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STUDYING THE EFFECT OF VITAMIN D DEFICIENCY AND ITS RELATIONSHIP TO CALCIUM DEFICIENCY FOR PEOPLE VISITING SOME MEDICAL LABORATORIES IN THE EASTERN PROVINCE OF SAUDI ARABIA.

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Abstract:

Background: Vitamin D deficiency is a significant public health concern, particularly among pregnant women, due to its potential adverse effects on maternal and fetal health. This study aimed to investigate the prevalence of vitamin D deficiency among pregnant women in the eastern province of Saudi Arabia, exploring seasonal variations and the influence of age on vitamin D status.

Methods: A cross-sectional study was conducted among pregnant women attending medical laboratories in the eastern province of Saudi Arabia during both winter and summer seasons. Serum 25-hydroxyvitamin D [25(OH)D] levels were measured, and demographic data, including age, were collected. Statistical analyses were performed to assess seasonal variations in vitamin D status and examine correlations between age and vitamin D levels.

Results: The study included a total of 165 pregnant women, with 80 participants during each season. Mean serum vitamin D levels were significantly higher during the summer season compared to winter (12.25 ng/mL vs. 8.24 ng/mL, respectively). However, there was no significant correlation between age and vitamin D levels in either season. The prevalence of vitamin D deficiency was notable, with 59% of participants classified as deficient (25(OH)D < 30 ng/mL).

Conclusion: This study highlights the high prevalence of vitamin D deficiency among pregnant women in the eastern province of Saudi Arabia, with seasonal variations observed in vitamin D status. While age did not significantly influence vitamin D levels, strategies to improve vitamin D status, including promoting sunlight exposure and dietary interventions, are warranted to mitigate the adverse health effects associated with vitamin D deficiency during pregnancy.

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Keywords: Vitamin D deficiency, pregnant women, seasonal variations, maternal health, Saudi Arabia.

Introduction:

Vitamin D is an essential vitamin important for bone health in pregnant women, adults, and children. It protects against rickets and osteomalacia because its generators are available in the body, where they are produced in the fat cells of the skin in the presence of sunlight (ultraviolet rays). More than 90% of vitamin D (VitD) is produced internally when the skin is exposed to sunlight. [1]

In addition to natural food sources such as cod liver oil, liver, eggs, butter, milk and its derivatives, diet supplements, and medications, Vitamin D (Vit D) is necessary to maintain normal blood levels of calcium and phosphate, which are in turn necessary for bones, muscle contraction, nerve conduction, and general cellular function in all cells of the body. It also increases the differentiation of many specialized cells in the body, such as bone cells, intestinal cells, and keratin cells. Vitamin D also has immune properties that may change the immune responses to infection in the living body. [2]

The hormonally active form of vitamin D is 1,25-dihydroxy vitamin D [1,25(23)OH]. The normal value for vitamin D is within 500 nanograms/ml, and a value below 20 nanograms/ml indicates a deficiency in vitamin D. This value varies from person to person as it decreases with age and changes in the seasons. The body needs 200 international units daily for both males and females. The seasonal level of vitamin D increases by 0.6–1.0 nanograms/ml per 100 international units/day. [3]

Many factors contribute to low vitamin D levels, including decreased production and conversion of the liver, decreased synthesis of vitamin D-binding protein, and increased consumption during acute vitamin D deficiency and systemic inflammation. While increasing vitamin D (D) leads to increased calcium deposition throughout the body, especially the kidneys, this can lead to kidney failure. Therefore, it should be used with caution and under close medical supervision. [4]

Pregnant women and infants are more susceptible to vitamin D deficiency. Therefore, the World Health Organization has encouraged this sensitive group to be exposed to the sun and to add this vitamin to their diets and baby milk. [5]

Many studies have found that the prevalence of vitamin D (D) deficiency is high among all age groups, even in countries close to the equator where exposure to sunlight is assumed to be sufficient to prevent vitamin D (D) deficiency, as well as in industrialized countries where food has been fortified with vitamin D (D) for several years. Especially children, infants, adolescents, and pregnant women. Vitamin D deficiency is common in the Middle East and North Africa, and doses of 1000 to 2000 international units per day may be necessary to reach the desired vitamin D level of 20 nanograms/ml. [6, 7]

Vitamin D is an essential nutrient, so pregnant women need to have adequate levels of vitamin D because transfer of this vitamin from mother to fetus is necessary for newborn growth. Breast milk is a poor source of vitamin D. A study in 2011 found that vitamin D

