

Assessment of knowledge, attitude and practices towards vitamin d in pregnant women and its relation with vitamin d status

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Abstract

This research paper delves into Vitamin D which is a vital nutrient during pregnancy, contributing significantly to the health of both the mother and the developing fetus. It plays a key role in calcium homeostasis and bone mineralization, which are critical for fetal skeletal growth. Adequate levels of vitamin D during pregnancy are also linked to the proper functioning of the immune system, reduction of inflammation, and regulation of cell growth. Vitamin D deficiency is common among pregnant females, influenced by factors such as limited sun exposure, darker skin pigmentation, dietary habits, and geographical location. Research has associated low levels of vitamin D in pregnant women with increased risks of complications such as gestational diabetes, preeclampsia, and preterm birth. Furthermore, insufficient vitamin D levels may adversely affect fetal development, potentially leading to low birth weight and increased susceptibility to respiratory and allergic conditions in the child. Vitamin D supplementation in pregnancy has been shown to improve maternal vitamin D status and may help mitigate some of these risks, although the exact dosage and duration remain areas of ongoing research. Routine monitoring of vitamin D levels in pregnant women, particularly those at higher risk of deficiency, is recommended to promote better health outcomes for both mother and child. Further research is needed to refine supplementation guidelines and fully understand the long-term effects of maternal vitamin D status on offspring health.

Keywords: Vitamin D, Pregnant women, Vitamin D supplementation, Vitamin D deficiency

Introduction:

Vitamin D in recent years has become a widely studied fat soluble vitamin because of its involvement in skeletal and extra-skeletal development and its deficiency has become a nationwide nutritional problem, yet it has been widely undiagnosed and untreated. Chronic vitamin D deficiency in adults results in osteomalacia, osteoporosis, muscle weakness^[1-4]. Its deficiency has also linked with the increased risk of developing hypertension, diabetes, obesity and high triglyceride level ultimately leading to increased risk of cardiovascular mortality^[2,5]. Researchers have shown epidemiological association of vitamin D deficiency and type1 diabetes. A meta-analysis of observational studies showed a 30% reduction in risk of type 1 diabetes mellitus in children receiving vitamin D supplements^[6,7]. In India, especially in the south India, despite being in the tropics with abundant sunlight there is a high prevalence of hypovitaminosis in young adults, children and more importantly pregnant women^[8,9]. Factors such as social and religious practices, taboos, modest dressing dietary calcium intake, urbanization and women preferring “desk jobs” and increased use of sunscreen can be the causes for this paradoxical effect.

Vitamin D deficiency in pregnancy leads to neonatal hypocalcaemia, infantile rickets and predisposition to lower respiratory tract infections, the main cause of infant mortality^[10]. It is also shown to cause increased risk of miscarriage, preeclampsia states etc.

Our study is focused on assessing the knowledge, attitude and practices towards Vitamin D by a simple questionnaire followed by assessment of vitamin D levels in pregnant women. **Review of literature:**

As discussed above we know that Vitamin D deficiency has a bearing not only on skeletal but also on extra-skeletal diseases. Owing to its multifarious implications on health, the epidemic of vitamin D deficiency in India is likely to significantly contribute to the enormous burden on the healthcare system of India.

In 2018 another study on the prevalence of Vitamin D deficiency in Indian women done by a team of Indian researchers, concluded that the cut off level for the vitamin D deficiency level should be revised in according to the need of the people of India and ICMR should also revise the recommended daily allowance to include daily recommendation of vitamin D level^[1]. But the study was conducted from sample criteria that included women who visited a gynecological clinic in Agra and Uttar Pradesh without taking into account or differentiating the diet, socioeconomic status, practices, beliefs and sun exposure of pregnant women residing in Southern Indian states furthering the need of an updated study such as ours

A study conducted in 2009 in Wisconsin University, USA, hypothesized that young adults would commonly have vitamin D deficiency and that a questionnaire could help identify subjects with the condition^[3]. The use of a questionnaire helped shape the results of the study and understand the knowledge and practices of the people which is what we expect to understand and calibrate with our study as well.

Coming to attitude, it is found that moderate knowledge among the people of North Ethiopia translated to good attitude among the subjects who were mothers with infants that were exposed to sunlight. This shows that there is significant association and correlation between knowledge and attitude among those women but this did not transpire to good practices and vitamin levels^[6].

A similar study done in 2009 on the prevalence of vitamin D deficiencies was restricted only to the northern part of India, i.e., latitude 26 degrees N and it showed results of high prevalence of hypovitaminosis D^[10], given their sunlight exposure is much less but larger part of the population are farmers and have more sun exposure time it is safe to assume that southern India with latitude of 12 degrees will show promising results.

