

A Correlation between various biochemical parameters of blood sugar and lipid profile with Vitamin D status in Perimenopausal women in tertiary care Hospital

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Abstract

Vitamin D is important for all age groups, especially women in menopause. In order to improve the health status of women in their postmenopausal stage, earlier identification of the risk population and prevention of the diseases in perimenopausal stage becomes indispensable. Due to the sharp increase in the morbidity status of elderly women, a study on the vitamin D status in perimenopausal women is essentially important, as an early identification and focus on promoting health, may reduce the disease in later life. The study was conducted in department of Biochemistry, Melmaruvathur Adhiparasakthi Institute of Medical Science and Research. This is descriptive study. Totally 72 perimenopausal was involved in this study and divided into two groups, each group consist of 36 women's. Vitamin D levels were significantly decreased in Hypovitaminosis D perimenuopausal women when compared with sufficient Vitamin D perimenuopausal women. In the present study we conclude that the Urgent measures needed should also include the assessment of vitamin D status in the population especially in females. It is reasonable for women to have 25(OH)D concentration measured at least once a year.

Keywords: Vitamin D, Hypovitaminosis and Perimenuopausal Women.

INTRODUCTION

Modern science and technologies of the world have increased the life expectancy of manhood. According to World Health Organization (WHO), the present decade women, have longer life expectancy of 48 to 70 years than men, with 45 to 60 years¹. In 1960 world women population aged over 60 years was below 250 million and it is estimated that in 2030, 1.2 billion women will be postmenopausal and this will increase by 4.7 million a year². But at the same time, recent studies shows that the quality of life in women is affected by conditions like falls and fractures, osteoporosis, hypertension, diabetes, metabolic syndrome, cardiovascular disorders, obesity, arthritis, cancer etc are common in women after their menopause¹⁻⁴ (Post menopause).

Hence postmenopausal women have high morbidity and mortality. Such morbidity reduction may have positive impact on women's quality of life and may reduce financial consequences to individuals, families, communities, and the nation^{3,4}. Hence, the present study mainly focuses on the role of vitamin D status in perimenopausal women.

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The studies during the past decades show Vitamin D, as an independent predictor of mortality. Event though, the vitamin D status, which has attained a lot of focus during the last couple of decades (19th and 20th century) as a possible multifunctional and important contributor to health and especially in the context of chronic lifestyle-related diseases; to the best of our knowledge, very few studies have been carried out on vitamin D status of women in maintaining health before menopause. Moreover, the assessment of vitamin D levels before menopause in females is particularly necessary to prevent post-menopausal disorders in women, which necessarily are preventable.

Perimenopause is a state of transition from reproductive life to menopause. There is no uniform definition of when this transitional period or “perimenopause” begins⁴. However, various criteria (such as first occurrence of more than 7 days difference in cycle length) have been proposed. The perimenopause extends until 12 months period of amenorrhea has elapsed. The average duration of perimenopause is documented as 4.8 years in a prospective study of cycle intervals and symptoms⁵. At present, a very few studies have been done on this population.

As vitamin D is more important in maintaining health, the level of vitamin D in perimenopausal women has been focused to prevent health issues after menopause⁶. Moreover, studies on Vitamin D status have been predominantly analyzed only after menopause. Therefore, the present study was designed to evaluate, the vitamin D status of women in perimenopausal age, of different physiological conditions. In addition, the aim of this study was to; compare the quality of life among perimenopausal women with vitamin D status in maintaining health.

Materials and Methods

The study was conducted during the period from July 2021 to August 2022 in the department of biochemistry, Adhiparasakthi Melmaruvathur Adhiparasakthi Institute of Medical Science and Research, Melmaruvathur, Tamil Nadu, India. This study was cross sectional study. Totally 72 perimenopausal was involved in this study and divided into two groups, each group consist of 36 women's. Ethical clearance was obtained from Institutional Ethical Committee conducted at the Adhiparasakthi Medical College. An informed consent was obtained from all the subjects participating in the present study.