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concentration varies from person to person depending on genetic differences between them. While another study found that pregnant women from different social, economic, and educational backgrounds had a deficiency and inadequacy in the proportion of vitamin D (D), [8]

Vitamin D deficiency (less than 50 nmol/L or 20 ng/ml) is associated with bone fractures. Severe vitamin D deficiency with a concentration of less than 30 nmol/L (or 12 ng/ml) significantly increases the risk of increased mortality, infections, and many other diseases. [9]

A recent study conducted in Sebha City between May and November 2016 showed that the prevalence of vitamin D deficiency was about 26.4% among both sexes. [10]

In 2015, researcher Ajlan found that vitamin D deficiency leads to a significant decrease in the concentrations of calcium, magnesium, hemoglobin, and blood sugar and an increase in the number of white blood cells without affecting platelets in pregnant women. [11]

A study conducted in 2013 found that vitamin D deficiency in pregnant women is accompanied by several diseases that are harmful to the health of mothers and newborns. These diseases include low birth weight in children, while in mothers it leads to preeclampsia, gestational diabetes, cesarean section, and depression. [12]

This was confirmed by a study in 2016 that found an association between vitamin D deficiency and an increased risk of preterm birth in pregnant women with blood vitamin D levels less than 20 ng/ml. In contrast, a study by Dave [13] et al. (2017) stated that vitamin D deficiency hurts pregnancy outcomes, leading to poor growth, prematurity, and even birth defects. They also reported an association between vitamin D deficiency and low birth weight. [13, 14]

A study reported that the prevalence of vitamin D deficiency is high in both normal pregnancies and complicated pregnancies due to preeclampsia, and this proportion is increased in preeclampsia. Pregnant women with vitamin D deficiency had premature babies and low birth weight babies. [15]

A study by researchers Ou [16] et al. in 2012 found no significant difference in the percentage of vitamin D deficiency between working women and housewives. This is because working women start their work between 8 am and 3 pm, which is the peak time for skin absorption of sunlight. In contrast, the same study also found a significant difference between veiled and unveiled women. because unveiled women do not use sunscreen, which allows ultraviolet rays to pass through and synthesize vitamin D in the arms, unlike the covered arms of veiled women, which block sunlight. [16]

The results of a study conducted in 2014 showed that the prevalence of vitamin D deficiency in pregnant women was 15%, while the prevalence of vitamin D deficiency increased to reach about 72% and the concentration of vitamin D was about 28 nmol/L. In Iran, the prevalence of vitamin D deficiency in pregnant women was about 20%, with a concentration of 10 nmol/L. The prevalence of vitamin D deficiency among Saudi pregnant women was about 51%, and the reason for this deficiency is a lack of adequate exposure to sunlight. [17]

This was confirmed by a study by Joshi and Eisman [18] (2010), which found that vitamin D deficiency is a common condition among Australians. Vitamin D deficiency was

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easily assessed in patients by measuring serum 25-hydroxy vitamin D, and the severity of its deficiency varied from patient to patient. Its deficiency leads to softening, fractures, and osteoporosis in the body. [18]

The results of a study by Riaz et. al., in 2016 in Libya showed a significant difference (P < 0.00) in vitamin D levels between the coastal and mountainous population environments and the desert and mountainous population environments, while there was no significant difference between the coastal and desert population environments in vitamin D levels at a significance level (P = 0.494). [19]

Aim of the study

The study aimed to determine the prevalence of vitamin D deficiency (Vitamin D) among pregnant women during the annual seasons, to study the effect of environmental factors (sunlight) on vitamin D deficiency among pregnant women, and to know the possible association between vitamin D deficiency and age among pregnant women during the annual seasons.

Methodology

This study was conducted on pregnant women with vitamin D deficiency in some medical laboratories in the city located in the Eastern Province of Saudi Arabia from January 2016 to January 2017. About 165 random samples were collected from pregnant women with vitamin D deficiency from previous records

Data collection

Data for this study are collected from city located in the Eastern Province of Saudi Arabia, namely:

1. Dammam
2. Dhahran
3. Al Khobar
4. Al-Ahsa
5. Jubail

Inclusion and exclusion criteria:

The study will include pregnant women attending medical laboratories in the eastern province of Saudi Arabia. These women must express willingness to participate in the study and provide informed consent. Additionally, they should be available for blood sample collection during both winter and summer seasons to accurately capture seasonal variations in vitamin D levels. Participants should possess the ability to communicate in either Arabic or English languages and must be 18 years of age or older to be eligible for inclusion in the study.