In 2017, a study done on Omani females gave observations wherein there was gross lack of consistency and confusion between knowledge, awareness and attitude among the female students^[12]. Reduction in outdoor exposure time due to desk jobs, excessive use of sunscreen and fear of dark complexion where some of the assessment factors which according to them determined their exposure to sunlight and inturn vitamin D levels. Similar factors may also be likely seen in our assessment for which the questionnaire followed by assessing the

vitamin D levels in expecting mothers is key.

Aims and objectives:

1. To explore the knowledge, attitude and practices regarding vitamin D among healthy pregnant women.
2. To determine the vitamin D status and correlate with knowledge, attitude and practice of vitamin D.

Materials and methodology:

Study design

A cross sectional descriptive study was conducted among pregnant women in their 1st trimester who attended the antenatal OPD, in our tertiary care Hospital over a period of two months.

Formula for calculation of sample size:[11]

Estimate sensitivity: $n = Z^2 \frac{p(1-p)}{e^2}$

$Z\alpha = 1.96$ at 95% C.I

$p = 29\%$

$e = 10\%$ (Allowable error) Then $n = 79$

Inclusion criteria:

Pregnant women above the age of 18 yrs who are booked and registered cases at the tertiary care Hospital. Exclusion criteria:

Exclusion criteria were age less than 18yrs or more than 40 yrs; women with chronic liver disease; women with renal disease; women on antitubercular or antiepileptic treatment in the previous 3 months and any other diagnosed co morbidities

A pre-designed, self-administered questionnaire was used which was validated before usage for data collection, which included parameters like demographic data, knowledge about vitamin D, attitude towards vitamin D deficiency and its manifestations, practice of regularly checking vitamin levels, supplements and natural sources.

Regarding knowledge score, right answers were given score "1" while wrong answers and do not know answers were given score "0." Thus, the total knowledge score is ranged between 0 to 9. While for attitude score, the responses were scored in a way that the higher the score the more positive the attitude towards importance of vitamin D. Strongly agree is given a score "5," agree "4," neutral "3," disagree "2," and strongly disagree "1." The participation in the study was on voluntary basis. All participants were given a briefing about objective of the study and were assured confidentiality in collection of personal data and demographics..

Blood samples to determine the vitamin D status were collected by venipuncture in EDTA-vacutainer tubes. Serum 25-hydroxyvitamin D (25-(OH) concentration assessment was performed using a commercial enzyme-linked immunosorbent assay (ELISA) from CALBIOTECH company. The ELISA was performed according to the manufacturer's written protocol. The 25-OH Vitamin D is a solid phase ELISA based on the principal of competitive binding. Pregnant women were classified into 1 of 3 groups that define vitamin D status:

- Severe vitamin D deficiency - Cut-off limits of 20ng/ml
- Moderate vitamin D deficiency - Cut-off limits of 30 ng/ml
- As mild deficiency. - Cut-off limit of <35ng/ml
- Normal limits greater than 35ng/ml

Ethical consideration:
Institutional Ethical committee clearance was taken before the study. Informed consent was taken from the patients and confidentiality maintained.

Data analysis:

Data entered in MS Excel and analyzed using IBM Statistical Package of Social Sciences (SPSS) version-23. Data analyzed by frequency, percentage and by Chi-square test. Correlations studied by Karl Pearson's Coefficient of Correlation. Statistical significance set at $P \leq 0.05$.

Observations and results:

In the present study 81 pregnant women in their 1st trimester attending the antenatal OPD participated in the survey and their vitamin D levels were assessed.

Majority (48.1%) of the pregnant women belonged to the age groups of 26-30 years which represents the prime reproductive years in Indian women, i.e., more than three fourths of the population. Less than 10% of the mothers were homemakers with reduced exposure to sunlight while most of the women, about 60% held jobs that required them to be exposed to sunlight at different times during the day (teachers, anganwadi workers, daily wage workers, sales women, engineers, etc.). Majority (93.8%) followed a mixed diet routine with good proportion of consuming eggs and seafood owing to the coastal geography. Using BG Prasad's classification [13], 37.2% of the women belonged to middle class (per capita income of 2000 to 3500 rupees), while 47% belonged to the lower middle and lower classes. Many were literate as basic education up to higher secondary schooling was completed by 75% of the women in the study population.

Table 1 depicts the sociodemographic characteristics of the pregnant women in their first trimester.

Knowledge about Vitamin D:

In our study, all 81 respondents were well aware of vitamin D and its benefits (Table 2). Majority, 69.1% received this information from doctor's advice, health programs and advertisements, while only 10% were not very aware. On assessing the knowledge regarding the sources of vitamin D, 39.5% were well aware of the right sources of vitamin D, while 43.2% and 17.3% chose incorrect option or were unaware respectively.

