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# Vitamin D Deficiency and Insufficiency Prevalence: A Retrospective Cohort Study in Syrian Adults

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**Abstract:** Mounting evidence suggests that vitamin D has probable implications in overall health, and prevents different chronic diseases. The objective of this study was to evaluate vitamin D status in different age-groups in a Syrian community. A retrospective cohort study was conducted with 390 consecutive blood samples from Syrian adults between 2 January 2018 and 31 December 2019. Data were collected from a private clinical biochemistry laboratory in Sahnaya, and analyzed for vitamin D levels. blood samples were grouped according to age, sex and season. Vitamin D levels (25OHD) were categorized into deficiency (<20 ng/mL), insufficiency (25-30 ng/mL) and sufficiency (>30ng/mL). While vitamin D levels were sufficient in 30.5%, they were insufficient in 35.4% and deficient in 34.1%. Of the deficient group, men were less likely than women to be deficient (9.0% or insufficient (11.6%). The overall prevalence rate of vitamin D deficiency was 36.4%, while it was 36.9% among those aged <65 years, 30.8% among men, and 34.5% among women**.** Lowest levels were in those aged 50-59 years 23.3 (± 12.9), and highest in those aged 70-79 years 30.2 (± 10.4) (p<0.05). Vitamin D deficiency and insufficiency were prevalent among the Syrian cohort, particularly among women and young adults.

**Keywords:** Vitamin D, deficiency, insufficiency.

## INTRODUCTION

Vitamin D deficiency is reported to be one of the most common medical problems worldwide [Sakye, S.A. *et al*., 2021]. It leads to poor skeletal health, and is linked to many serious diseases including type 1 diabetes [Gil-Díaz, M.C. *et al*., 2019] cardiovascular diseases [Latic, N. *et al*., 2020], malignancies [Nica-Badea, D. *et al*., 2021], and some autoimmune conditions [Mailhot, G. *et al*., 2020]. Vitamin D can be mainly sourced through cutaneous synthesis of cholecalciferol in the presence of sunlight [Courbebaisse, M. *et al*., 2020]. Another source is diet including oily fish, cod liver oil [Balami, S. *et al*., 2019], and mushrooms exposed to sunlight. [Ibrahim, R.M. *et al*., 2022] 25-hydroxyvitamin D is the major form. Once formed, it travels to the kidney where it is converted into the biologically active form 1,25-dihydroxyvitamin D which regulates calcium and phosphate absorption from the intestine [Holick, M.F. *et al*., 2017]. Vitamin D has an extra -skeletal effects due to its active form, metabolites, and vitamin D receptor (VDR). Vitamin D receptor is expressed widely in multiple tissues and cells that are not involved in calcium or phosphate control [Bouillon, R. *et al*., 2022], including the heart, brain, skin, breast, prostate, and gut [Marino, R. *et al*., 2019]

Depending on previous literatures, a blood level of (25-OHD) of 20 ng/mL and above is adequate for maximum bone health [Holick, M.F. *et al*., 2017].

Investigation of vitamin D status in different age-groups and in different climates in a community is necessary and has considerable implications for general health. In the current study, we aimed to retrospectively evaluate age and gender-related rates of vitamin D insufficiency and deficiency in adult participants. They had Vitamin D levels assessed when attending their Practitioners in Sahnaya, which is located in Damascus countryside.

## METHODS AND MATERIALS

We included consecutive blood samples with requests for vitamin D levels sent from Practitioners in Sahnaya to a private clinical biochemistry laboratory between 2 January 2018 and 31 December 2019. Data were collected for date of sample, age of participant on the date the sample was taken, sex and vitamin D levels. We included samples from adults only. They were categorized into 7 age groups: 20-29 years, 30-39 years, 40-49 years ,50-59 years, 60-69 years, 70-79 years, 80 years and more. Serum vitamin D (25-OHD) was measured using VIDAS® 25-OH Vitamin D Total assay [Moreau, E. *et al*., 2016]. It is the major circulating form of vitamin D, and is considered the functional indicator of vitamin D stores in human body [Delos Reyes, J. *et al*., 2017].