Conversely, certain criteria will exclude individuals from participation in the study. Pregnant women with pre-existing medical conditions known to affect vitamin D metabolism, such as hyperparathyroidism or renal disease, will be excluded. Additionally, those who exceed the recommended dosage of vitamin D supplements (more than 1000 IU/day) or are taking medications known to interfere with vitamin D metabolism (such as corticosteroids or anticonvulsants) will not be eligible. History of malabsorption syndromes, multiple pregnancies, or bariatric surgery will also serve as exclusion criteria. Further, pregnant women with

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pregnancy complications requiring hospitalization or intensive medical care, as well as those concurrently participating in another clinical trial, will be excluded from the study. These criteria are put in place to ensure the integrity of the study results and the safety of participants throughout the research process.

Research Tools:

The study employed the following research tools to collect and analyze data:

The primary outcome measure of this study will be to determine the prevalence of vitamin D deficiency among pregnant women in the eastern province of Saudi Arabia during both winter and summer seasons. Vitamin D deficiency will be assessed based on established cutoff levels of serum 25-hydroxyvitamin D [25(OH)D]. Additionally, the study will examine the mean serum vitamin D levels among pregnant women during these seasons to provide insights into seasonal variations in vitamin D status. This measure will help elucidate how environmental factors, such as sunlight exposure, may influence vitamin D synthesis and metabolism among pregnant women residing in this region.

Furthermore, the study aims to assess the association between age and serum vitamin D levels among pregnant women. By investigating potential correlations between age and vitamin D status during different seasons, the study seeks to identify any age-related trends in vitamin D deficiency prevalence. Additionally, the impact of sunlight exposure on serum vitamin D levels will be evaluated as an outcome measure. This analysis will provide valuable insights into the role of environmental factors, particularly sunlight exposure, in influencing vitamin D status among pregnant women.

Moreover, the study will assess the prevalence of severe vitamin D deficiency, defined as serum 25(OH)D levels below a certain threshold, to identify pregnant women at higher risk for adverse health outcomes. Additionally, if feasible, the study may explore correlations between vitamin D status and pregnancy outcomes such as gestational diabetes, pre-eclampsia, and low birth weight. These outcome measures will contribute to a comprehensive understanding of the factors influencing vitamin D status during pregnancy and inform strategies for the prevention and management of vitamin D deficiency in this population.

Statistical analysis

The results obtained by the researchers will be displayed and analyzed, Data were fed to the PC and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). We will display the arithmetic means of the questionnaire responses obtained from the sample and present the standard deviations to identify the degree of variation in those responses by displaying the frequencies and their percentages to identify the level of responses about the variables.

Results and Discussion

The data offers insight into the prevalence of vitamin D deficiency within the studied population, segmented into distinct severity levels based on serum 25-hydroxyvitamin D [25(OH)D] concentrations. Among the observed findings, it is notable that 14% of the population exhibited severe deficiency in vitamin D, characterized by serum levels below 10 ng/mL. This indicates a concerning proportion of individuals experiencing a severe lack of vitamin D, a condition associated with heightened risks of bone disorders and compromised immune function.

Furthermore, the data indicates that 27% of the population fell into the category of moderate deficiency, with serum levels ranging below 20 ng/mL but above 10 ng/mL. While not as severe as those with severe deficiency, individuals within this group remain at risk of experiencing adverse health effects linked to insufficient vitamin D levels. This underscores the significance of addressing moderate deficiency to mitigate potential health complications.

Moreover, a substantial majority, comprising 59% of the population, was identified as deficient in vitamin D, with serum levels below 30 ng/mL but above 20 ng/mL. While not classified as severely or moderately deficient, individuals within this category still exhibit inadequate vitamin D levels, which could predispose them to various health conditions associated with vitamin D deficiency.