On testing their knowledge on dairy products, fats and sunlight being a source of vitamin D production, 45% agreed that consumption of these products is essential. Though 40% were not too sure, 38(48%) women in the population knew that sunlight exposure is essential and 27 (33.3%) among the 81 women knew the best time to be exposed to reap maximum benefits as well. In addition to this, 41 (50.6%) opted for supplements and increased dietary intake in the hypothetical occurrence of deficiency state.

The pregnant women were well aware, i.e., 100% were aware of the normal levels of vitamin D required and its effects in the body metabolism. 66% of them also knew the effects of hypovitaminosis D on pregnancy as well as on the newborn.

As depicted in figure 1, on scoring the knowledge level 42 (54%) women had good knowledge about vitamin D with a mean score of ± 1.03 .

Attitude of vitamin D:

Based on the results obtained in table 3 and figure 2, maximum women 78 (98%) had scores between 36-50 points indicating an overall a good/positive attitude.

Moreover 55.6%, 55.6% and 48% strongly disagreed to negative attitudes/behaviors such as staying away from sunlight exposure, fearing tanning, food sources not being good enough to obtain vitamin D adequately and Vitamin D being non-essential in pregnancy respectively.

Majority had a very positive attitude towards vitamin D being essential for fetus (65.4% agreed while 21% strongly

agreed). 43% agreed that vitamin D analysis should be done during routine antenatal investigations because 59% felt that mothers in India are not aware of the association of vitamin D in pregnancy. 54.3% had a neutral attitude towards the usage of fortified foods as a better option and 82.7% were neutral to the usage of sunscreen.

The results also pointed out that 58% of the pregnant women were keen to know more about Vitamin D and all 81 participants said they had good exposure to sunlight

Some negative attitudes were also seen among the pregnant women such as 29(35.8%) were neutral or not keen on getting regular vitamin D levels assessed as part of routine antenatal checkups. 27(33.3%) disagreed to the usage of fortified foods and supplements which can pose a problem in case these women fall into hypovitaminosis states.

Practices adopted to improve the general vitamin D status:

Thirty three (40.7%) pregnant women obtained a score of 3-6 points indicating good practices being followed while the rest were not intentionally following any set practices to attain optimum vitamin D levels (figure 3).

Considerably good practices were being followed by mothers as 43.2% regularly exercised with good sunlight exposure while 32% exercised or walked outside or did chores in the midday timeframe which is the optimum time for maximum sunlight exposure. Even though 42% did not consciously put effort into eating vitamin rich foods, the remaining 48% did so in varying proportions. 80% consumed foods fortified with vitamins during pregnancy only, in which Vitamin D is an essential component, 98% did not routinely test vitamin levels and on reasoning out they owed this factor to the fact that the tests were expensive.

Vitamin D status:

The serum levels assessed in the pregnant women in their first trimester was found to be within the normal range of > 35ng/dL (figure 4).

By using Carl Pearson's coefficient, the vitamin D levels assessed in the pregnant women's serum samples were correlated with their knowledge, attitude and practices and the results are shown in Table 5. 'p' Value < 0.05 was considered statistically significant and vitamin D status and practices were only parameters found to be significant in our study. But on further analysis of the correlation between individual questions/parameters and vitamin D levels it was found that there was significant correlation($p < 0.05$) in 4 domains of attitude namely- question 3 that assessed if vitamin D could be omitted in pregnancy as it is not essential to which the women strongly disagreed, question 4 analyzed their attitude towards importance of vitamin D in foetal growth and development, question 6 determined the women's attitude towards the lack of knowledge among mothers in general and question 8 tested their attitude towards sunscreen usage being a cause of inadequate production of vitamin D. The last three were answered with a positive attitude and since it showed significance it highlights that positive attitude has an impact on increased vitamin levels (table 6). Table 7 depicts the correlation analysis done between all the parameters, i.e., between knowledge, attitude and practices. No significant correlation between parameters other than practices and vitamin D levels.

Table 1. Sociodemographic characteristics of pregnant women in their first trimester.

