metabolism, regulation and associated diseases," *Medecine Sciences*, vol. 22, no. 12, pp. 1095-1100, 2006.

[2]   J. Li *et al.*, "1α,25-Dihydroxyvitamin D hydroxylase in adipocytes," *The Journal of Steroid Biochemistry and Molecular Biology*, vol. 112, no. 1, pp. 122-126, 2008. https://doi.org/10.1016/j.jsbmb.2008.09.006

[3]   J. S. Adams and M. Hewison, "Update in Vitamin D," *The Journal of Clinical Endocrinology & Metabolism*, vol. 95, no. 2, pp. 471-478, 2010. https://doi.org/10.1210/jc.2009-1773

[4]   S. Belaid, A. Martin, A.-M. Schott, M. Laville, and M.-F. Le Goaziou, "Hypovitaminosis D among 18-to-49-years-old women wearing concealing clothes, an ignored reality in general practice," *La Presse Médicale*, vol. 37, no. 2, Part 1, pp. 201-206, 2008. https://doi.org/10.1016/j.lpm.2007.06.024

[5]   R. El Beloui, H. Abouihsane, S. Hadir, and F. Lmidmani, "Vitamin D deficiency in veiled Moroccan women: A prospective survey," *Annales d'Endocrinologie*, vol. 84, no. 1, p. 152, 2023.

[6]   S. Baki, G. El Mghari, N. El Ansari, I. Harkati, A. Tali, and L. Chabaa, "Vitamin D status in Moroccan women living in Marrakech," *Annales d'Endocrinologie*, vol. 76, no. Pt 2, p. 490, 2015.

[7]   F. Allali *et al.*, "High prevalence of hypovitaminosis D in Morocco: Relationship to lifestyle, physical performance, bone markers, and bone mineral density," *Seminars in Arthritis and Rheumatism*, vol. 38, no. 6, pp. 444-451, 2009/06/01/ 2009. https://doi.org/10.1016/j.semarthrit.2008.01.009

[8]   X. Deplanque, A. Wullens, and L. Norberciak, "Prevalence and risk factors of vitamin D deficiency in healthy adults aged 18–65 years in Northern France," *La Revue de Médecine Interne*, vol. 38, no. 6, pp. 368-373, 2017. https://doi.org/10.1016/j.revmed.2016.12.013

[9]   P. Edouard, S. Nguyen, and P. Billard, "Prevalence of vitamin D insufficiency among high-level French gymnasts," *Journal de Traumatologie du Sport*, vol. 36, no. 1, pp. 12–19, 2019.

[10]   M. Naifar *et al.*, "Vitamin D reference range in Southern Tunisian women," *Nutrition Clinique et Métabolisme*, vol. 34, no. 2, pp. 169–176, 2020.

[11]   K. Nassar, S. Zaher, A. Ajerouassi, W. Rachidi, and S. Janani, "Vitamin D and calcium phosphate status in patients monitored for postmenopausal osteoporosis: A report of 701 cases," *Revue du Rhumatisme*, vol. 91, no. S1, p. A341, 2024.