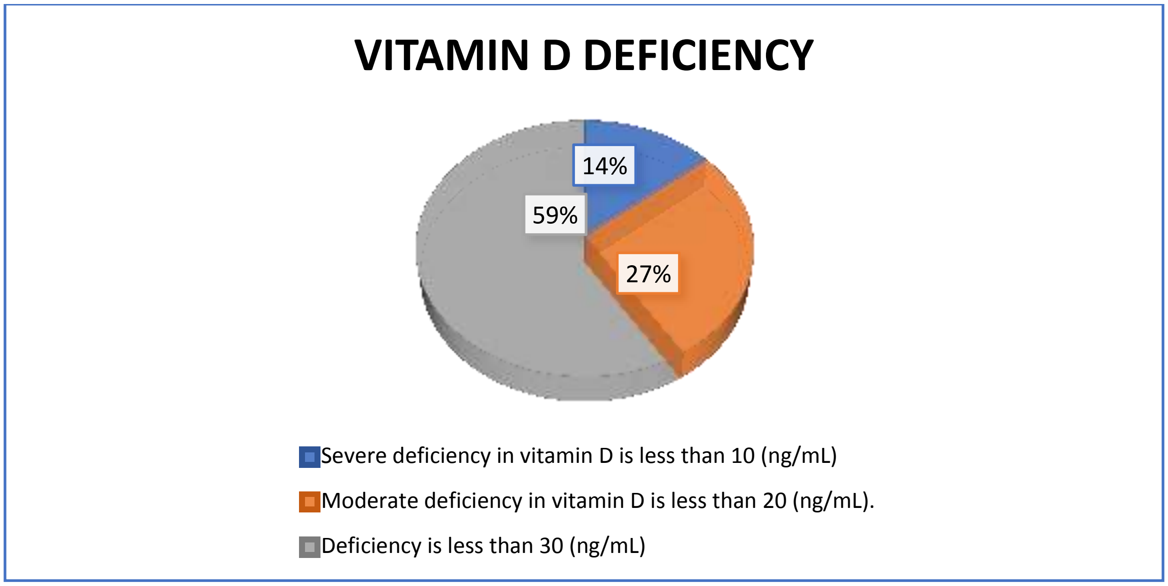

Figure 1: Rates of vitamin D among the studied samples

This result is consistent with many studies that consider vitamin D deficiency to be a major problem in many countries around the world, and pregnant women are the most vulnerable group to this deficiency, accounting for up to 40% of all cases of vitamin D deficiency in women in general.

This was confirmed by a study published in 2016 that found that the majority of patients had vitamin D levels between 0 and 20 nanograms/mL.

The results of the current study also agree with a study by Fouda [20] et al. (2016) in Saudi Arabia, which explained that the reason for the decrease in vitamin D in pregnant women is due to the physiological need of the body to increase its concentration during pregnancy, which requires an increase in the biochemical variables in the mother's blood to meet the needs of the fetus. It also mentioned that the main reason for vitamin D deficiency is the low production of vitamin D in the body. [20]

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The results of the current study are consistent with the results of a study conducted in Athens in 2002, which found that the percentage of vitamin D deficiency among pregnant women was less than 8 nanograms/ml. This deficiency was explained by the fact that pregnant women do not take vitamin D in the first months of pregnancy due to a lack of awareness and health culture about the risks of this deficiency. [21]

Distribution of study samples according to seasons

Table 1: Distribution of study samples according to the annual seasons

	Winter season		***Summer season***	
	Age	**Vitamin D**	**Age**	**Vitamin D**
No of sample	80	80	85	85
Mean± SD	28.2 ± 0.81	8.24 ± 0.92	29.6 ± 1.25	12.25 ± 0.85

Table 1 presents the distribution of study samples based on the annual seasons, specifically the winter and summer seasons. The table includes data on the number of samples collected, the mean age of participants, and the mean serum vitamin D levels for each season.

During the winter season, a total of 80 samples were collected, with participants exhibiting a mean age of 28.2 years (± 0.81) and a corresponding mean serum vitamin D level of 8.24 ng/mL (± 0.92). In contrast, during the summer season, 85 samples were collected, with participants having a slightly higher mean age of 29.6 years (± 1.25) and a notably higher mean serum vitamin D level of 12.25 ng/mL (± 0.85).

These findings suggest a seasonal variation in both the mean age of participants and their serum vitamin D levels. Specifically, participants tended to be slightly older during the summer season compared to the winter season. Additionally, the mean serum vitamin D levels were higher among participants during the summer season compared to the winter season, indicating a potential influence of seasonal factors such as increased sunlight exposure on vitamin D synthesis.