Parameter s	CATEGORY	NUMBER	PERCENTAG E%
Age of the mother	19 to 25 years	17	21
	26 to 30 years	39	48.1
	31 to 35 years	20	24.7
	36 to 40 years	5	6.2
Occupatio n of the mother	Accountant	5	6.2
	Anganwadi teacher	2	2.5
	Bank staff	1	1.2
	Clerical staff	6	7.4
	Daily wage worker	12	14.8

	Homemaker	2	2.5
	Engineer	25	30.9
	Homemaker	6	7.4
	Housemaid	1	1.2
	Lab technician	1	1.2
	Maid	6	7.4
	Maintenance staff	1	1.2
	Medical assistant	9	11.1
	Sales person	3	3.7
	Teacher	1	1.2
	Technician		
Type of diet of the mother	Vegetarian	5	6.2
	Mixed	76	93.8
Socioeconomic status of the family	Lower class	16	19.8
	Lower middle class	22	27.2
	Middle class	30	37
	Upper middle class	13	16

Table 2. Assessment of knowledge regarding vitamin D among pregnant women in 1st trimester.

QUESTIONS/ITEMS	Frequency	Percentage
Aware of the importance or heard of vitamin D	81	100.0
2 a. Right sources of vitamin D selected	32	39.5
b. Incorrect sources of vitamin D were selected	35	43.2
c. Not aware of sources	14	17.3
3 a. Correct Vit.D deficiency manifestations	2	2.5
b. Incorrect Vit.D deficiency manifestations	58	71.6
c. Not aware of the deficiency signs	21	25.9
4 a. Effects of vit.D wrongly chosen	2	2.5
b. Effects of Vit.D rightly chosen	66	81.5
c. Not aware at all	13	16.0
5 Normal level of vit.D rightly chosen by women	81	100.0
6 a. Milk and fat consumption required to produce Vit.D	45	55.6

	b. Not required to consume above foods	22	27.2
	c. Unaware	14	17.3
7	Best time to be exposed to sunlight for Vit.D		
	a. Midday sunlight to stand directly under it	27	33.3
	b. 8am-10 am or after 4pm	21	25.9
	c. Not aware	33	40.7
8	Incase of deficiency, apt choice of treatment.		
	a.Increase intake of foods rich in vit.D,more exposure to sunlight,supplements	41	50.6
	b.Will resolve on its own,leave it	29	35.8
	c.Not aware	11	13.6
9	Learnt /got information about Vit.D from		
	a.Newspapers and media	4	4.9
	b. Doctor's advice	56	69.1
	c. Friends and family	11	13.6
	d. Not aware	10	12.3

Figure 1 : Status of knowledge assessed and scored in the given population

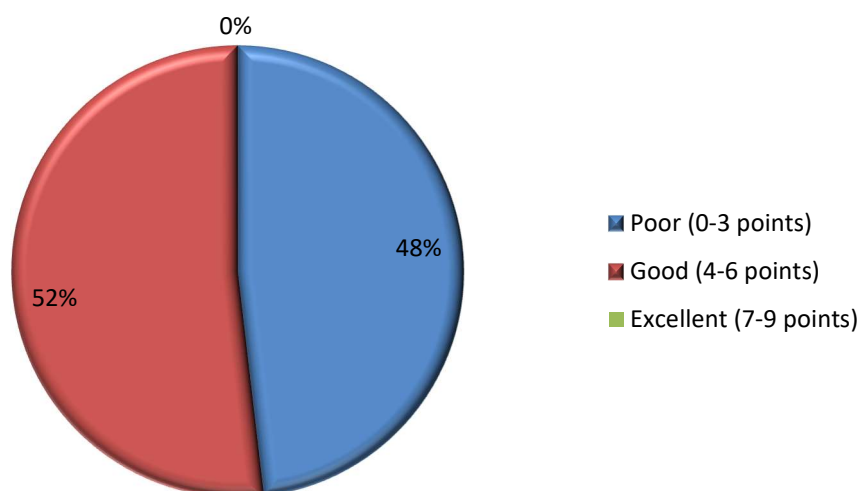


Table 3. Attitude of mothers towards vitamin D.

Questions/items	Frequency	%
1. Stay away from exposure to even mild sunlight due to tanning		0
a. Strongly agree (1)	0	0
b. Agree(2)	0	1
c. Neutral(3)	12	4
		.
		8
d. Disagree(4)		5
	45	5
		.
		6
e. Strongly disagree(5)		2
	24	9
		.
		6
2. Food sources not enough to maintain Vit.D in pregnancy		-
a. Strongly agree (1)	-	-
b. Agree(2)	-	1
c. Neutral(3)	12	4
		.
		8
d. Disagree(4)		5
	45	5
		.
		6
e. Strongly disagree(5)		2
	24	9
		.
		6
3. Vit D is not essential in pregnancy		
a. Strongly agree (1)		6
b. Agree(2)	5	.
c. Neutral(3)		2
		4
d. Disagree(4)		8
	39	.
		1

