# Lowest Deficiency of Vitamin D & Vitamin B12 in Indian Old Population and Postmenopausal Women

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## Abstract

**Background:** The present study compared the prevalence of deficiency of these components in various groups of Indian population.

**Methods:** The serum concentrations for vitamin D, iron, vitamin B12, cholesterol and calcium were determined by an automated analyzer with the use of commercial kits.

**Results:** Vitamin D and vitamin B12 deficiency was significantly higher in young population in comparison to older age group. Older age groups were found to have low cholesterol levels, high vitamin D and vitamin B12 levels when compared with other age groups. Female infants have lower prevalence of vitamin D deficiency and high prevalence of vitamin B12 and iron deficiency when compared with male infants. Female adults and young population showed significantly low levels of iron in comparison to age matched males. Premenopausal women had significantly low levels and high prevalence of deficiency vitamin D and vitamin B12 in comparison to postmenopausal women.

**Conclusion:** This study recommend supplementation of multivitamins to all pre-menopausal women and breast fed infants regardless of being given formula feeds. This study also showed that prevalence of deficiency of these components changes within various age groups and young population is at high risk of vitamin deficiency.

***Keywords:*** *Vitamin D, Age, Vitamin B12, Calcium, Iron, Menopause*

## Introduction

Vitamin D plays an important role in calcium and phosphate resorption, bone health and mineralization[(1)]. Very few Indian studies have been published on the consequences of Vitamin D deficiency (VDD) leading to availability of most of the data from overseas studies.

Iron in particular is involved in many physiological processes, particularly in the production of red blood cells and myoglobin[(2, 3).] Therefore, the lack of this mineral is associated with iron deficient anemia (IDA). Although IDA occurs at all age and involves both the sexes[(4)], there is a paucity of data about the age and sex wise epidemiology of anaemia in Indian population.

Indian population is more sensitive to vitamin B12 deficiency due to vegetarian food habit[(5)]. Deficient is related with irreversible and potentially severe diseases and eventual growth problems if the deficiency is left untreated. However, data documenting age and sex wise status of vitamin B12 deficiency in India in general population is limited.

Hypercholesterolemia is very common among Asian population and it could be due to genetic risk, lifestyle factors, and suboptimal dietary habits. The likelihood of dying from cardiovascular diseases in young people doubles with every 40 point increase in total cholesterol. Although several reports and reviews documented the increasing prevalence of high cholesterol, and declining smoking rates among the educated Indians[(6)]. All of these

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evaluations have multiple biases such as compilation of several studies from different sources and different methodologies[7].

In the present study, we evaluated the age and sex wise concentrations and prevalence of deficiency of vitamin D, vitamin B12, calcium, iron and cholesterol in Indian population, pre-menopausal and postmenopausal women. This study fills lacuna in literature and presents prevalence of deficiency of these components in Indian general population.

## Materials and Methods

**Population:** In the present study levels of vitamin D, cholesterol, calcium, vitamin B12, and iron was estimated in Indian population (2018 January-2019 December). Patients were categorized into 5 groups i) Infants (0-2 years) ii) children (3-12 years) iii) Teenager (13-18) iv) Young (19-35) v) adult (36-65) and vi) old (>65). Table 1 describe the number of patients in each group and demonstrate the normal range of each component. Individuals who came only for their normal routine check-up and ready to be the part of this study was only included.

Blood samples were collected from all the patients by taking aseptic precautions and transferred to serum vials. Once the blood is clotted, all the samples were centrifuged for 3000 RPM (revolutions per minute) for 5 minutes. The serum concentrations for vitamin D, iron, vitamin B12, cholesterol and calcium were determined by an automated analyzer (CX 9; Beckman, Brea, CA) with the use of commercial kits (Beckman coulter, CA).