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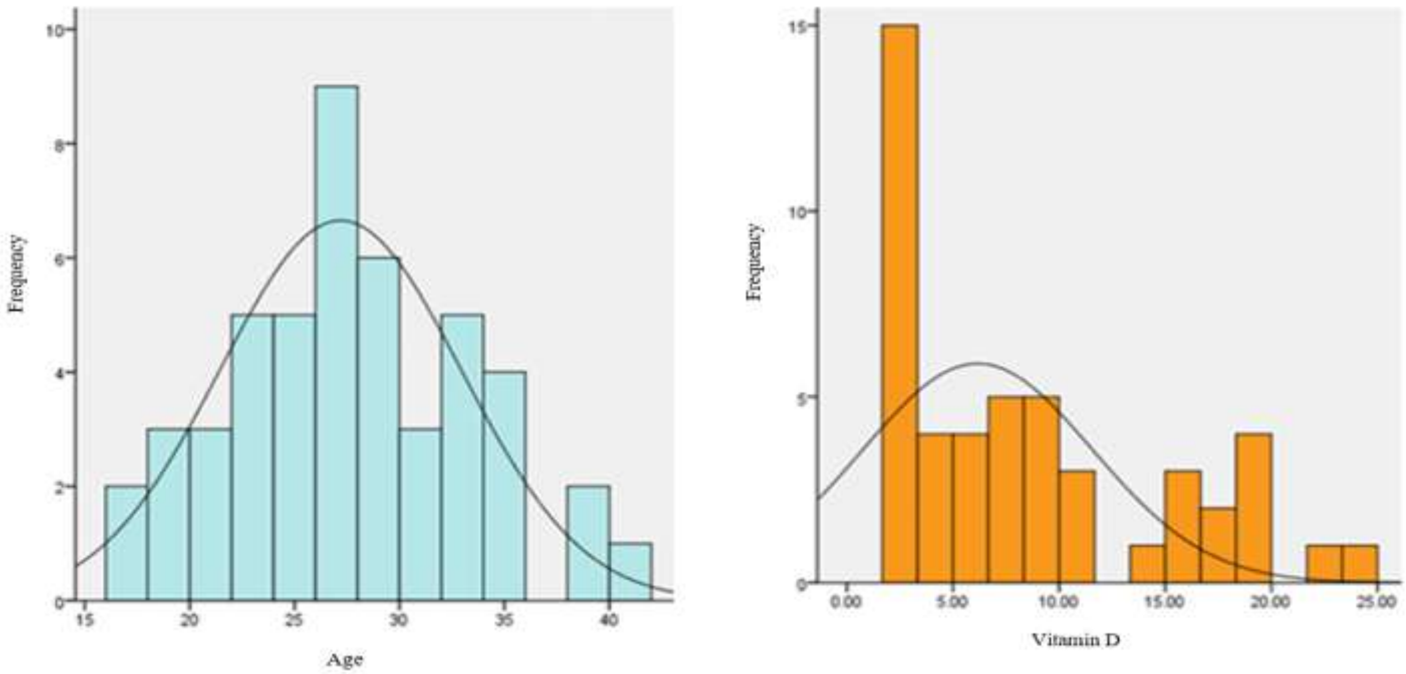

Figure 2: the distribution of age data and vitamin D levels in annual cold season samples

Overall, the data presented in Table 1 highlights the importance of considering seasonal variations when assessing vitamin D status among study participants and underscores the potential impact of environmental factors such as sunlight exposure on serum vitamin D levels.

