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Comparative study of serum vitamin D levels in population of urban and rural areas of Meerut- A cross-sectional study at tertiary care center of Meerut

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Introduction- Vitamin D deficiency is prevalent worldwide, both in tropical and temperate climates. Nevertheless, it is the nutritional deficiency that is still under diagnosed and undertreated. Various studies have shown poor Vitamin D status irrespective of age, sex, and geography. So, our present study aims is assess the serum vit D levels of rural and urban population so that timely screening and prevention of disease related to vit -d deficiency can be done.

Material and Method-This is a cross sectional study conducted at tertiary health centre of Meerut from nov 2022 to oct 2023 with total 212 subjects attending community health centre divided into rural (102) and urban (110) were screened for vit D level.

Result: In our study mean serum level of vit D of rural population was 17.67ng/ml ± SD12.03 and the median 14.3(10.1- 21.85), which was comparatively lower then urban population with mean 14.46 ±SD11.01 and median 10.45 (7.32-17.08) and was found to be significantly significant.

Conclusion- Our study concluded that vit D screening should be done at various level in our society so that multiple chronic diseases can be prevented timely which are prevalent because of vit d deficiency.

Key words- Vitamin D, rural, urban

Introduction

Vitamin D deficiency is a public health problem in our country. Its deficiency is widely prevalent in rural and urban population. Vitamin D is a fat soluble vitamin which plays a critical role in regulating plasma calcium concentration through effects on intestinal absorption and bone metabolism.

The vitamins D are a group of sterols that have a hormone like function. Precisely categorizing, Vitamin D (Vit D) is not a vitamin but a hormone because of its renal metabolic product calcitriol, which act like a secosteroid hormone that targets more than 1000 genes in the human body. Vit D is vitally important for development, growth and maintenance of health at all times during the life cycle from birth till old age. It is now recommended for even healthy people (those without the diseases of Vit D deficiency) have Vit D level measured and seek advice if deficient[1]

The Endocrine Society considers an individual Vitamin D deficient at less than 20 ng/ml, insufficient between 20-30 ng/ml and Vitamin D optimal at more than 30 ng/ml.[2]

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Vitamin D is formed in the skin from 7-dehydrocholestrol during exposure to solar ultraviolet B radiation. Although vitamin D can be derived from the diet, only a few foods naturally contain vitamin D such as oily fish. It is stored in its inactive form in the liver and peripheral fat tissue for the body to extract and activate by hydroxylation in the liver and kidney respectively. The circulating concentration of 25-hydroxyvitamin D is the common biomarker used to assess vitamin D status. In healthy subjects, vitamin D deficiency can occur from inadequate intake of vitamin D coupled with inadequate sunlight exposure[3].

Vitamin D deficiency is a global problem and its deficiency is widely prevalent in urban Indian population across all age groups and sections of society.[4-5]

Vitamin D deficiency/insufficiency (VDD/VDI) is now recognized as a pandemic. VDD is a major public health problem worldwide in all age groups, even in equatorial regions where ultraviolet (UV) rays were assumed to be adequate enough to prevent this deficiency. Across the globe, over a billion people have low Vitamin D levels irrespective of age and ethnicity.[6-10]

Aims and objective:

1. To compare the serum vit D levels of rural and urban population.
2. To screen the population of rural and urban areas for vit D deficiency.
3. Timely identification, prevention and educating people regarding vit D deficiency diseases.

MATERIAL AND METHOD

Present study was a hospital-based study conducted jointly by Department of Medicine, Department of Community Medicine and Department of Biochemistry, Subharti Medical College and its associated Chhatrapati Shivaji Subharti (CSS) Hospital Meerut. After having ethical clearance from the institute, patients will be enrolled from Urban and Rural health centres of Subharti CSS Hospital.

Study design: cross sectional study

Study duration: November 2022 to October 2023

Sample size: Total 212 patients (rural: 102 urban: 110)

Subject and selection method: Individual attending the urban and rural health centre of meerut after fulfilling the inclusion and exclusion criteria. The age and sex of the subjects, present past and family history were taken from each patient and noted in the pre-designed research format. Routine and systemic examination ware carried out and findings were noted.

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Blood sample was taken for serum vit D level assessment and test was conducted free of cost subjected to Shubarti medical college meerut

INCLUSION CRITERIA:

Patient visiting community health center of urban and rural areas of meerut

EXCLUSION CRITERIA:

- All pregnant female.
- Patient of age < 18 years and age > 60 years.
- Any other chronic illness.
- Vitamin D supplement.
- Acute and chronic inflammatory condition.