## Results

**Lowest prevalence of vitamin D deficiency in older population**

The mean 25(OH)-D concentration of the study group was 25.40 ± 13.20 ng/ml. Overall, 71% of the study population were defined as having vitamin D deficiency. Old population (>65 years age) had highest vitamin D levels and low vitamin D deficiency than children, teenager, young and adult population except infants. The prevalence of vitamin D deficiency was highest in children and young groups (78%) (Table 2).

Next comparison was done in between males and females of each group. Female adults have significantly higher vitamin D concentration than age matched males (Table 2). No significant difference in vitamin D concentration was found in males and females of other age groups.

**Lowest prevalence of vitamin B12 deficiency in older population**

47% of the population showed vitamin 12 deficiency. The mean concentration of vitamin B12 was 270±242. The prevalence of vitamin B12 deficiency was lowest in older population and highest in young group. Similar trend was seen in vitamin B12 concentration. Old population had significantly high vitamin B12 levels and low vitamin B12 deficiency than other groups. Whereas, female teenagers and adults have significantly high vitamin B12 levels in comparison to age matched males. This data showed that female adults have significantly high vitamin D and vitamin B12 levels when compared with age matched males (Table3).

**Highest prevalence of iron deficiency in old population**

71% of old males showed significantly high prevalence of iron deficiency. Similarly female infants showed low iron levels and high prevalence of iron deficiency when compared with males. Female adults (55±37) and young population (57±43) showed significantly low levels of iron in comparison to age matched males (adults: 81±54,p=0.0007 and young: 80±33, p=0.006). No significant difference was observed in calcium levels among all the groups (Table 4).

Highest cholesterol level in Adults

25% of population showed high cholesterol level (≥200 mg/dl). Whereas we did not get any sample for infants and children group, all teenagers were having normal cholesterol levels. 31% of adults showed highest cholesterol levels in comparison to 18% of older population (p=0.04). Similarly mean concentration of cholesterol was highest in adults (183±43; p<0.05)) in comparison to teenagers. No significant difference was observed in other groups. Young females (48%) showed high prevalence of cholesterol when compared with age matched males (28%; p=0.0005) (Table 5).

**Status of vitamin D, vitamin 12, iron, cholesterol and calcium in pre and postmenopausal women**

Premenopausal women had significantly low levels and high prevalence of deficiency vitamin D and vitamin B12 in comparison to postmenopausal women. No significant difference was observed in iron, calcium and cholesterol levels (Table 6).

**Table 1: Total number of individuals in each age group and Normal range of each component**

| | **Infants (N)** | **Child (N)** | **Teenager (N)** | **Young (N)** | **Adults (N)** | **Old (N)** | **Total** |
|---|---|---|---|---|---|---|---|
| Vitamin D (ng/ml) | 131 | 155 | 139 | 1482 | 2100 | 227 | 1423 |
| Vitamin B12 (pg/ml) | 60 | 51 | 139 | 1748 | 3138 | 472 | 5608 |
| Iron (ug/dL) | 27 | 10 | 9 | 121 | 148 | 26 | 341 |
| Calcium (mg/dl) | 96 | 63 | 62 | 360 | 498 | 40 | 1119 |
| Cholesterol (mg/dl) | 0 | 0 | 14 | 199 | 527 | 53 | 793 |
| | Normal laboratory range as per the manufacturer recommendation | | | | | | |
| Vitamin D (ng/ml) | 30-100 ng/ml | | | | | | |
| Cholesterol (mg/dl) | 125-199 mg/dl | | | | | | |
| Vitamin B12 (pg/ml) | 190-950 pg/ml | | | | | | |
| Calcium (mg/dl) | 8.5-10.5 mg/dl | | | | | | |
| Iron (ug/dL) | Child 50-120µg/dl, Male 65-175µg/dl, Female 50-170µg/dl | | | | | | |