	e. Strongly disagree(5)	37	4 5 . 7
4.	Vitamin D is essential for fetus and mother		
	a. Strongly disagree (1)	11	1 3 . 6
	b. Disagree(2)		6 5 . 4
	c. Neutral(3)		2 1 . 0
	d. Agree(4)	53	
	e. Strongly agree(5)	17	
5.	Do you think vit.D assessment should be included in normal routine ANC blood investigation		
	a. Strongly disagree (1)	9	1 1 . 1
	b. Disagree(2)		3 5 . 8
	c. Neutral(3)	29	
	d. Agree(4)		3 5 . 8
	e. Strongly agree(5)	29	
		14	1 7 . 3
6.	Mothers in India are unaware of the importance of Vit.D in pregnancy		
	a. Strongly disagree (1)		8 . 6
	b. Disagree(2)	7	
	c. Neutral(3)		

d. Agree(4)	48	59
e. Strongly agree(5)	26	32
		1

7 Supplements and fortified foods are a better option a. Strongly disagree (1) b. Disagree(2) c. Neutral(3) d. Agree(4) e. Strongly agree (5)	31 44 6	38 35 43 74
8 Sunscreen can reduce the production of vitamin D a. Strongly disagree (1) b. Disagree(2) c. Neutral(3) d. Agree(4) e. Strongly agree	67 14	82 71 73
9 Do you wish to learn more about vitamin D a. Strongly disagree (1) b. Disagree(2) c. Neutral(3)	11	13 6

d. Agree(4)		47	5
			8
			.
			0
e. Strongly agree(5)		23	2
			8
			.
			4
10.	Do you get exposed to sunlight often	81	
	a. Strongly disagree (1)		
	b. Disagree(2)		
	c. Neutral(3)		
	d. Agree(4)		1
	e. Strongly agree(5)		0
		0	0
			.
			0

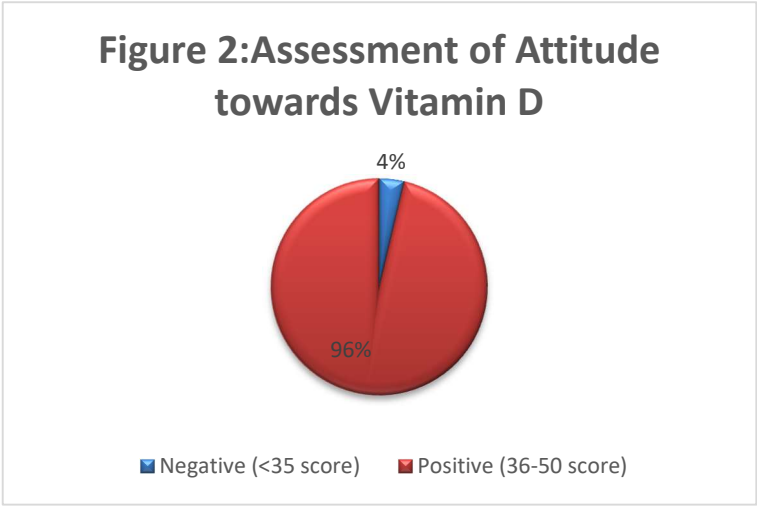


Table 4. PRACTICES followed by pregnant women that yield to better serum Vitamin D levels.

Question/Item (Scores for each)	Freq uenc y	%
1.Exercises/walks /chores done regularly with good exposure to sunlight		
a.Not done or not aware (0)	20	2
		4
		7

b.Done in the morning or evening (1)	35	4 3 . 2
c.Done during midday (2)	26	3 2 . 1
2.Do you consciously eat food rich in vitamin D sources		
a.Do not eat /not aware of consumption(0)	34	4 2 . 0
b.Yes, but less than 3 days a week(1)	28	3 4 . 6
c.. Yes, almost daily (2)	19	2 3 . 5
3. Taking vitamin D supplements or fortified foods		
a. Yes ,but only during pregnancy(1)	65	8 0 . 2
b. Not taking or not aware (0)	15	1 8 . 5
c. Yes, ,n a regular basis including pre pregnancy(2)	1	1 . 2
4.Have you or do you check vitamin D levels in routine blood tests		
a.No routinely not checked	80	9 8. 8
b.Checked recently	1	1. 2