The participants of the study were 72 women between 40-55 yrs, who agree to participate in the study and were regularly or irregularly menstruating. They were recruited from volunteers who were medical and Para-medical personnel's working in the hospital and their relatives, relatives accompanying the patients and females from master health checkup clinic, at Adhiparasakthi Melmaruvathur Adhiparasakthi Institute of Medical Science and Research, Melmaruvathur,. The participants belong to different

religious and socioeconomic backgrounds. 25(OH)D was estimated in the study population. Based on the 25(OH) D status, 36 women with adequate vitamin D status (25(OH)D >30 ng), is taken as sufficient vitamin D and 36 age matched women with inadequate vitamin D (25(OH) VIT D <30 ng) was taken as hypovitaminosis D.

Anthropometry

Anthropometric measurements viz. height (cm) and weight (kg), were recorded as per the guidelines suggested by Jelliffe⁷. The height was measured using anthropometric rod to nearest 0.1 cm. The subjects were weighed on portable platform weighing balance to nearest 0.5 kg with ordinary clothes.

BMI was calculated by using the formula expressed as the ratio of weight in kgs to height in square meters.

$$\text{BMI} = (\text{Weight (Kg)} / (\text{Height (m)}^2))$$

Biochemical Parameters

Serum 25 OH vitamin D, Fasting and Postprandial plasma glucose, Lipid profile, Serum calcium and Serum phosphate were the biochemical parameters estimated in the study population. Vitamin D estimated by ELISA methods remaining parameters were estimated by using standard methods. All the chemicals were purchased from sigma remaining chemicals were purchased from SRL Chennai.

Collection of Blood Sample

The blood samples of the respondents were collected after an overnight fast, 1ml in sodium fluoride coated sugar tubes and 3ml in plain tubes between 8 am to 9 am. 1 ml of blood for postprandial blood sugar was collected 2 hrs after breakfast. The blood drawn was allowed to coagulate and the serum was separated by centrifuging and stored at -20°C until assayed.

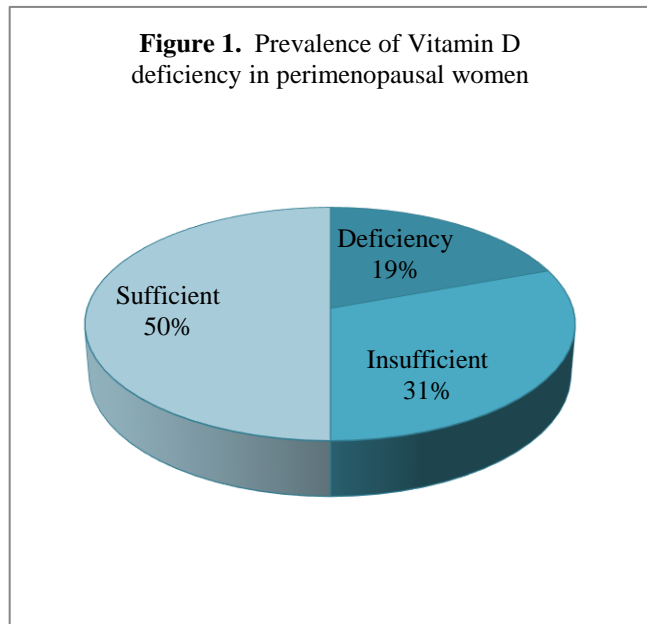
Results

Vitamin D is an essentially important micronutrient for women of all ages. Not only does Vitamin D insufficiency leads to health issues of human, but it has also been associated with many female-specific health concerns, including preeclampsia, breast cancer, perimenstrual syndrome and peri and post menopausal diseases. Since very few foods contain significant amounts of Vitamin D naturally, women living in countries that have very limited food items fortified with Vitamin D like India, need to rely on sunlight exposure to attain adequate Vitamin D status. Therefore, in the present section, the results obtained during our study of Vitamin D status on perimenopausal women has been explored in detail as follows:

Prevalence of Vitamin D deficiency in perimenopausal women

In general, the determinant of Vitamin D status is the concentration of 25(OH)D in the serum because it is the major circulating metabolite that is directly dependent on substrate supply from both skin and oral sources and is regarded as gold

standard indicator of Vitamin D status. According to endocrine society, in our study, the Vitamin D values was grouped into three categories i.e., VD sufficient (>30ng/ml), VD insufficient (20-30ng/ml) and VD deficient (<20 ng/ml) groups. In our study, Vitamin D values were estimated in perimenopausal women of 40-55 years without any history of signs and symptoms of clinical diseases, attending Adhiparasakthi Melmaruvathur Adhiparasakthi Institute of Medical Science and Research, Melmaruvathur. (Figure.1)