### Definition of Vitamin D Deficiency

Vitamin D status was categorized into deficiency defined as 25-OH vitamin D level (25-OHD <20 ng/mL), insufficiency defined as (25-OHD 20-30 ng/mL) and sufficiency defined as (25-OHD >30 ng/mL) [Hovsepian, S. *et al*., 2011]. Seasons were



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defined as follows: spring (March, April and May), summer (June, July and August), autumn (September, October and November) and winter (December, January and February. [Delos Reyes, J. *et al*., 2017].

## STATISTICAL ANALYSIS

Data analyses were performed using Prism (version 8) statistical package. Data were expressed as means ± SD. Different groups were compared using Kruskal – Wallis test followed by Dunn test for multiple comparisons. P values < 0.05 were considered statistically significant**.**

A prevalence rate was calculated as the percentage of the number of samples taken from people who were classified as vitamin D deficiency by the total number of people in the corresponding category.

## RESULTS

A total of 390 consecutive samples aged 20 years or older were included in this study. Of the total, 90% (n=351) were from women, and their ages were ranging from 20 to 84 years. Whereas, 10% (n=39) were from men, and their ages were ranging from 20 to 86 years. The mean age of the participants was 46.9 (± 14.2) years, and 12% (n=48) of the study population were 65 years or older.

The highest concentration of vitamin D among the study cohort was 93.53 ng/mL, which belongs to a male aged 20-29. Meanwhile, the lowest concentration was 6.9, which belongs to a female aged 40-49.

The seasonal distribution was as follows: 27.95% (n=109) of samples were received during winter, 20.77% (n=81) during spring, 25.64% (n=100) during summer and 25.64% (n=100) during autumn.

The mean ± SD of vitamin D levels was 25.9 ± 12.3 ng/mL in the study population and was 29.4 ± 15.8 ng/mL in men and 25.5 ± 11.8 ng/mL in women. The overall prevalence rate of vitamin D deficiency (≤20 ng/mL) was 36.4%, while it was 14.6% among those aged >65 years. Furthermore, it was 30.8% among males and 34.5% females.

Vitamin D levels were sufficient in 30.5% (n=119), but they were insufficient in 35.4% (n=138) and deficient in 34.1% (n=133). Men were less likely than women to be deficient (9.0% (n=12) or insufficient (11.6% (n=16)).

By age group, levels were lowest in those aged 50-59 years 23.3 (± 12.9), and highest in those aged 70-79 years 30.2 (± 10.4) (p<0.05). Significant differences were observed in the mean (±SD) values for serum (25-OH) vitamin D between those aged 40-49 years 27.2 (±11.9) vs those aged 30-39 years 23.5 (± 9.5) (p<0.05). Also, for those aged 50-59 years 23.3 (± 12.9) vs those aged 60-69 years 28.9 (± 14.6) (p<0.05), and those aged 40-49 years vs those aged 60-69 years (p<0.05). Figure (1).

By season, the mean serum vitamin D levels were lowest during autumn 24.5 (± 9.2) and summer 25.2 (± 12.5) with no significant statistical difference in comparison with the other seasonal groups. Figure (2).

Highest rates of deficiency were seen in those aged 50-59 years 46.2% (n=77) and 30-39 years 41.7% (n=71) (p<0.05). Table (1). The highest rate of deficiency 39% (n=42) was seen in samples taken during summer (p<0.05). Figure (3). Significant variation was observed for mean vitamin D deficiency levels between blood samples collected during spring 16.7 (±2) vs those collected during summer 14 (± 4.3) (p<0.05). Figure (3).



