



VITAMIN D DEFICIENCY IN WOMEN NOT EXPOSE TO SUNLIGHT: A CROSS SECTIONAL STUDY

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Abstract: The present study was designed to determine the effect of environmental factors on vitamin D deficiency and its associated risk factors in females not exposed to sun light. The present study is a questionnaire based study. The present study was a cross-sectional survey which was conducted in Private and Public institutes of Hyderabad on females. The total population was 120 students, with ages ranging from 15-35 years. Data was collected through individual questionnaire based. Results showed that females were diagnosed with vitamin D deficiency due to less exposure to sunlight and low vitamin D supplements intake which leads to symptoms like muscle pain or fatigue. Most of the students did not receive any education on managing vitamin-D levels and we delivered short awareness session during data collection..

Key words: Vitamin D deficiency, Niqab, Abaya, Sun exposure, Vitamin D supplements

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INTRODUCTION

Vitamins are a group of chemical elements found in food that our systems require in small quantities to perform important activities. This group is greatly dependent on the fat-soluble vitamin D.¹ The discovery of vitamin D by Mellanby in 1920 created much interest in the medical profession. Research has shown that vitamin D acts more like a hormone than a vitamin. The active form, 25(OH)2D circulates throughout the body and acts on many tissues (Habeeba and Kalpana, 2021; Fathia *et al.* 2018). Sunlight has 3 rays: UVA, UVB, and UVC (Habeeba and Kalpana, 2021). Cutaneous 7-dehydrocholesterol absorbs UVB radiation (290-320 nm) and is converted to provitamin D3, which is then converted to vitamin D3 (Fathia *et al.* 2018). The main source of vitamin D is the synthesis by skin under direct exposure to sunlight, which triggers the synthesis of pre-vitamin D3 (Aji *et al.* 2019). Vitamin D is produced in the skin when the body is exposed to sunshine for 1000-1500 hours in the spring, summer and autumn. Foods and supplements also help convert vitamin D2. This is because there are very few good sources of vitamin D in the diet and thus only 10% of vitamin D needs are made up via diet. Supplementation with vitamin D can help to meet higher needs (Aji *et al.* 2019).

Vitamin D comes in two main forms, D2 and D3 and is important for human health. Vitamin D2 (ergocalciferol) is produced by plants including yeast and mushrooms. Vitamin D3 (cholecalciferol) is synthesised by skin cells when exposed to UVB, and is found in foods of animal origin. Studies suggest that vitamin D absorbed through the skin

remains in the bloodstream longer than that from food (Alibrahim *et al.* 2024). Regardless of the source of vitamin D, be it sunlight, food or supplements, 25-hydroxyvitamin D (25(OH) D) is thought to be the best reflection of vitamin D status. In healthy individuals, ~85-90% of vitamin D is bound to vitamin D binding protein, <1% is free or 0.03%. A small amount (~10-15%) of 25(OH)D is weakly bound to albumin. According to the "free hormone hypothesis," one way to measure vitamin D status is through a biological marker called free 25(OH)D since only free 25(OH)D can be taken into and used by cells. In support of this hypothesis, it has been shown that genetically modified mice who lack the protein that binds to vitamin D only present with signs of vitamin D deficiency if their diet contains insufficient amounts of vitamin D. Researchers propose that measuring free vitamin D leads to a better understanding of vitamin D status in ethnically diverse populations where measuring total vitamin D can lead to inappropriate conclusions as seen with hepatic and renal disease (Shefin *et al.*, 2018). Vitamin D deficiency is typically defined as 25(OH)D levels <50 nmol/L, however there remains considerable debate regarding the optimum level of Vitamin D. Diagnosing individuals with Vitamin D deficiency may be difficult as many do not have symptoms. Many experts believe an individual has an insufficient amount of vitamin D if their serum 25(OH)D concentration is <20 ng/ml (Kazmi *et al.*, 2020). Usually, vitamin D intoxication does not occur until the amount reaches upto 150 ng/ml (Shefin *et al.*, 2018). Vitamin D's relationship with bone health has been established for years via its effects on increasing absorption of calcium and phosphorus from the intestine. More recent