The pie chart in Fig 1 demonstrates the percentage of Vitamin D deficiency, insufficiency and sufficiency in perimenopausal women attending Adhiparasakthi Melmaruvathur Adhiparasakthi Institute of Medical Science and Research, Melmaruvathur. The percentage of study population with deficient, insufficient and sufficient vitamin D levels were respectively 19%, 31% and 50% as shown in the pie wedge for the respective Vitamin D concentrations of 16.30, 22.05 and 36.59 ng/ml.

Relation between age of perimenopausal women and Vitamin D

The observed results in Table 1 clearly reveals that 31% (n=22) of the participants were found to have Vitamin D level between 20-30ng/ml (VD insufficient) and 19% (n=14) of the participants were found to have Vitamin D level <20 ng/ml (VD deficient) and also 50% (n=36) of the study participants have sufficient Vitamin D levels. The observed mean ages of sufficient, insufficient and deficient women were 46.27±3.67, 45.71±3.24 and 46.78±4.31 respectively.

Table 1: Relation between age of perimenopausal women and Vitamin D

Vitamin D	Sufficient	Insufficient	Deficient	P valve
Number of participants	36	22	14	NA
Percentage of study population	50%	31%	19%	NA
25(OH)D	36.59±6.80	22.05±1.58	16.30±3.01	0.000**a,b
Age	46.27±3.67	45.71±3.24	46.78±4.31	NS
	Sufficient	Hypovitaminosis D		
Number of participants	36	36		NA
25(OH)D	36.59±6.80	19.82±3.6		0.000
Age	46.27±3.67	46.24±3.77		NS

a-Comparison between sufficient and insufficient Vitamin D level

b-Comparison between insufficient and deficient Vitamin D level

P< 0.001 is considered significant

NS- Not significant

NA- Not applicable

In our study, the three categories of Vitamin D values were classified into two groups namely Hypovitaminosis D group (Deficient and Insufficient; n=36) and Sufficient Vitamin D (n=36) group for further analysis. The observed mean value of perimenopausal women with hypovitaminosis D was 19.82±3.6 and sufficient Vitamin D was 36.59±6.8 as shown

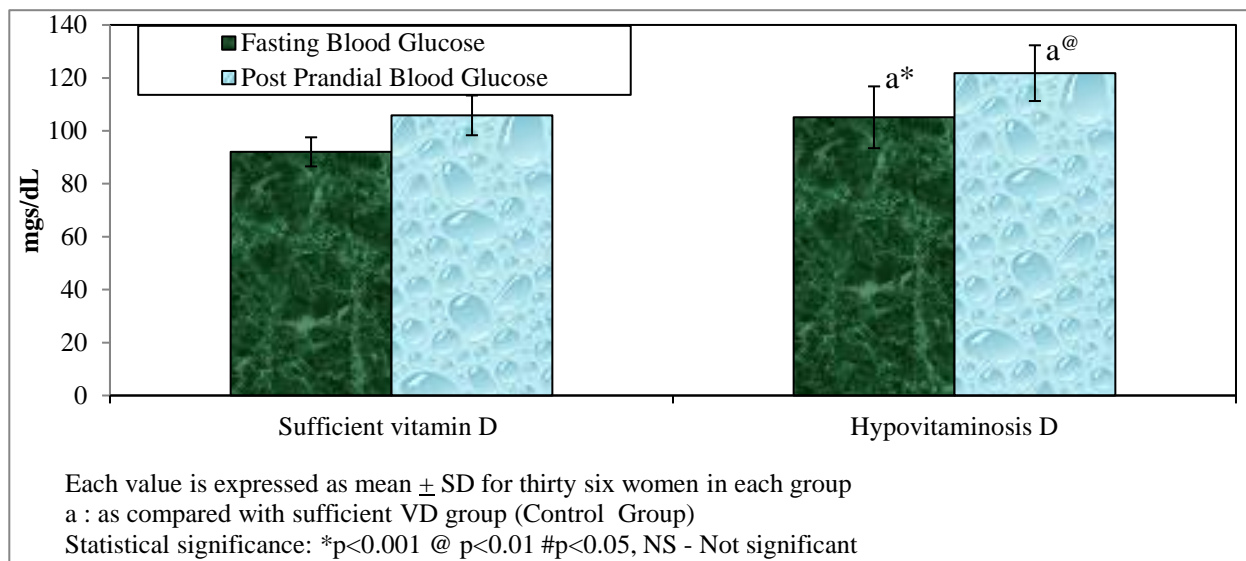
in Table 1. Therefore, from the above results, the study clearly shows that the age of perimenopausal women was not related to the status of Vitamin D.