DATA ANALYSIS-

- **Measurement of vitamin D**
- **Type of sample:** serum/ plasma
- **Method:** immunoassay

OBSERVATION AND RESULT

Out of total 212 individuals, 102 were included in rural group and 110 were included in urban group after taking all informed consent and following observations were made and tabulated below-

1-Association between 'Vitamin D Category' and 'Vitamin D (ng/mL)' in (Residence: Urban)

Vitamin D (ng/mL)	Vitamin D Category			Kruskal Wallis Test	
	<20 ng/mL	20-30 ng/mL	≥30 ng/mL	$\chi 2$	p value
Mean (SD)	10.04 (4.05)	24.79 (3.28)	40.85 (11.02)	51.088	<0.001
Median (IQR)	9 (6.9-12.6)	24.15 (22.6-28.08)	35.3 (32.65-50.4)		

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Vitamin D (ng/mL)	Vitamin D Category			Kruskal Wallis Test	
	<20 ng/mL	20-30 ng/mL	≥30 ng/mL	χ2	p value
Min - Max	3.3 - 19.4	20 - 29	30 - 58.5		

Pairwise Comparison of Subcategories of Vitamin D Category	Adjusted P Value
<20 ng/mL - ≥30 ng/mL	<0.001
<20 ng/mL - 20-30 ng/mL	<0.001
≥30 ng/mL - 20-30 ng/mL	0.835

Post-Hoc pairwise tests for Kruskal-Wallis test performed using Dunn Test method with Sidak correction.

The variable Vitamin D (ng/mL) was not normally distributed in the 3 subgroups of the variable Vitamin D Category. Thus, non-parametric tests (Kruskal Wallis Test) were used to make group comparisons.

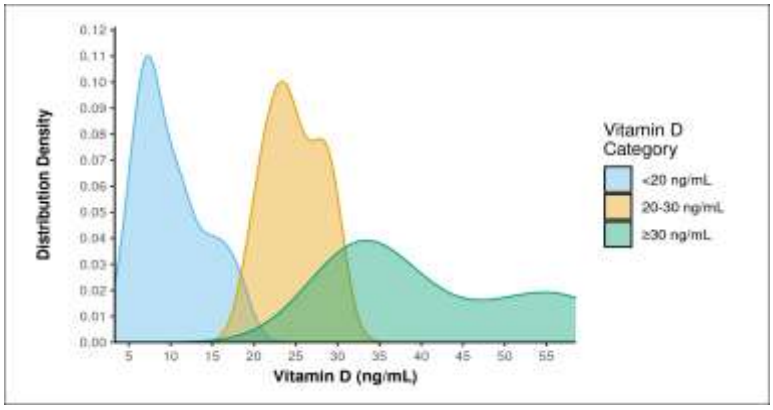
The mean (SD) of Vitamin D (ng/mL) in the Vitamin D Category: <20 ng/mL group was 10.04 (4.05). The mean (SD) of Vitamin D (ng/mL) in the Vitamin D Category: 20-30 ng/mL group was 24.79 (3.28). The mean (SD) of Vitamin D (ng/mL) in the Vitamin D Category: ≥30 ng/mL group was 40.85 (11.02). The median (IQR) of Vitamin D (ng/mL) in the Vitamin D Category: <20 ng/mL group was 9 (6.9-12.6). The median (IQR) of Vitamin D (ng/mL) in the Vitamin D Category: 20-30 ng/mL group was 24.15 (22.6-28.08). The median (IQR) of Vitamin D (ng/mL) in the Vitamin D Category: ≥30 ng/mL group was 35.3 (32.65-50.4). The Vitamin D (ng/mL) in the Vitamin D Category: <20 ng/mL ranged from 3.3 - 19.4. The Vitamin D (ng/mL) in the Vitamin D Category: 20-30 ng/mL ranged from 20 - 29. The Vitamin D (ng/mL) in the Vitamin D Category: ≥30 ng/mL ranged from 30 - 58.5.

There was a significant difference between the 3 groups in terms of Vitamin D (ng/mL) ($\chi 2$ = 51.088, p = <0.001), with the median Vitamin D (ng/mL) being highest in the Vitamin D Category: ≥30 ng/mL group.

