

# Correlation study of Vitamin D status with Thyroid among north Gujarat Indian

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## Abstract

**Background:** The objective of the study was to evaluate the correlation of vitamin D status with thyroid in north Gujarat, Indian population. This is because to give deep understanding for depiction of the vitamin D status with thyroid among north Gujarat Indians.

**Methods:** This study is retrospective in which data of subjects (>18 years) who undergone thyroid and 25(OH)D test at various study sites across the north Gujarat in India. Primary study variables were proportion of subjects with Vitamin D (25(Hydroxy)D) Total (Deficiency (<30 ng/ml), Sufficiency (30-100 ng/ml)) and in thyroid (T3, T4 and TSH).

**Results:** Data from 1109 subjects (mean SD) age: 46.97 (13.39 years) was considered for the analysis of this study. A total of 941 (84.9%) subjects had Vitamin D level <30 ng/ml. Prevalence of vitamin D level <30 ng/ml was found marginally higher in males (85.78%) than females (83.81%). The incidence of vitamin D level <30 ng/ml was highest in the age group of 21 – 40 (87.17%) years, followed by > 60 (86.34%) years and 41 – 60 (82.57%) years. For thyroid profile 1000 (90.2%) subjects had within the stated values while 109 (9.8%) subjects had low or more than the stated values. Hence 1000 (90.2%) subjects are normal and 109 (9.8%) subjects are abnormal thyroid profile.

**Conclusions:** This study shows a high prevalence of Vitamin D deficiency in the Indian population of north Gujarat irrespective of age and sex. This study found that the developing thyroid dysfunction with deficient and sufficient levels of vitamin D. These identified deficient of Vitamin D represent part of a bigger concern which need for optimal public health action.

**Key words:** vitamin D deficiency; thyroid; 25-hydroxy vitamin D; prevalence

## Introduction

Vitamin D is a fat-soluble vitamin that plays a vital role in human physiology [1]. Vitamin D has essential roles in the metabolism of calcium and phosphorus, that are required for normal mineralization of bone, muscle contraction, nerve conduction, and general cellular function in all the body cells [1,2]. It is also found to be important for immune function, inflammation, cell proliferation, and differentiation [3,4]. The uniqueness of Vitamin D lies in the fact that not only it can be ingested in the diet as Cholecalciferol (Vitamin D3) or Ergocalciferol (Vitamin D2), but can also be synthesized in the skin through adequate sunlight exposure [5].

The dominant source of Vitamin D in humans is the endogenous production of Vitamin D3 in the skin following exposure to ultraviolet-B (UVB) (290-320 nm) radiation from sunlight [6]. But, despite the dual mechanisms of attainment (diet and sunlight), Vitamin D deficiency is very common globally, with a significant geographical variation [5]. Asians, particularly people in south Asia and the middle east region, are reported to have a poor Vitamin D status despite adequate sunshine in their regions [5,7].

Circulating 25-hydroxy Vitamin D {25(OH)D} is considered the best determinant of Vitamin D status in an individual. The Vitamin D levels are categorized as deficient when 25(OH)D is <20 ng/ml, insufficient when ≥20-

29 ng/ml and sufficient when  $\geq 30$  ng/ml [8]. Vitamin D deficiency has recently been recognized as a widespread global disorder and common in metropolitan cities of the world and India [9,10]. Particularly prevalent among elderly people, it is estimated that 1 billion people globally have vitamin D deficiency or insufficiency [11].

Although India is located between 8.4° and 37.6° north latitude and the majority of the Indian population is exposed to sufficient sunlight throughout the year, the prevalence of vitamin D deficiency in the Indian population ranges from 34.5% to 99%; with community-based and hospital-based Indian studies reporting a prevalence ranging from 34.5% to 94% and 37% to 99%, respectively [9,12-33].

Vitamin D deficiency results in a variety of skeletal and extra-skeletal manifestations [1]. Recently vitamin D deficiency has also shown to be associated with colorectal cancer, diabetes mellitus, infection, multiple sclerosis, cardiovascular disease, breast cancer, autoimmunity and allergy, depression, and postural instability [5]. Although these associations have been identified mostly in observational studies which may be subject to many interpretations, the lack of randomized controlled study data in these areas does not negate these causative relationships [5]. Additionally, an increasing number of studies have suggested that vitamin D may influence other important health outcomes in infants, children, and pregnant and lactating women [2]. Owing to its wide-ranging impact on health, the epidemic of vitamin D deficiency in India is likely to significantly contribute to the enormous burden on the healthcare system [8]. However, in a large country like India covering several latitudes, ethnicities, cultures, traditions, and attitudes, the current data on Vitamin D status is inadequate and classified in different ways, making interpretation difficult [17-21]. At present, there is no north Gujarat, India data depicting the extent of Vitamin D deficiency among India. The objective of the present retrospective study was to evaluate the Vitamin D levels in the north Gujarat Indian, in order to provide a comprehensive picture of the Vitamin D status among north Gujarat Indians.

The thyroid gland is a small organ that's located in the front of the neck, wrapped around the windpipe (trachea). It's shaped like a butterfly, smaller in the middle with two wide wings that extend around the side of throat. The thyroid is a gland, where it creates and release substances that help the body do a specific thing. Thyroid gland makes hormones that help and control many vital functions of body [13].

Thyroid has an important job to do within body — releasing and controlling thyroid hormones that control metabolism. Metabolism is a process where the food taken into body is transformed into energy. This energy is used throughout entire body to keep many of body's systems working correctly. Think of metabolism as a generator. It takes in raw energy and uses it to power something bigger [14].