Vitamin D and Blood Glucose

Figure 2 shows the relation between the blood glucose levels in hypovitaminosis D and sufficient VD perimenopausal women. The blood levels of fasting and post prandial

glucose were observed in both the groups of perimenopausal women. The levels of fasting and post prandial glucose were found to be significantly ($p < 0.001$) decreased in VD sufficient women compared to hypovitaminosis D women.

Figure 2: Relation between Vitamin D and blood glucose

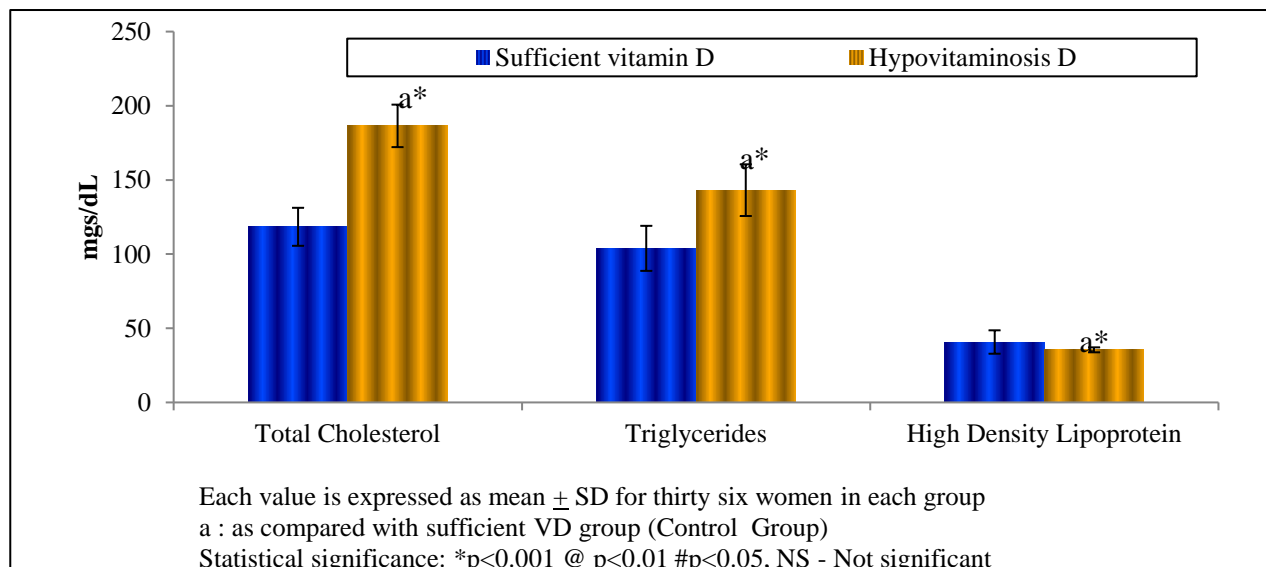


Vitamin D and Lipid Profile

Figure 3 illustrates the levels of Total Cholesterol (TC), Triglycerid-es (TGL) and High Density Lipoprotein (HDL) in sufficient and hypovitaminosis D perimenopausal

women. The levels of TC and TGL were found to be significantly negatively correlated ($p < 0.001$) with Vitamin D levels. HDL was found to be significantly increased ($P < 0.001$) in sufficient VD women compared to hypovitaminosis D women.