**Table 2: Age and sex-wise distribution of vitamin D levels and deficiency in Indian population**

| | **Infants** | **Child** | **Teenager** | **Young** | **Adults** | **Old** |
|---|---|---|---|---|---|---|
| **Vitamin D (ng/ml)** | 27.99 ±21.37 (N=131) | 22.94±15.09 (N=155) | 22.66±13.58 (N=139) | 23.06±12.52 (N=1482) | 25.86±15.64 (N=2100) | 29.93±19.61 (N=227) |
| **Deficiency of vitamin D ( % population)** | | | | | | |
| **Vitamin D** | 70 | 78 | 75 | 78 | 69 | 59 |

| | **Infants** | | | **Child** | | | **Teenagers** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Vit. D (ng/ml)** | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** |
| | 25.40±22.64 (N=60) | 30.10±20.03 (N=71) | 0.21 | 24.74± 19.15 (N=64) | 21.68± 11.24 (N=91) | 0.21 | 24.11± 15.6 (N=41) | 21.98± 12.64 (N=98) | 0.40 |
| | **Young** | | | **Adult** | | | **Old** | | |
| | 23.91±12 (N=453) | 22.69±12 (N=1029) | 0.07 | 23.66±14 (N=754) | 26.46±15 (N=1346) | **0.0001** | 28.07± 13 (N=138) | 32.79± 25 N=89) | 0.06 |
| **Deficiency of vitamin D ( % population)** | | | | | | | | | |
| | **Infants** | | | **Child** | | | **Teenagers** | | |
| **Deficiency of vit D (% population)** | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** |
| | 76 | 62 | 0.03 | 73 | 81 | 0.09 | 70 | 73 | 0.75 |
| | **Young** | | | **Adult** | | | **Old** | | |
| | 76 | 79 | 0.73 | 75 | 68 | 0.34 | 62 | 53 | 0.25 |

**Table 3: Age and sex wise distribution of vitamin B12 levels and deficiency in Indian population**

| | **Infants** | **Child** | **Teenager** | **Young** | **Adults** | **Old** |
|---|---|---|---|---|---|---|
| **Vitamin B12 (pg/ml)** | 296±279 (N=60) | 238±149 (N=51) | 234±186 (N=139) | 201±172 (N=1748) | 257±245 (N=3138) | 394±421 (N=472) |
| **Deficiency of vitamin B12 ( % population)** | | | | | | |
| **Vitamin B12** | 40 | 52 | 50 | 60 | 50 | 32 |

| **Vit. B12 (pg/ml)** | **Infants** | | | **Child** | | | **Teenagers** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** |
| | 393±335 (N=26) | 210±145 (N=34) | **0.005** | 240±141 (N=19) | 237±154 (N=32) | 0.94 | 177±82 (N=37) | 254±207 (N=102) | **0.03** |
| | **Young** | | | **Adult** | | | **Old** | | |
| | 193±157 (N=723) | 208±182 (N=1025) | 0.07 | 230±227 (N=1327) | 277±256 (N=1811) | **0.0001** | 375±398 (N=265) | 425±456 (N=199) | 0.21 |

| **Deficiency of vit B12 (% population)** | **Infants** | | | **Child** | | | **Teenagers** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** |
| | 30 | 48 | **0.01** | 43 | 56 | 0.07 | 59 | 47 | 0.12 |
| | **Young** | | | **Adult** | | | **Old** | | |
| | 62 | 58 | 0.66 | 55 | 45 | 0.16 | 34 | 30 | 0.54 |