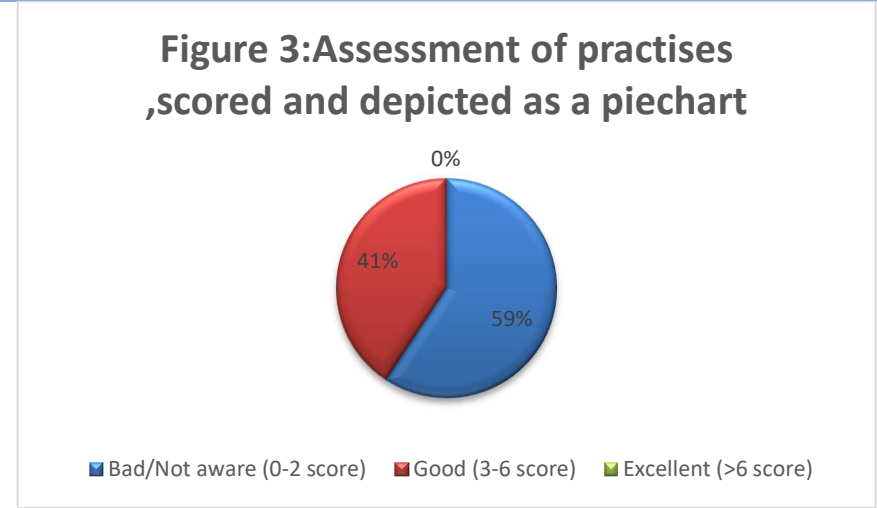


Table 5. Carl Pearson correlation between vitamin D and each parameter namely knowledge, attitude and practices.

Parameters correlated	Mean +/- S.D	r value	P value
1) Vitamin D Knowledge	76.6+/- 14	0.182	0.105
	3.4 +/- 1.03		
2) Vitamin D Attitude	76.6+/- 14	0.211	0.059
	38.2+/- 1.6		
3) Vitamin D Practices	76.6+/- 14	0.3	0.013
	2.1+/- 1.3		

Figure 4. Serum vitamin D levels assessed by ELISA method.

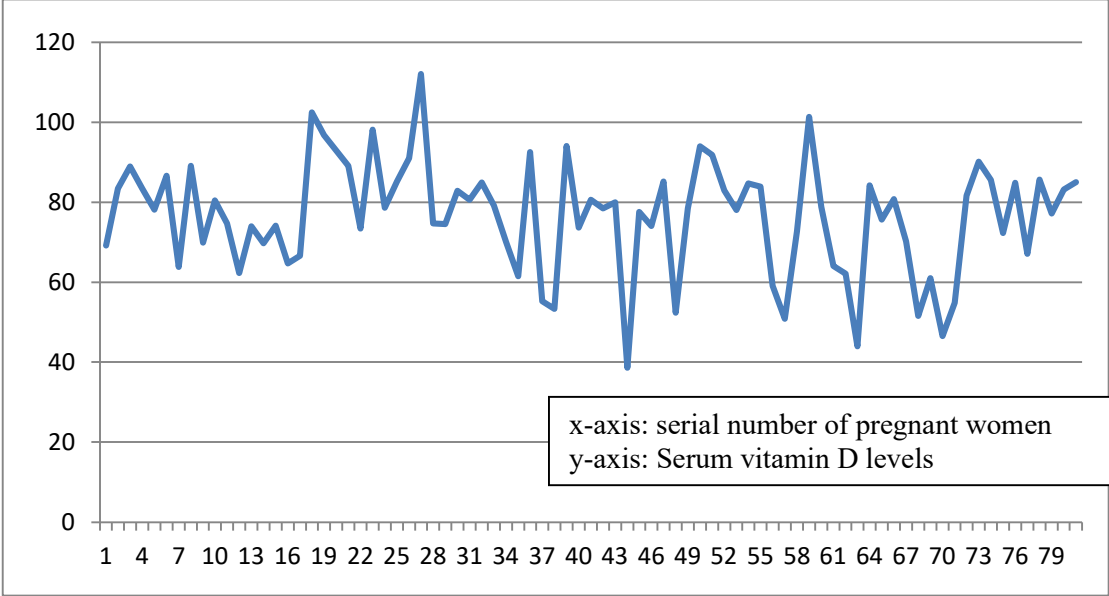


Table 6. Correlations between all 4 parameters of knowledge, attitude, practices and vitamin levels in serum.

		Vit. D	knowledge	attitude	practice
Vit d	Pearson Correlation	1	.182	.211	.275*
	Significance (2-tailed)		.105	.059	.013
Knowledge	Pearson Correlation	.182	1	.041	.112
	Significance (2-tailed)	.105	.81	.717	.321
Attitude	Pearson Correlation	.211	.041	1	.108
	Significance (2-tailed)	.059	.717		.336
Practice	Pearson Correlation	.275*	.112	.108	1
	Significance (2-tailed)	.013	.321	.336	

Table 7. Individual Correlations which are significant.