Figure 3: Relation between Vitamin D and lipid profile



Discussion

Vitamin D deficiency is of particular concern among women in many south Asian countries due to low availability of vitamin D-rich foods, dark skin pigmentation, and cultural and religious practices that promote the wearing of

concealing clothing. However, the information regarding the vitamin D status of many sub population in south Asian countries are limited. The current study was conducted to assess the vitamin D status of 72 Tamil women of perimenopausal age and determine whether vitamin D status influences the susceptibility to promote better quality of life.

Prevalence of Vitamin D deficiency in perimenopausal women

In general, there are multiple factors that affect the availability of the Vitamin D as well as the body's response to it. The one of the major natural source of Vitamin D, for most population, is the skin synthesis of Vitamin D₃. The factors that limit sunlight exposure and intensity will determine the prevalence of Vitamin D deficiency. Hence, low Vitamin D status may be caused by a number of factors, including insufficient synthesis in the skin (due to limited sunlight exposure) and inadequate intake or absorption of VD₈.

In our study, we observed that nearly 53% of hospital workers were found to have sufficient vitamin D levels because this population includes hospital attenders and sweepers who used to go out in sunlight for their work. 47% of low vitamin D levels were observed among hospital workers who were technicians, staff nurses and departmental attenders who were not adequately exposed to sunlight. The obtained results in our present study, clearly reveals that limited sunlight exposure and intensity determine the prevalence of Vitamin D levels as correlated with the already reported literatures⁸.

In our study, we observed that nearly 69% of the population exposed to sunlight more than 15 min were found to have sufficient vitamin D levels. In contrary, 31% of the population exposed to sunlight more than 15 min were found to have low vitamin D levels. It may be due the reason that they not exposed to sunlight between 11 am and 3 pm, because the skin is able to generate significant quantities of vitamin D only between the hours of 11:00 am and 3:00 pm⁹. Moreover, in our study, in order to avoid the seasonal variation on vitamin D levels, the collection of blood samples was done between December to February 2012. Less sunlight during these months may also contribute to low vitamin D status in the study participants.

According to the reported literatures, for elderly people, the exposure of hands, face, and arms to suberythemal doses of radiation (10±15 min between 11am and 2 pm) two to three times a week in the summer would satisfy a requirement of 400 IU/day of vitamin D₁₀. This vitamin D is stored by the circulating vitamin-D-binding protein, to be released for future use. For many women these stores are inadequate to maintain good health. The above points validate the observed findings in our study.

In general, the lifestyle also plays an increasingly important role in sunlight exposure, as most women join the work force or house-wives, who stays at home most of the time¹⁵⁷. In addition, darker skin pigmentation also reduces skin synthesis of vitamin D₃. Recent studies also demonstrate that dark skinned Asians are at increased risk of vitamin D deficiency¹¹.

In our present study, the obtained results (House wife - 81%

and working women – 47%) correlates with the above fact that house wives and working women are more prone for low Vitamin D levels.

A reported study shows that the prevalence of VDD is approaching 90% due to their limited exposure to sunlight which supports our study¹². In addition, from our study, lack of physical activity was observed among almost 78% of the total hypovitaminosis D population, will also contribute to high prevalence of low vitamin D levels. Thus from our study, it is clearly understood that decreased exposure to sunlight and less outdoor physical activity can have great effects on vitamin D levels.

In many countries, throughout all continents, Vitamin D insufficiency

(<20 ng/ml) exists in around 50% of the populations. Within the Asian region, there are not many reports on Vitamin D status of this population except pockets of studies among children, pregnant women or post-menopausal women. In India, generally low serum 25(OH)D concentrations have been reported¹⁵⁹. The mean serum 25(OH)D was 12 ng/ml in a survey among hospital staff from India, while the mean serum 25(OH)D was 14 ng/ml among pregnant women and 14.4 ng/ml in postmenopausal women¹⁵⁹. In Beijing, China, mean serum 25(OH)D in adolescent girls was 12-14ng/ml. In Japan, mean serum 25(OH)D of 34 nmol/L was observed in women younger than 30 years and 30 nmol/L in immobile older persons¹³. In the Korea National Health and Nutrition Examination Survey (KNHANES), Vitamin D insufficiency (< 50 nmol/l) was found in 64.5% females.