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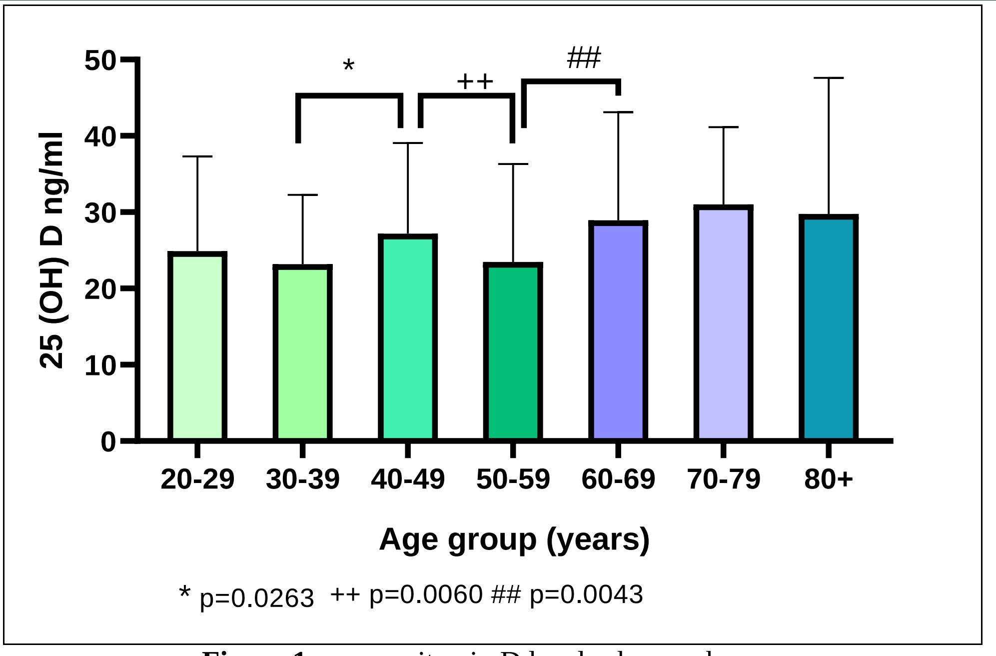


**Figure 1:** serum vitamin D levels changes by age

**Table 1:** Vitamin D deficiency rate (%) changes by age

| Group (years) | Samples number | Deficiency rate% |
|---|---|---|
| 20-29 | 46 | %37.5 |
| 30-39 | 71 | %41.66 * |
| 40-49 | 117 | %35.59 ++ |
| 50-59 | 77 | %46.15 ## |
| 60-69 | 54 | %21.82 |
| 70-79 | 18 | %5.26 |
| 80+ | 6 | %28.57 |

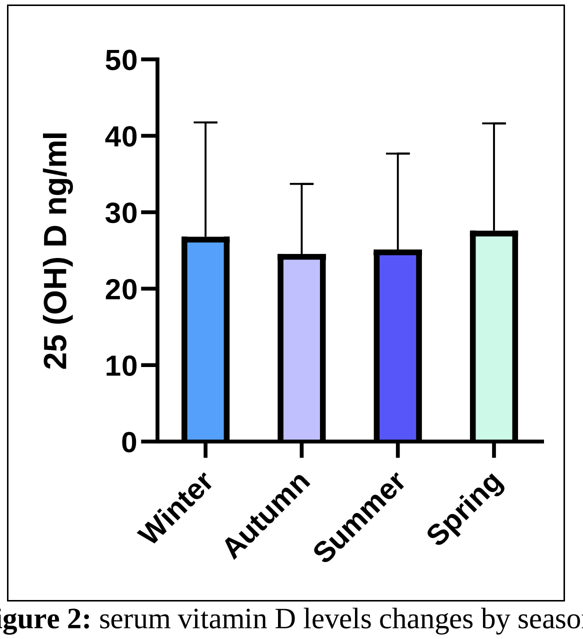


**Figure 2:** serum vitamin D levels changes by season



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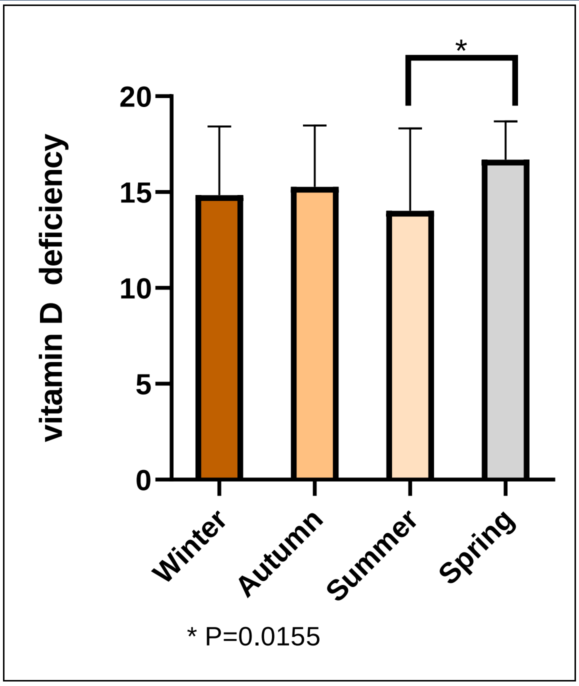