research has shown that vitamin D has an important role in the invasion of the trophoblast, as well as cellular division and control (Lee *et al.*, 2020). There is increasing evidence that humans need much more vitamin D than previously considered optimal.⁵ There is an emerging consensus about the importance of 25OHD to the health, development and functioning of the skeletal, muscular, reproductive, and integumentary systems of all individuals, regardless of age or race (Kazmi *et al.*, 2020). Studies demonstrate that vitamin D levels may help reduce the occurrence and severity of chronic illnesses such as cancer, autoimmune diseases, type II diabetes, hypertension, asthma, and flare-ups of COPD. Vitamin D can promote the immune response and can provide increasing levels of cathelicidin, an antimicrobial protein created by neutrophils and macrophages in the lungs. The presence of vitamin D metabolites can lead to the generation of reactive oxygen species, which in turn can lead to the stimulation of autophagy (Saeed *et al.*, 2021).

Vitamin D is key in ensuring that the skeleton remains strong and healthy. A deficiency of vitamin D has been associated with many negative health outcomes including osteoporosis, fall risk, and weakness in the muscles. The National Osteoporosis Foundation (NOF) recommends that individuals under the age of 50 receive between 400 – 800 IU (international units) of Vitamin D each day and that individuals over the age of 50 receive between 800 – 1,000 IU per day. A deficiency in Vitamin D can create different outcomes depending on how long someone has had a Vitamin D deficiency and the severity of their deficiency, with the most severe deficiency possibly leading to a condition known as osteomalacia. Additionally, low levels of Vitamin D can have negative effects on a person's immune system, creating chances for obesity, cardiovascular disease, and inflammatory diseases.

Because Vitamin D has many functions in the skin, taking vitamin D supplements may relieve several types of dermal ailments. The attention paid to Vitamin D's role in skin pathologies has grown markedly. Vitamin D deficiency has been implicated with numerous skin pathologies, such as atopic dermatitis, psoriasis, vitiligo, polymorphous light eruption, mycosis fungoides, alopecia areata, and systemic lupus erythematosus (SLE) (Seetan *et al.*, 2022). Recent studies examining the relationship between Vitamin D levels and psychological well-being have noted that low levels of 25(OH)D can lead to inflammation as well as either depression or the potential for depression. A statistically significant relation was established between baseline levels of Vitamin D and frequency of depression in a longitudinal data analysis. It is also assumed that psychological health and Vitamin D levels are connected because those who have experienced higher Vitamin D levels have reported feeling better in their mental health and reduced levels of stress (Pang *et al.*, 2021).

High rates of Vitamin D insufficiency can be found in women, particularly in Asia as reported by IOF; women are more susceptible to having lower levels of this important

nutrient than men all over the world because of multiple reasons, including sun safety by wearing sunscreen or wearing solarium protective clothing (Seetan *et al.*, 2022). Recently, Vitamin D's importance for women's health during conception, pregnancy, during lactation, and shortly thereafter has been the focus of many studies, determining that Vitamin D's function is essential for many different phases in a woman's life (Habeeba and Kalpana, 2021). Women, who cover their body with a heavy veil, have limited exposure to sunlight, and use sunscreen may be at risk for vitamin D deficiency. Compared to women in the western dress, women in completely covered herself had the lowest level of serum 25(OH)D (Mostafa, 2020; Missiriya, *et al.*, 2020). Many women feel they must cover their whole bodies when they go outside and thus limit their exposure to the sun. There is also wide variability in how much of their bodies are covered and because of this, there are numerous studies on the subject of women showed low vitamin D levels (Shefin *et al.*, 2018). It was studied that Many Arab and Eastern women living in the West suffer from vitamin D deficiency, which is comparable to the situation in Eastern countries. Research indicates that vitamin D levels are influenced by cultural factors rather than country of residence (Bedewy *et al.*, 2022).

It was reported that premenopausal women still have limited understanding about vitamin D sources and other variables impacting their status. Many young women, who are at the highest risk of vitamin D insufficiency, have unfavorable attitudes about sun exposure, despite understanding about its advantages (Zareef and Jackson, 2021).