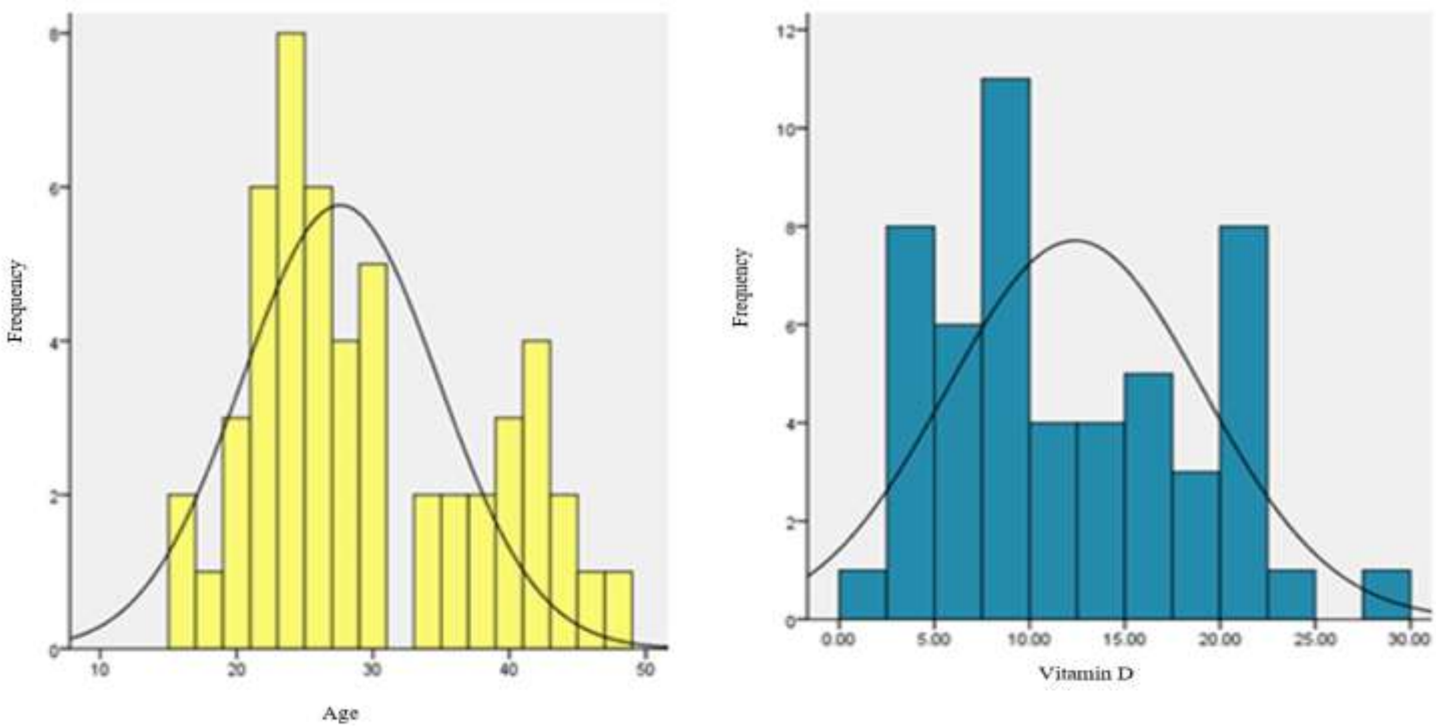

Figure 3: Distribution of age and vitamin D level data in annual hot season samples

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The results of this study confirm the results of many studies, including the results of a study conducted in Ukraine that found that vitamin D deficiency is a common condition among pregnant women during the winter and a study by Albakoush and Azab [22] (2016) that stated that changes in the four seasons affect cases of vitamin D deficiency if cases of deficiency are observed in the winter and spring seasons, even in Middle Eastern countries that are exposed to long hours of sunlight. [22]

In addition to other factors that affect this deficiency, including obesity, dark skin color, and damage to vitamin D production pathways in the body, a study by Prentice et al. [23] (2008) explained that the reason for the decrease in vitamin D is lifestyle and lack of exposure to sunlight for religious and cultural reasons, fear of skin tanning, the use of sunscreen cosmetics, and not eating foods rich in vitamin D in the diet. [23]

A study conducted in Saudi Arabia explained that the reason for the decrease in vitamin D concentration in the body is due to the physiological need to increase its concentration during pregnancy, which requires an increase in biochemical variables in the mother's blood to meet the needs of the fetus. [20]

A study by Sahu [24] et al. (2009) in India, which was conducted on two groups of adolescent women and pregnant women in the winter and summer seasons, found vitamin D deficiency in both groups. In the summer, the concentration of vitamin D was lower than its concentration in the winter. This confirms that the use of sunscreen powders and dark skin color leads to a large extent to reducing the production of vitamin D in the skin and reducing its concentration in the blood. [24]

Air pollution also reduces skin production of vitamin D, and heavy metals reduce serum vitamin D levels by increasing renal tubular dysfunction. In contrast, a study in 1964 stated that exposure to sunlight in the summer for half an hour a day is sufficient to obtain a sufficient amount of vitamin D 50,000 international units in people with white skin.

The sun is considered the main source of vitamin D, as it provides humans with 95% of the vitamin. Therefore, it is recommended to expose even a small part of the body to the sun during the day from 11 am to 2 pm for some time of only 5–10 minutes, which is considered sufficient for the body's need for vitamin D from sunlight.

Correlation between age and vitamin D level in cold and hot season samples

Two methods were used to verify the presence of a correlation between age and vitamin D concentration in the samples examined in the cold and hot seasons. These are the scatter plot method, which shows the presence of a specific trend in the data, and the Spearman correlation coefficient (R), which reveals the nature of the relationship between the data and the strength of this relationship. All results were extracted and interpreted based on a 95% confidence level.

It is clear from the scatter plot in Figure (4) that there is a slight trend in the data (R2 = 0.002) so the concentration of vitamin D increases very slightly with age in the cold season. While in the hot season, a slight inverse trend was observed in the data (R2 = 0.031), so the concentration of vitamin D decreases slightly with age.