Strength of Association (Kendall's Tau) = 0.58 (Large Effect Size)

The density plot below depicts the distribution of Vitamin D (ng/mL) in the 3 different groups of the variable Vitamin D Category in urban areas

Figure: Association Between Vitamin D Category and Vitamin D (ng/mL) urban population



2.Association between 'Vitamin D Category' and 'Vitamin D (ng/mL)' in (Residence: Rural)

Vitamin D (ng/mL)	Vitamin D Category			Kruskal Wallis Test	
	<20 ng/mL	20-30 ng/mL	≥30 ng/mL	χ2	p value
Mean (SD)	12.07 (3.67)	23.83 (2.77)	45.51 (20.82)	67.174	<0.001
Median (IQR)	11.95 (9.93-14.93)	23.3 (21.7-25.85)	37.3 (35.2-38.8)		
Min - Max	5.3 - 19	20.2 - 29.9	31.3 - 93		

Pairwise Comparison of Subcategories of Vitamin D Category	Adjusted P Value
<20 ng/mL - ≥30 ng/mL	<0.001
<20 ng/mL - 20-30 ng/mL	<0.001
≥30 ng/mL - 20-30 ng/mL	0.426

Post-Hoc pairwise tests for Kruskal-Wallis test performed using Dunn Test method with Sidak correction.

The variable Vitamin D (ng/mL) was not normally distributed in the 3 subgroups of the variable Vitamin D Category. Thus, non-parametric tests (Kruskal Wallis Test) were used to make group comparisons.

The mean (SD) of Vitamin D (ng/mL) in the Vitamin D Category: <20 ng/mL group was 12.07 (3.67). The mean (SD) of Vitamin D (ng/mL) in the Vitamin D Category: 20-30 ng/mL group was 23.83 (2.77). The mean (SD) of Vitamin D (ng/mL) in the Vitamin D Category: ≥30 ng/mL

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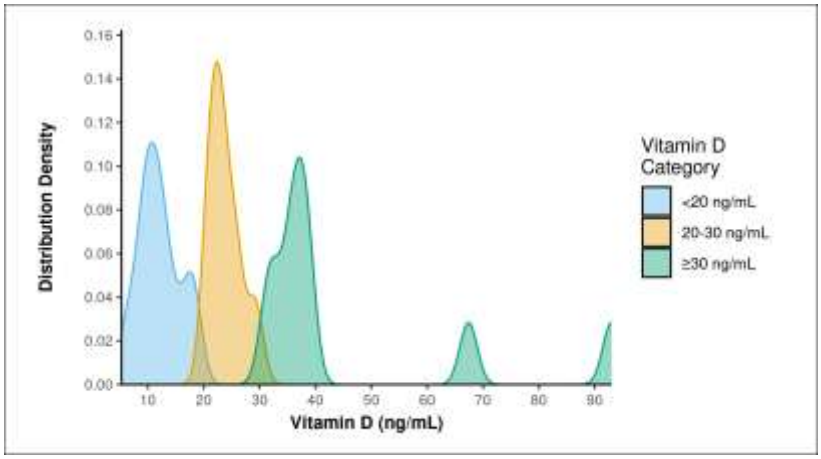
group was 45.51 (20.82). The median (IQR) of Vitamin D (ng/mL) in the Vitamin D Category: <20 ng/mL group was 11.95 (9.93-14.93). The median (IQR) of Vitamin D (ng/mL) in the Vitamin D Category: 20-30 ng/mL group was 23.3 (21.7-25.85). The median (IQR) of Vitamin D (ng/mL) in the Vitamin D Category: ≥30 ng/mL group was 37.3 (35.2-38.8). The Vitamin D (ng/mL) in the Vitamin D Category: <20 ng/mL ranged from 5.3 - 19. The Vitamin D (ng/mL) in the Vitamin D Category: 20-30 ng/mL ranged from 20.2 - 29.9. The Vitamin D (ng/mL) in the Vitamin D Category: ≥30 ng/mL ranged from 31.3 - 93.

There was a significant difference between the 3 groups in terms of Vitamin D (ng/mL) ($\chi 2$ = 67.174, p = <0.001), with the median Vitamin D (ng/mL) being highest in the Vitamin D Category: ≥30 ng/mL group.

Strength of Association (Kendall's Tau) = 0.69 (Large Effect Size)

The density plot below depicts the distribution of Vitamin D (ng/mL) in the 3 different groups of the variable Vitamin D Category in rural areas

Figure: Association Between Vitamin D Category and Vitamin D (ng/mL) rural population



3.comparison of vit D between urban and rural population

Vitamin D (ng/mL)	Residence		Wilcoxon-Mann-Whitney U Test	
	Urban	Rural	W	p value
Mean (SD)	14.46 (11.01)	17.67 (12.03)	4033.000	<0.001
Median (IQR)	10.45 (7.32-17.08)	14.3 (10.1-21.85)		
Min - Max	3.3 - 58.5	5.3 - 93		

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The variable Vitamin D (ng/mL) was not normally distributed in the 2 subgroups of the variable Residence. Thus, non-parametric tests (Wilcoxon-Mann-Whitney U Test) were used to make group comparisons.