According to Binobead's, low vitamin D levels are common among healthy females of all ages in some tropical countries. This could be due to a lack of sunlight, a lack of vitamin D-rich diets, or a lack of awareness about its relevance (Binobead *et al.*, 2019). Pregnant women in tropical areas can prevent vitamin D deficiency by consuming at least 15 mcg of vitamin D daily and getting at least 27% of their body surface area exposed to sunlight (Chee *et al.*, 2022). According to Gerges *et al.* (2020), it was discovered that vitamin D deficiency and insufficiency are common among Egyptian women of reproductive age who participated in the study; 56% of the included women had vitamin D deficiency (Gerges *et al.*, 2021). It was reported that TD and FD mean values rose with higher BMI, older age, and in uncovered women. Males have larger amounts of T and FD compared to females, and females are more likely to have severe deficiencies (Abdulrahman *et al.*, 2022). According to Judistiani *et al.* (2019), covering whole body is a common practice in many nations and has been linked to vitamin D insufficiency in the Middle East and South Asia. He discovered that the minimum amount of sun exposure was approximately 37 minutes per day. However, for covered women, exposure to the sun is limited to 13.5% or less of their body and those women should increase their exposure duration to at least 65 minutes each day (Judistiani *et al.*, 2019). It was also Reports that university students between

the ages of 20 and 25 who regularly exposed their bodies to sunlight were able to achieve optimal levels of 25(OH)D i.e 34 ng/ml, whereas those who wore veils and had little to no sun exposure had 25(OH)D levels as low as 22 ng/ml (Akhtar *et al.*, 2019).

It was found that the average Vitamin D levels among Hindus, Muslims, and Christians were 24.46 ng/ml, 12.21 ng/ml, and 30.77 ng/ml, respectively. The difference was statistically significant ($P = 0.02$). The lower Vitamin D levels could be attributed to their social behaviour. Clothing also prevents the formation of previtamin D3 from 7-dehydrocholesterol (Jairam *et al.*, 2020). Vitamin D deficiency was extremely common in the study group, despite the fact that their houses has generally sunny area throughout the year. Furthermore, females showed lower levels than males, and veiled women had lower serum concentrations than non-veiled persons. Female gender and clothing choices have been established as independent indicators of vitamin D insufficiency (Almelli, 2023).

Women had two fold higher risk of having inadequate levels of vitamin D than men (El-Khateeb *et al.* 2019). Except for the high percentage in females this could be due to lack of sun exposure due to dress choice, even though Jordan is sunny almost all of the year. We found that 95% of women in this study were veiled, either completely covered (which covers the whole body including the face and hands).The study finding women who not exposed to sunlight are more common with poor vitamin D status than women who exposed properly with sunlight (El-Khateeb *et al.*, 2019).

It was found that Only 14% of the participants were exposed to direct sunlight, which could be attributed to hot temperature and cultural concerns. In this regard, one could conclude that the population will compensate by consuming more vitamin D-fortified foods and pills. However, around one-third of the study participants never consumed vitamin D- fortified food or also unaware the foods are fortified with vitamin D (Somaili *et al.*, 2024).

According to Fatima Ibrahim Al-Yatama *et al.* 2019, most food items in Kuwait and many other Middle Eastern countries are not vitamin D fortified. The inhabitants of these countries are thus driven to rely on vitamin D3 synthesis by solar exposure. Vitamin D levels were lower in the group who are fully covered as compared to other group, indicating that clothing style may contribute to vitamin D deficiency (Al-Yatama *et al.*,2019).

MATERIALS AND METHODS

Study Design/Type

Cross-Sectional Study

Study Setting

Public and Private Medical Institutes of Hyderabad

Study Duration

Duration of study was six months

Sample method and sample size

Convenient random sampling method, 120

Inclusion Criteria

Females aged between 15 years to 35 years

Females with Consent

Females who wear covered cloths

Females with vitamin D deficiency

Exclusion Criteria

Females who were not willing to participate in the study

Pregnant or lactating females

Females with hypothyroidism

Females having a celiac or inflammatory bowel disease

Females with diagnosed malignancy

Data Collection Procedure

The data collection procedure was based on questionnaire which was filled individually by students. Consent form was also signed. Questionnaire form contains 2 sections, first one demographic data and 2nd self-questionnaire.

Data Analysis Process

Data was analyzed by Statistical Package for the Social Sciences version 25.

Statistical analysis

Data were analyzed using SPSS version 25.0 with descriptive statistics and inferential tests (Bonferroni test, $P < 0.05$).

RESULTS AND DISCUSSION

Results obtained from questionnaire showed that the percentages of non-exposed females that intentionally avoid sun exposure due to cultural or religious reasons are 39.2% and females who do not intentionally avoid sun exposure are 60.8% (Figure 1). It was also found that percentage of females who completely covered themselves and also received any education on managing vitamin D levels are 35.0% and females without the education of vitamin D importance are 65.0% (Figure 2).