Parameters	Attitude 3	Attitude 4	Attitude 6	Attitude 8
Vitamin level(mean 76.6ng/Dl)	p= 0.026	p= 0.008	p= 0.001	p=0.02

Discussion:

The aim of our study was to assess the knowledge, attitude and practices of pregnant women towards vitamin D and correlate these findings with their serum vitamin D levels. Vitamin D deficiency in pregnancy leads to neonatal hypocalcaemia, infantile rickets and predisposition to lower respiratory tract infections, the main cause of infant mortality^[10]. It is also shown to cause increased risk of miscarriage, preeclampsia states etc.

A general trend seen and analyzed in studies done earlier showed a gross deficiency in vitamin D levels in girls and pregnant women residing in rural northern India^{[10][14]} as well as vitamin D insufficiency states among south Indian women (Tirupati) in the postmenopausal age groups^[9] and in those with associated calcium deficiencies^[8]. Even studies done among healthy young (20-35 years) individuals in the western parts of India yielded similar results^[15]. But much of these studies were done many years ago and did not factor in the current changes in trends.

The level of knowledge among our study population of pregnant south Indian women improved notably as seen in the results obtained above and even their knowledge of the importance of dietary calcium (55%) was significant as opposed to the results seen in pregnant women in northern India^[10] where even dietary calcium intake was low and 43% and had osteomalacia as well, which was not seen in our study population. 53.3% of Indian students in the north had good knowledge but still showed a deficiency^[16] in retrospect to our study, wherein mean standard deviation of knowledge was 3.4+/-1.03 with 52% women having good knowledge and significant number i.e. 48% having poor knowledge but still had high levels of vitamin D in blood. The women in our study responded with valid answers to sources, deficiency manifestations, normal requirements of vitamin D as opposed to studies in Saudi Arabian and Omani females^[2,12]. Despite 90.6% in these studies had good knowledge, there was a gross ignorance about sun being a primary inexpensive source of vitamin D, as well as they lacked knowledge about daily recommended dose and time of sun exposure required to get enough vitamin D, which the women in our study knew to be 10 - 20 min approximately. Moreover, the sources of information regarding vitamin D for the pregnant women in our study was 56% from doctors' advice and only 4% from media and newspapers, etc. in contrary to studies done in the UK wherein they received information from the media (25.3%), followed by friends/family (19.6%) and only 18.4% from health professionals^[17].

In assessing the attitude trends, our study showed a high frequency i.e., 78 out of the 81 women or 95% had a positive attitude towards vitamin D as opposed to just 56% having a positive attitude as seen in studies done in the UK^[17]. 55.6%, 55.6% and 48% strongly disagreed to negative attitudes/behaviors such as staying away from sunlight exposure fearing tanning, food sources not being good enough to obtain vitamin D adequately and Vitamin D being non-essential in pregnancy while studies done in China, showed a gross negative attitude towards sun exposure, fear of tanning as they have a general preference to light skin^[18] and negative attitude was also seen in studies done in Vietnam especially towards supplements and dietary modifications^[19] which is the opposite to our study results.

Previous experiments and studies suggest that Indians require about three times the UV exposure as white Caucasians to produce the same amount of vitamin D ^[20] and on assessing the practices among them we saw that most of the women 43.2% (early morning or evening sunrays) and 32.1% (midday sunrays) are exposed to these UV rays in the course of doing chores, commuting to work or exercising. Moreover, a key feature to note in our study was that the pregnant women had good practices like about 80% consumed foods fortified with vitamins out of which 35% were irregular in their consumption and 26% regularly consumed diet rich in Vitamin D which was not the case as seen in studies done in our neighboring country of Pakistan. Studies showed that there was a dire need for educating the public on vitamin supplementation ^[21]. Improper practices and high coverage with clothing and sunscreens seen in the Omani females ^[12] was not the scenario observed in the women of our study, where they opt for more breathable clothing during pregnancy owing to the humidity in the district and are also not in practice of daily usage of sunscreens. Skin exposure to ultraviolet rays and right duration of sunlight is an established fact in genesis of vitamin d ^[22,23] which the pregnant women here are seen to get in abundance being in a coastal tropical zone.

Studies have shown that Indian socio-religious and cultural practices did not facilitate adequate sun exposure, thereby negating potential benefits of plentiful sunshine ^[23] which is contrary to our study findings that showed women when pregnant were aware that they needed to walk out in the sun and get some exposure as it was thought to be beneficial to the child. Similar findings were observed in studies done in West Ethiopia and Northern India ^[1,14,22 24].