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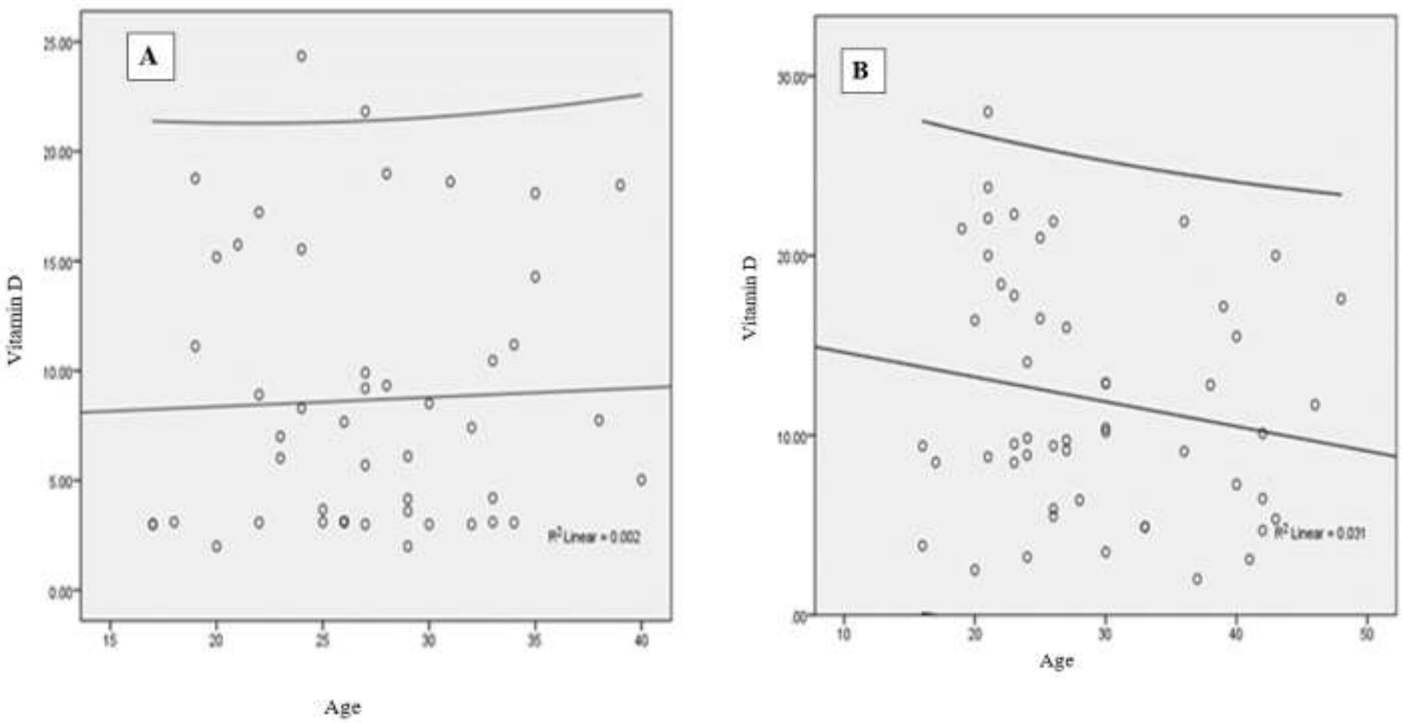

Figure 4: scatter plot of data from A-cold season samples and A-hot season samples

Table 2 presents the correlation between age and vitamin D concentration during both the winter and summer seasons. The table displays Spearman's correlation coefficients and their corresponding p-values (significance levels) for each correlation analysis.

In the winter season, the correlation coefficient between age and vitamin D concentration is 0.082, suggesting a weak positive correlation. However, the p-value associated with this correlation is 0.6, indicating that the correlation is not statistically significant. This implies that there is no meaningful relationship between age and vitamin D concentration among participants during the winter season.

Similarly, in the summer season, the correlation coefficient between age and vitamin D concentration is -0.179, indicating a weak negative correlation. Again, the p-value associated with this correlation is 0.172, which is not statistically significant. Thus, like in the winter season, there is no meaningful relationship between age and vitamin D concentration among participants during the summer season.

Overall, the data in Table 2 suggests that there is no significant correlation between age and vitamin D concentration in either the winter or summer seasons among the study participants. These findings indicate that age does not appear to influence vitamin D concentration in this population during either season.

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Table 2: shows the correlation between age and vitamin D concentration in the cold and hot seasons.