The mean (SD) of Vitamin D (ng/mL) in the Residence: Urban group was 14.46 (11.01). The mean (SD) of Vitamin D (ng/mL) in the Residence: Rural group was 17.67 (12.03). The median (IQR) of Vitamin D (ng/mL) in the Residence: Urban group was 10.45 (7.32-17.08). The median (IQR) of Vitamin D (ng/mL) in the Residence: Rural group was 14.3 (10.1-21.85). The Vitamin D (ng/mL) in the Residence: Urban ranged from 3.3 - 58.5. The Vitamin D (ng/mL) in the Residence: Rural ranged from 5.3 - 93.

There was a significant difference between the 2 groups in terms of Vitamin D (ng/mL) (W = 4033.000, p = <0.001), with the median Vitamin D (ng/mL) being highest in the Residence: Rural group.

Strength of Association (Point-Biserial Correlation) = 0.14 (Small Effect Size)

Discussion-

Vitamin D deficiency is prevalent worldwide, both in tropical and temperate climates. Nevertheless, it is the nutritional deficiency that is still under diagnosed and undertreated. Various studies have shown poor Vitamin D status irrespective of age, sex, and geography.[9-11] As there is no standard guideline followed all worldwide for classifying the Vitamin D status, studies have different cutoff values for the deficiency. The vast majority of these studies used serum 25(OH) D level of <20 ng/ml as Vitamin D deficiency.

These studies which included various age groups reflect the magnitude of the problem. High prevalence was seen throughout the country. Although the causes of Vitamin D deficiency hold no mystery, we have failed to prevent it to a large extent. India is bright and sunny, has a tropical climate with adequate sunshine. Most of the Indian population live in areas with adequate sunlight round the year, thus Vitamin D deficiency is counter-intuitive.

In our study mean serum level of vit D of rural population was 17.67ng/ml with sd 12.03 and the median 14.3(10.1- 21.85) which was comparatively lower then urban population with mean 14.46 with sd 11.01 and median 10.45 (7.32-17.08) and was found to be significantly significant.

Similar study was published by by Harinarayan et al.[12] who postulated that the rural population, who by the virtue of their occupation, active lifestyle and sufficient sunlight exposure might be expected to have adequate Vit D, too have been found deficient. This can be due to the high phytate and low calcium diet they consume. Phytate rich diet is known to reduce the intestinal absorption of calcium. Hence, low dietary calcium increases the catabolism of 25(OH) D and increases the inactive metabolites with the resultant reduction in 25(OH)D concentrations.[12-13]

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Another study was published by Chan SP et al. (2009) reported a significant difference in mean 25(OH) vitamin D concentrations between urban and rural subjects and reported that rural subjects had higher 25(OH) vitamin D concentrations compared to urban subjects [70.7±18.3 vs. 45.7±15.5nmol/L (or 28.3±7.3 vs. 18.3±6.2 ng/mL)].

Population in rural areas generally has different occupation and lifestyle. In rural areas, large proportion of men and women work as farmers and are exposed to more sunlight whereas people living in urban areas generally work indoor and do not get adequate exposure to sunlight[14.]

Although the urban population in our study was found to have better vit D level then rural but still the urban population do have vit D deficiency in Toto. This might be because the People in urban areas are involved in activities that avoid sun light, e.g., protection from sunlight by use of umbrella and sunscreen[15-16] . On the other hand, melanin pigment, produced by melanocytes on exposure to sunlight absorbs UV-B rays and thus attenuates the final dose of UV-B energy reaching 7-dehydrocholesterol in basal layers of epidermis. Therefore melanin functions as natural sunscreen and reduces the skin's ability to synthesize vitamin D as much as 99%. Therefore persons with dark skin are more likely to have vitamin D deficiency and need more direct sunlight to have optimum amount vitamin D synthesis by skin[16-17].

Conclusion: Vitamin d deficiency is major issue widespread in india and the population we screened were only those who presented to us. Therefore a large population need to be assessed to understand the correct scenario so that multiple chronic diseases can be prevented which occurs due to vit d deficiency in our society.

LACUNAE IN OUR STUDY: This study was conducted at health center level and only those subjects were evaluated who presented to us in opd and a large group of population residing in villages could not be screened. For more precise and comprehensive results door to door sampling of large number of population is needed that give us better results.

CONFLICTS OF INTRESET-nil

FIANICIAL SUPPORT AND SPONSORSHIP-nil

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