**Table 4: Age and sex wise distribution of iron and calcium levels and deficiency in Indian population**

| **Iron (ug/dL)** | **Infants** | | | **Child** | | | **Teenagers** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** |
| | 62±63 (N=14) | 37±16 (N=13) | 0.17 | 61±50 (N=5) | 33±18 (N=5) | 0.27 | 27.6±6.4 (N=2) | 56±42 (N=7) | 0.39 |
| | **Young** | | | **Adult** | | | **Old** | | |
| | 80±33 (N=33) | 57±43 (N=88) | **0.006** | 81±54 (N=57) | 55±37 (N=91) | **0.0007** | 67±58 (N=14) | 67±58 (N=12) | 1.0 |
| **Deficiency of iron (% population)** | | | | | | | | | |
| **Deficiency of iron (% population)** | **Infants** | | | **Child** | | | **Teenagers** | | |
| | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** |
| | 78 | 100 | **0.0001** | 60 | 66 | 0.46 | 100 | 57 | **Not comparable due to n=2 in males** |
| | **Young** | | | **Adult** | | | **Old** | | |
| | 36 | 48 | 0.11 | 43 | 56 | 0.08 | 71 | 50 | **0.0003** |

| | **Infants** | **Child** | **Teenager** | **Young** | **Adults** | **Old** |
|---|---|---|---|---|---|---|
| **Calcium (mg/dl)** | 8.8±1.4 (N=96) | 9±0.86 (N=63) | 8.9±0.8 (N=62) | 9±0.9 (N=360) | 8.9±0.83 (N=498) | 9.1±1.1 (N=40) |
| **Deficiency of calcium ( % population)** | | | | | | |
| **Calcium** | 21 | 19 | 27 | 21 | 20 | 20 |

| **Calcium (mg/dL)** | **Infants** | | | **Child** | | | **Teenagers** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** |
| | 8.6±1.2 (N=64) | 9.1±1.7 (N=32) | 0.09 | 8.9±0.8 (N=32) | 9.1±0.8 (N=31) | 0.35 | 8.8±0.85 (N=18) | 8.9±0.84 (N=44) | 0.67 |
| | **Young** | | | **Adult** | | | **Old** | | |
| | 9.1±0.98 (N=97) | 8.8±0.83 (N=263) | **0.004** | 8.8±0.86 (N=150) | 8.9±0.80 (N=348) | 0.2 | 9±1.02 (N=18) | 9.2±1.1 (N=22) | 0.56 |
| **Deficiency of calcium (% population)** | | | | | | | | | |
| **Deficiency of calcium (% population)** | **Infants** | | | **Child** | | | **Teenagers** | | |
| | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** | **Male** | **Female** | **p-Value** |
| | 26 | 16 | 0.11 | 18 | 19 | 1.0 | 33 | 25 | 0.27 |
| | **Young** | | | **Adult** | | | **Old** | | |
| | 16 | 23 | 0.28 | 22 | 20 | 0.86 | 22 | 18 | 0.59 |

**Table 5: Age and sex-wise tabular representation of cholesterol levels in Indian population**

| High cholesterol (% population) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Young | | Adult | | Old | | |
| Cholesterol (% population) | | | 25 | | 31 | | 18 | | |
| | Infants | Child | Teenager | Young | Adults | Old | | | |
| Cholesterol (mg/dl) | NA | NA | 148±23 (N=14) | 178±39 (N=199) | 183±43 (N=527) | 168±62 (N=53) | | | |
| Cholesterol (mg/dl) | Infants | | | Child | | | Teenagers | | |
| | Male | Female | p-Value | Male | Female | p-Value | Male | Female | p-Value |
| | 8.6±1.2 (N=64) | 9.1±1.7 (N=32) | 0.09 | 8.9±0.86 (N=32) | 9.1±0.86 (N=31) | 0.35 | 8.8±0.85 (N=18) | 8.9±0.84 (N=44) | 0.67 |
| | Young | | | Adult | | | Old | | |
| | 9.1±0.98 (N=97) | 8.8±0.83 (N=263) | **0.004** | 8.8±0.86 (N=150) | 8.9±0.80 (N=348) | 0.2 | 9±1.02 (N=18) | 9.2±1.1 (N=22) | 0.56 |
| High cholesterol (% population) | | | | | | | | | |
| High cholesterol (% population) | Infants | | | Child | | | Teenagers | | |
| | Male | Female | p-Value | Male | Female | p-Value | Male | Female | p-Value |
| | NA | NA | | NA | NA | | 0 | 0 | |
| | Young | | | Adult | | | Old | | |
| | 28 | 48 | **0.0005** | 28 | 34 | 0.44 | 20 | 17 | 0.71 |