		Winter season		Summer season	
		Age	Vitamin D	Age	Vitamin D
Age	Spearman's correlation	1	0.082	1	-0.179
	Sig. (2-tailed)	-	0.6	-	0.172
Vitamin D	Spearman's correlation	0.082	1	-0.179	1
	Sig. (2-tailed)	0.6	-	0.172	-

The results of this study are consistent with many studies and contradict the study by Melamed [25] et al. (2005), which stated that vitamin D deficiency is independently associated with age, female gender, ethnicity, diabetes, high body mass index, and smoking. The level of vitamin D concentration (17.8 nanograms/ml) is independently associated with all causes of death in the general population. [25]

The study by Albakoush and Azab (2016) also stated that there is a relationship between vitamin D deficiency and age, which reached 73.1% in the age group (60–18) years. [22]

The study by Faris (2016) found that the percentage of deficiency was 38% in the age group (17–24) years. This was confirmed by the study by Ajlan (2015), which found that the risk factors for vitamin D deficiency in developing countries include age, female gender, winter season, skin pigmentation, malnutrition, low exposure to sunlight, covered clothing patterns, and obesity. [2, 11]

The low level of vitamin D among pregnant women during the cold and hot seasons is due to several factors, including lack of exposure to the sun, environmental factors, dietary factors, and some medications taken by pregnant women. It may also be due to the small number of samples or the nature of the geographical location. Therefore, it is recommended to expose yourself to sunlight for a sufficient period—for half an hour a day—to get vitamin D from ultraviolet rays and to follow a diet rich in vitamin supplements. There is a need for more studies in industrial areas to know the impact of industrial pollution on the prevalence of vitamin D deficiency in these areas and to compare it with other areas.

Conclusions:

Seasonal Variation in Vitamin D Levels: The study findings reveal a notable seasonal variation in serum vitamin D levels, with participants exhibiting higher mean vitamin D concentrations during the summer season compared to the winter season. This observation suggests that environmental factors such as increased sunlight exposure during the summer months may contribute to higher vitamin D synthesis among the study population.

No Significant Correlation between Age and Vitamin D Concentration: Analysis of the correlation between age and vitamin D concentration during both the winter and summer seasons did not yield statistically significant results. This indicates that age does not appear to influence vitamin D levels among the study participants, regardless of the season. Therefore, other factors such as dietary intake, sun exposure habits, and physiological differences may play a more significant role in determining vitamin D status.

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Implications for Public Health Interventions: These findings underscore the importance of considering seasonal variations and individual factors when assessing vitamin D status and designing public health interventions. Strategies aimed at improving vitamin D levels should take into account factors such as sunlight exposure, dietary intake, and supplementation, particularly during seasons with lower sunlight exposure.

Further Research Directions: While this study provides valuable insights into the seasonal and age-related patterns of vitamin D concentration among pregnant women in the eastern province of Saudi Arabia, further research is warranted to explore additional factors that may influence vitamin D status. Future studies could investigate the impact of dietary habits, cultural practices, and geographic location on vitamin D levels to develop more targeted interventions for improving vitamin D status and overall health outcomes.

Recommendations:

Promote Sunlight Exposure: Encourage pregnant women in the eastern province of Saudi Arabia to spend adequate time outdoors, particularly during the winter months when sunlight exposure is limited. Advising on safe sun exposure practices, such as spending time outdoors during midday when UVB rays are strongest, can help enhance vitamin D synthesis.

Dietary Guidance: Provide education on dietary sources of vitamin D and encourage pregnant women to consume foods rich in vitamin D, such as fatty fish (salmon, mackerel), fortified dairy products, and fortified cereals. Additionally, consider offering vitamin D supplementation to pregnant women with inadequate dietary intake or limited sunlight exposure, particularly during the winter season.

Healthcare Provider Education: Educate healthcare providers, including obstetricians, midwives, and general practitioners, about the importance of assessing and monitoring vitamin D status during pregnancy. Training healthcare providers to identify at-risk individuals and provide appropriate recommendations for vitamin D supplementation or lifestyle modifications can help improve maternal and fetal health outcomes.

Public Health Campaigns: Implement public health campaigns aimed at raising awareness about the importance of maintaining adequate vitamin D levels during pregnancy. Utilize various channels, including social media, community health centers, and prenatal care clinics, to disseminate information about the benefits of vitamin D, sources of vitamin D, and strategies for optimizing vitamin D status.

Further Research: Conduct additional research to explore the impact of cultural practices, dietary habits, and geographic location on vitamin D status among pregnant women in the eastern province of Saudi Arabia. Investigate the effectiveness of targeted interventions, such as vitamin D supplementation programs or community-based initiatives, in improving vitamin D levels and reducing the prevalence of vitamin D deficiency among pregnant women.

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