In our investigation, the percentage of study population of deficiency, insufficiency and sufficiency were respectively 19%, 31% and 50% with the respective Vitamin D concentrations of 16.30, 22.05 and 36.59 ng/ml. In our study, we found that the prevalence of hypovitaminosis D, as defined by 25(OH) D levels lower than 30 ng/ml, was also common among otherwise healthy women with mean concentration of 19.82±3.6, which is found to be better than the above mentioned studies.

Vitamin D and blood Glucose

In our study, the blood glucose levels of fasting and post prandial glucose were observed in both hypovitaminosis D and sufficient VD perimenopausal women. The fasting blood sugar levels ranges from 93.21 to 134.32 mg/dl in hypovitaminosis D women and in sufficient vitamin D women from 80.12 mg/dl to 100.01mg/dl. The post prandial blood sugar levels ranges from 97.72 to 142.22 mg/dl in hypovitaminosis D women and in sufficient vitamin D women from 90.92 mg/dl to 120.51mg/dl. The levels of fasting and post prandial blood glucose were found to be significantly lower in VD sufficient women compared to hypovitaminosis D women although the concentrations were within the normal limits.

The reason for the above obtained results may due to presence of the vitamin D receptor in pancreas. In addition, Vitamin D

deficiency impairs glucose and arginine induced insulin secretion in perfused rat pancreas. Adequate vitamin D status facilitates the biosynthetic capacity of the β -pancreatic cells and accelerates the conversion of pro-insulin to insulin. The role for vitamin D in glucose and insulin metabolism is well supported in animal studies. In addition, 1, 25(OH)2D directly activates transcription of the human insulin receptor gene, activates peroxisome proliferator activator receptor- δ , stimulates the expression of insulin receptor, and enhances insulin-mediated glucose transport in vitro¹⁴. Animal and in vitro studies provide compelling evidence that vitamin D may play a functional role in the preservation of glucose tolerance through its effects on insulin secretion and insulin sensitivity.

Our findings are supported by Nita G. Forouhi et al that 25(OH)D was significantly related to blood sugar levels and also showed an inverse association with fasting glucose and insulin with VD. A recent study in 753 postmenopausal women attending a university hospital outpatient clinic in Australia found an inverse association between fasting plasma glucose and serum 25-hydroxyvitamin D15.

Vitamin D and Lipid Profile

Vitamin D deficiency due to inadequate exposure to sunlight increases the blood cholesterol level, by affecting the squalene metabolism, to progress to cholesterol synthesis rather than vitamin D synthesis. Vitamin D deficiency also has been linked with metabolic derangements, including abnormal lipoproteins. Although the mechanistic role of Vitamin D deficiency in the pathogenesis of dyslipidaemia was not well understood, Vitamin D supplementation was reported to attenuate the beneficial effect of hormone replacement therapy on serum lipid levels. Vitamin D has been associated with atherosclerosis at each stage of its development from subclinical plaque to the associated cardiovascular morbidity and mortality¹⁶.

Our present investigation shows that the lipid profile parameters, total cholesterol and the TGL were significantly increased in perimenopausal women with hypovitaminosis D compared with the sufficient vitamin D status. HDL was found to be positively significant correlated with Vitamin D. Our results were further supported by Joshua F. Baker¹⁶. The earlier study of Kumaravel Rajakumar et al also showed positive correlation between 25(OH)D and HDL cholesterol in children¹⁷. Another study by Johnson et al noted a positive association with 25(OH)D and HDL cholesterol ($r=0.41$; $P<0.001$) also supports our findings¹⁸.

Conclusion

The consequences in postmenopausal women with pre-existing loss of estrogen, will be aggravated by age-related changes in the VDR and vitamin D synthesis. The result is a further increased risk of malignancy, bone loss, hypertension, diabetes, depression, falls and osteoporotic fractures. In the present study we conclude that the Urgent

measures needed should also include the assessment of vitamin D status in the population especially in females. It is reasonable for women to have 25(OH)D concentration measured at least once a year. Public health messages on the importance of vitamin D, its role in overall wellbeing and ways of achieving sufficient vitamin D status should also be disseminated to the public.

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