**Table 6: Status of vitamin D, B12, Iron, calcium and cholesterol in pre and postmenopausal women**

| | Pre-menopausal women(>18 and <40) | Post-menopausal women (>55) | p-value | Pre-menopausal women (>18 and <40) | Post-menopausal women (>55) | p-value |
|---|---|---|---|---|---|---|
| | Level | | | Prevalence of deficiency (%) | | |
| Vitamin D (ng/ml) | 23±12 (n-1250) | 30± 21 (n=435) | 0.0001 | 78 | 57 | 0.0015 |
| Vitamin B12 (pg/ml) | 213±179 (n=1456) | 354±350 (n=661) | 0.0001 | 58 | 38 | 0.0046 |
| Calcium (mg/dl) | 8.8±0.83 (n=335) | 9.0±0.91 (n=76) | 0.063 | 24 | 19 | 0.38 |
| Iron (ug/dL) | 56±42 (n=114) | 56±44 (n=39) | 1.0 | 51 | 59 | 0.26 |
| | High cholesterol (%) | | High cholesterol (%) | | | |
| Cholesterol (mg/dl) | 23 | | 31 | | P=0.20 | |

## Discussion

The community-based Indian studies of healthy controls reported a prevalence of VDD ranging from 50% to 94%. Estimated prevalence of vitamin D deficiency in 71% population agrees with the current understanding of status of Indian population.

Age dependent increasing prevalence of vitamin D deficiency has been reported by many studies[8, 9]. However, in the current study, prevalence was particularly low in old population and adults. Moreover,

>70% of teenagers, children and a young age were deficient of vitamin D. Many factors such as amount of sun exposure and vitamin D supplements could be a possible factor. Children, teenagers and young people spend most of their times indoors either due to education or work in India in contrast to elderly.

There is evidence that a deficit in iron may disturb the synthesis of vitamin D3 and lead to its mild deficiency. Out of the 27 children enrolled in the study 89 % were deficient in iron levels (<50 µg/dl). Iron deficiency during pregnancy and exclusive dependency of infants on breast feeding could be the leading causes of anaemia in infants and young children. In spite of the recommendation of iron and folic acid by Indian Government, the implementation of the programme is poor due to lack of logistic planning and liability[10]. Our results are in agreement with other Indian studies [11] and indicate that the iron supplementation programme for children aged ≤24 months should be better monitored with more focus on female infants.

In a recent study adults have been shown to have higher risk of Vitamin B12 deficiency[12]. However, in our study lowest prevalence of vitamin B12 deficiency in adults and highest prevalence in infants is seen. This could be again due to complete dependency of infants on breast feeding. Human breast milk contains low levels of vitamins and therefore, supplementation of multivitamins to all breast fed infants is necessary regardless of being given formula feeds.

Increasing trend of cardiovascular diseases due to high cholesterol is very common in India in contrast to developed countries where the incidence has decreased[13]. In our study 25% of the population have high cholesterol level and adults are having highest cholesterol levels in comparison to young and old population. However, we have not estimated levels LDL, HDL and triglycerides.

Whereas several studies have reported vitamin D inadequacy in post-menopausal women, we have found a higher proportion of vitamin-D-inadequacy in pre-menopausal women. This study suggests that pre-menopausal Indian women should be supplemented with multivitamins.

The strengths of this study are the large study population of all the age groups and comparison between males and females of age matched population. However, limitations include information about dietary intake of vitamin D, vitamin b12, iron, calcium and cholesterol, the amount of sun exposure, the amount of time spent outdoors, the use of sun-screen, and seasonal variation is lacking. All of these factors could affect the levels of these components.

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