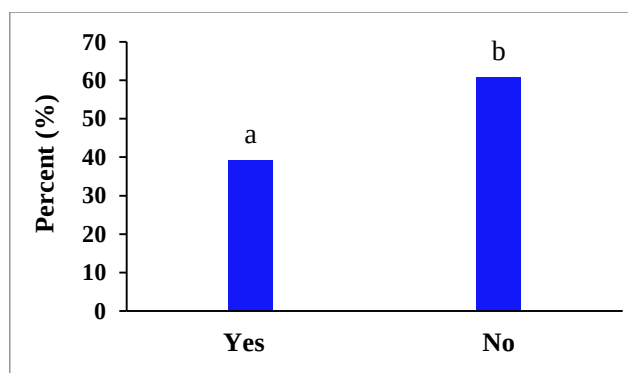


Figure 1: Female intentionally avoid of sun exposure (means $\pm$ S.E., n = 6) (Bonferroni test, $P < 0.05$)

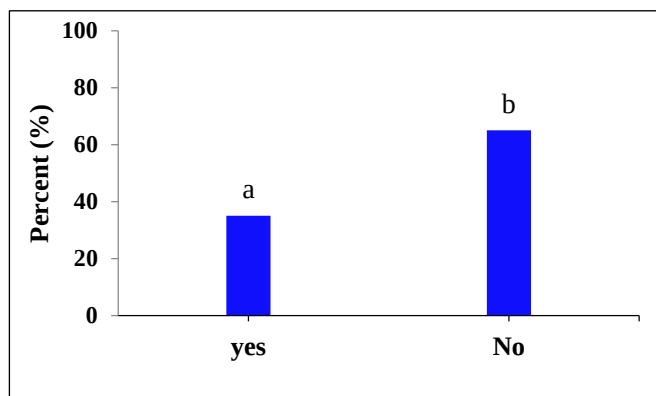


Figure 2: Female received education about the managing of sunlight (means± S.E., n = 6) (Bonferroni test, $P < 0.05$)

Figure 3 showed percentage of average sun exposure that females have had in the past week in which the frequency of females with less than 5 minutes per day was 7.5% and females with 5-15 minutes per day was 44.2% and females with 30 minutes per day 25.0% and females with more than 30 minutes per day was 23.3%.

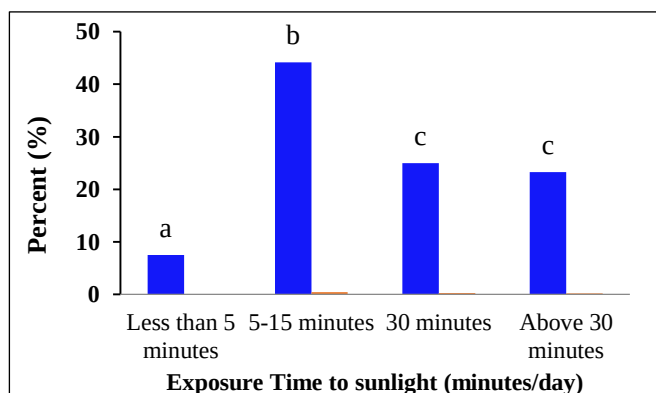


Figure 3: Female received exposure to sunlight (minutes/day) (means± S.E., n = 6) (Bonferroni test, $P < 0.05$)

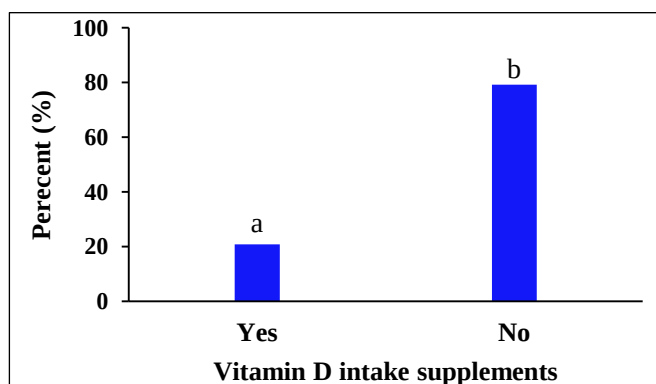


Figure 4: Female intake vitamin supplements (means± S.E., n = 6) (Bonferroni test, $P < 0.05$)