At the end of assessment our study revealed normal vitamin D levels (more than 35ng/dL) in all the 81 participants as opposed to 32% having hypovitaminosis D in pregnant women in northern India ^[10]. and even among the healthy general adult (18 years) population seen in Kuwait ^[25]. The reason for this difference is probably due to the fact that most of the women, >70%, that belonged to our study group, held occupations that required them to be exposed to sunlight at different times in the day. Owing to the urban background and literacy rates among them and most importantly the numerous health programs, advertisements, advices from health care professionals surrounding the Covid 19 pandemic, many were well informed and adopted certain lifestyle changes as prophylaxis to the infection ^[26]. Recent trends showed that people believed that nutritional supplementation had a proven ability as immune boosting along with antiviral action, hence could be taken prophylactically ^[27]. Moreover, vitamin D supplementation being proven as a safe intervention during pregnancy ^[28] and also being a well-known fact among physicians, more and more advocacy for has taken place thereby boosting the vitamin D levels in these women as compared to the earlier studies in Delhi and northern India where hypovitaminosis D was prevalent ^[10,14].

Conclusion:

From our study results, it is fairly established that there is a change in trends among pregnant women (specifically south Indian pregnant women in their first trimester with similar socioeconomic and sociodemographic characteristics). More women are shifting towards being better well-informed about their Health and nutritional status and this improvement in Knowledge, Attitude and Practices with respect to vitamin D, as assessed by us, can be attributed to better information being imparted in the light of Covid 19 pandemic, the increased concern about the well-being of the unborn child and better availability of multivitamin supplementation and fortified foods in the market as compared to earlier times.

Our study also shows that the correlation between Vitamin D in serum and Practices adopted by the women are statistically significant ($p=0.013$). Another factor to keep in mind is that many pregnant women in the study group were unintentionally following good practices that boost Vitamin levels but had only moderate awareness or applicative knowledge about it. Even though, on assessing correlation between all 4 parameters, yielded no significance except between practices and vitamin D levels, significance was found between some domains of attitude assessment and vitamin levels, when individual questions were correlated. This suggests that a positive attitude in these domains impacts the practices which in turn are reflected in better vitamin D status. But overall there was positive moderate correlation between vitamin D levels and attitude and practices ('r' value). 42 had good

knowledge while 39 had poor knowledge or unaware. 78 had positive attitude and 33 had good practices.

By doing this study we have noticed that hardly any studies have been done for this demographic of individuals and it is assumed that pregnant women have insufficient vitamin D levels based on data from isolated studies done in other countries and regions. This study is therefore one of a kind focusing on pregnant south Indian women in their first trimester. Taking into consideration the current trends we have concluded that normal vitamin levels prevail and helps us generate necessary nutritional programs to target the populations that are at risk and give them incentives rather than those who have got good levels of vitamin D and also improves the cost effectiveness by removing routine screening of vitamin D which is not required unless at-risk thereby saving money which is a key factor in a developing country like India.

Summary:

- The main purpose of this study was to explore the knowledge, attitude and practices regarding vitamin D among healthy pregnant women and to determine the vitamin D status in serum samples of the women in the study sample and to correlate this with knowledge, attitude and practices with respect to vitamin D.
- This was a 2-month long questionnaire along with serum analysis based cross-sectional observational study where 81 women who were pregnant and in their first trimester were selected through random sampling when they visited for routine Antenatal care(ANC) checkups in a tertiary care hospital and questionnaires were provided followed by blood samples taken along with routine ANC investigation. The responses were then statistically analyzed and the positive and negative responses were tabulated.
- The population selected showed good knowledge (51% good knowledge while 49% poor knowledge).Attitude assessed shows a positive attitude towards promotive measures of Vitamin D i.e. 96% and 40.7% had intentionally good practices while 59.3% were unaware of the practices or had poor practices.
- Vitamin D levels in all pregnant women in the first trimester were found to be in the normal range and analysis of correlation revealed significance ($p=0.013$) between Vitamin D levels and practices.
- The knowledge, attitude and practices towards vitamin D are substantially better than previous studies in other regions but there is scope in improvement and also this must be maintained in post partum period leading up to old age.

Suggestions: This study was restricted to a small isolated population of Antenatal cases in 1st trimester who were healthy and had no other co-morbidities. A better assessment can be made if we include populations from different regions (with varying geographical terrains and time of sunlight exposure like the desert, Deccan plateau, hilly areas, etc.) within the country, different occupations that are seen in metropolitan cities, towns, etc in equal proportions and to extend the study into 2nd and 3rd trimesters to see the progression of vitamin D status as pregnancy continues.

Contribution Statement:

All authors have made a substantial, direct, and intellectual contribution to the work and approved it for publication. Dr.Shreya Seira Honarius contributed to the entire conceptualization, supervision and data collecting and analysis .Dr.John Abraham, Dr Anieta Merin Jacob, Dr.Clement Prakash , played a key role in reviewing and editing the final manuscript.

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