Figure (3): Vitamin D deficiency levels changes by season

## DISCUSSION

Despite the Middle Eastern region enjoys sunlight most days of the year, the prevalence of vitamin D deficiency has been widely documented across its populations. [Arabi, A. *et al*., 2021]

The results of the study in Sahnaya, a sunny city located in Damascus countryside, confirms the high rates of vitamin D deficiency (%34.1) and insufficiency (35.4%) among the adult population with higher prevalence among women and younger adults. These rates are in line with findings from previous reports from the Middle Eastern regions [Arabi, A. *et al*., 2021]. Similar to previous studies [Okan, S. *et al*., 2020], our findings showed that women were more likely to be vitamin D-deficient than men.

Unlike our findings, Sanghera et al. found lower 25-OH Vitamin D levels in men compared to women [Sanghera, D.K. *et al*., 2017]. These gender-related variations could be related to the differences in body fat depot. Adipose tissue has the ability to store and release vitamin D at a rate that is proportionate to its concentration in plasma. [Abbas, M.A. *et al*., 2017] Gender-associated variations in 25-OH Vitamin D levels could be related to the action of sex hormones on vitamin D synthesis/breakdown [Muscogiuri, G. *et al*., 2019]. The majority of our cohort were women. Although this may suggest the likelihood of women visiting practices for health reviews, it may also have occurred because of the concentration on vitamin D deficiency in women. That may reflect less recognition among the public and/or practitioners of the potential depletion for vitamin D and its related problems among men such as osteoporosis [Delos Reyes, J.*et al*., 2017.

Other agents which restrict exposure to sun in Syria is living in apartments which is exceeding due to increased population. Furthermore, people tend to use anti-solar creams on their face avoiding skin cancer.

Age is another variable affects 25-OH Vitamin D levels. However, in the present study, vitamin D levels were not inversely proportional to age. 25-OH Vitamin D level was significantly lower in the <65 years of age group compared to the group aged ≥65 years, whereas most studies reported the higher prevalence of vitamin D deficiency among the elderly people [Lips, P. *et al*., 2001]. It may be due to supplementation of vitamin D among elderly people, by using multivitamin tablets. In addition, younger people lean toward living in apartments, while older people prefer living in houses. Another possible reason could be the different dietary patterns in different population groups.

Vitamin D synthesis could be considerably affected by the amount of UVB in sunlight. Notably, it varies by season as an environmental factor, latitude, and hour of the day [Topal, İ. *et al*., 2018]. In this study, the lowest levels of vitamin D were in summer. It is possibly due to clothing style of individuals in the region and lack



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of the sunbathing habit during summer months. Similarly, - AlQuaiz et al. found that mean levels of Vitamin D of the participants whose samples were collected during the winter months were higher than those whose samples were collected during summer [AlQuaiz, A.M . *et al*., 2018] . In contrast, several studies have demonstrated that vitamin D deficiency and mean of vitamin D level have been higher in winter [Raza, A. *et al*., 2019; Lin, L.Y. *et al*., 2021].

The strength of this study lies in the inclusion of consecutive samples received by the laboratory over an eight-year period, and a wide age range as well. Opposed to previous studies which focused basicly on the older female population, our study included the males too.

The chief limitation of this study is its retrospective manner of sample identification and observational nature. As we obtained our data from the laboratory, there was a lack of data regarding clinical characteristics of the participants, including indication for testing, medications (including supplementation. Also, we did not have any information about patients like height, weight, medical history, social circumstances, sun cream usage, and the time of sun-light exposure.

## CONCLUSION

Great awareness is required to educate Syrian about the ways of improving and maintaining 25(OH) vitamin D levels. Safe sunlight exposure, physical activity programs, diet, and vitamin D supplements are crucial factors to avoid low 25(OH) vitamin D concentrations. The Ministry of Health should take strong measures to prevent Vitamin D deficiency by educational programs about its simple and inexpensive sources.

## AUTHOR CONTRIBUTION

Joelle Haddad and Samer Wahod were responsible for the database. Wissam Dahi designed the protocol for this study and performed the database checks, statistical analyses and wrote the manuscript. All authors approved the final manuscript.

## CONFLICT OF INTEREST

The authors declare no competing interests.

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