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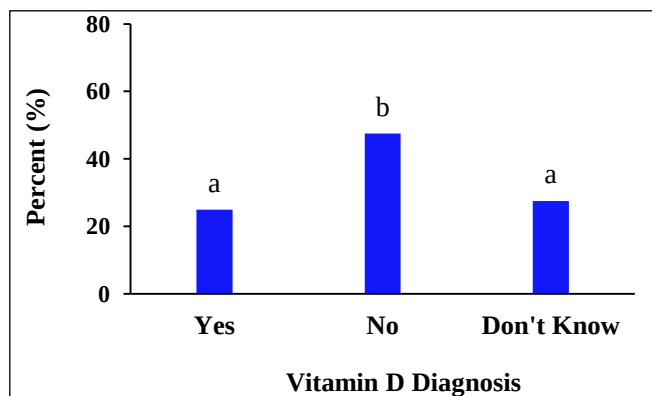


Figure 5: Female diagnosed with Vitamin D deficiency (means± S.E., n = 6) (Bonferroni test, $P < 0.05$)

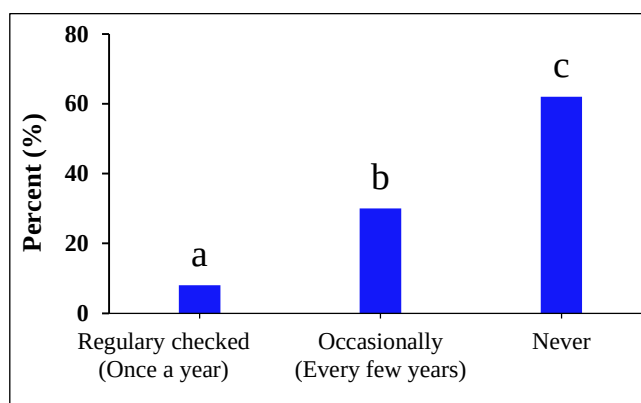


Figure 6. Female checked Vitamin D level (means± S.E., n = 6) (Bonferroni test, $P < 0.05$)

DISCUSSION

The key finding of this study was that the lowest levels of serum 25(OH)D were mostly found in females not exposed to sunlight. This could have been due to their limited exposure to sunlight when they walked outside, leading to vitamin D deficiency. There was a rising inclination to avoid meals containing vitamin D3-rich ingredients such as eggs and milk, as well as those that improved its absorption, such as tuna. According to the report, 39.2% of females purposefully avoided sun exposure for cultural or religious reasons. The findings revealed that numerous bone illnesses, including rickets and osteomalacia, persisted even in areas with sunny weather, which should have increased vitamin D synthesis through sun exposure. The overall prevalence ranged from 30% to 90%. The study's age range was 18 to 25 years. and girls who had their vitamin D levels evaluated by a healthcare expert were 8.3% each year. Furthermore, the study found that 20.8% of covered females utilized vitamin D pills regularly, with a considerable majority (65.8%) reporting symptoms of vitamin D insufficiency, such as muscle soreness or exhaustion. According to another researcher, there was still a substantial lack of information about vitamin D or its sources, which mostly affected females due to their bodies being covered by religious

clothing (Abaya), limiting sun exposure. Overall, these data underlined the importance of increasing vitamin D awareness and education among females, especially in future vitamin D source intervention efforts. Several studies also showed that sun exposure and diet played an important role in maintaining appropriate levels of 25(OH)D.

CONCLUSIONS

This study found that not exposed to sunlight have a higher risk of Vitamin D deficiency due to their clothing patterns. The study found that many women struggle to maintain adequate vitamin D levels due to limited sun exposure and a lack of knowledge about treating vitamin D deficiency. The survey found that 39.2% of people avoid the sun for religious or cultural reasons, resulting in poor vitamin D levels. Only 35% of respondents reported receiving advice on maintaining vitamin D levels while wearing a dress which completely cover them, indicating a knowledge gap. Only 8.3% of such women get their vitamin D levels tested by medical professionals, and 79.2% do not take vitamin D supplements regularly, despite the health risks associated with vitamin D deficiency. Additionally, 65.8% of individuals reported symptoms such as muscle discomfort and exhaustion, which are often associated with vitamin D deficiencies. While 37.5% of women have a family history of vitamin D insufficiency, inadequate sun exposure and low supplementation rates continue to contribute to the problem.

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