The thyroid controls metabolism with a few specific hormones — T4 (thyroxine, contains four iodide atoms) and T3 (triiodothyronine, contains three iodide atoms). These two hormones are created by the thyroid and they tell the body's cells how much energy to use. When your thyroid works properly, it will maintain the right number of hormones to keep your metabolism working at the right rate. As the hormones are used, the thyroid creates replacements [15,16].

For the most part, the symptoms of thyroid disease can be divided into two groups — those related to having too much thyroid hormone (hyperthyroidism) and those related to having too little thyroid hormone (hypothyroidism) [13-16].

**Symptoms of an overactive thyroid (hyperthyroidism) can include: [15,16].**

Experiencing anxiety, irritability and nervousness.

Having trouble sleeping.

Losing weight.

Having an enlarged thyroid gland or a goiter.

Having muscle weakness and tremors.

Experiencing irregular menstrual periods or having your menstrual cycle stop.

Feeling sensitive to heat.

Having vision problems or eye irritation.

**Symptoms of an underactive thyroid (hypothyroidism) can include:**

Feeling tired (fatigue).

Gaining weight.

Experiencing forgetfulness.

Having frequent and heavy menstrual periods.

Having dry and coarse hair.

Having a hoarse voice.

Experiencing an intolerance to cold temperatures.

Several studies have reported low serum levels of vitamin D in hypothyroid patients which in turn may lead to some musculoskeletal complaints in patients [15, 37].

There are two mechanisms that may explain why serum levels of vitamin D is low in hypothyroid patients; one is that the low levels of vitamin D may be due to poor absorption of vitamin D from the intestine and the other is the body of patients may not activate vitamin D properly [16, 27-30].

## Methods

### Study design and population

In this retrospective study data were collected from the pre-decided study sites, records of subjects who underwent 25(OH)D and thyroid (T3, T4 and TSH) testing across north Gujarat in India, between January 2021 and March 2022.

Data of subjects above 18 years of age, having valid records, was considered for this retrospective analysis. Subject records having incomplete information were excluded. The data was collected from different study sites in which all 25(OH)D and thyroid (T3, T4 and TSH) tests were done at same processing laboratory (Thyrocare technologies Limited, Mumbai, India). The laboratory data included subjects' demographic details (sex, age etc) and results of serum 25(OH)D and thyroid function profile (T3, T4, TSH) tests.

The study was conducted in conformity with the principles of the declaration of international council for harmonization-good clinical practices (ICH-GCP) guidelines, Indian council of medical research, Indian GCP guidelines, and as per the approved protocol. The approval from the independent ethics committee was taken for the study. Since this was a retrospective data collection study, informed consent was not required. Patient confidentiality was maintained during the data entry and analysis process.

### Assessments

Vitamin D status in north Gujarat Indian population was categorized as Vitamin D deficiency: (25(OH)D)  $< 30$  ng/ml, Vitamin D sufficiency: 25(OH)D  $> 30$  ng/ml and If any one, more than one or all of Thyroid profile parameter/s is/are abnormal {low or high than normal value stated in case record form (CRF) T3: 58 - 159 ng/dl, T4: 4.5-12  $\mu$ g/dl, TSH: 0.35 - 4.94  $\mu$ IU/ml} it will be considered thyroid dysfunction/abnormality as per study protocol working definition.

### Study variables

The primary study variables were the proportion of subjects with vitamin D deficiency and thyroid abnormality. The secondary study variables included proportion of subjects categorized with vitamin D deficiency and thyroid

abnormality on the basis of sex, age groups (21-40, 41-60 and >60 years) along with further bifurcation of sex and age group prevalence.

**Statistical analysis**

Qualitative (categorical) and quantitative (continuous) variables are presented using descriptive statistics. Qualitative variables were evaluated by the chi-square to assess the relationships between variables in the study population, and the corresponding p value is presented. Data were analyzed using SPSS® statistics software, version 20.

**Ethical approval**

Data analysis was initiated after approval from independent ethics committee.

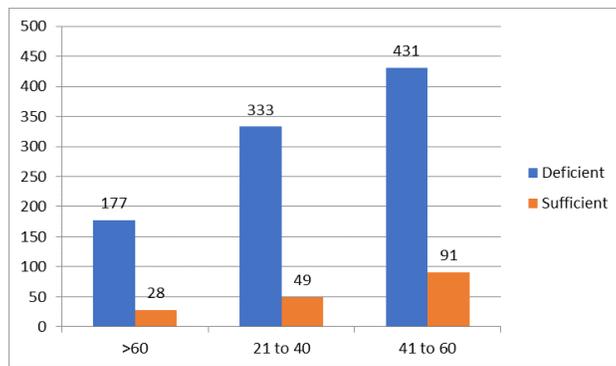
**Results**

Out of 1109, 941 (84.9%) subjects had vitamin D level of <30 ng/ml, while 168 (15.1%) subjects had Vitamin D level (>30ng/ml). Out of 1109, 1000 (90.2%) subjects had T3, T4, TSH and thyroid profile levels are within the stated values (T3: 58 - 159 ng/dl, T4: 4.5-12 µg/dl and TSH: 0.35 - 4.94 µIU/ml) while 109 (9.8%) subjects had low or more than the stated values respectively hence 1000 (90.2%) subjects are normal and 109 (9.8%) subjects are abnormal thyroid profile.

Vitamin D status in the north Gujarat Indian population overall and as per age-group is summarized in Table 1 and depicted in Figure 1. In the north Gujarat Indian population, the prevalence of Vitamin D level <30 ng/ml was higher in the age-group of 21 – 40 (87.17%) years, followed by > 60 (86.34%) years and 41 – 60 (82.57%) years.

Age groups (years)	Total		21- 40		41- 60		>60	
Subjects	1109		382		522		205	
Vitamin d Status n %	N	%	N	%	N	%	N	%
Deficiency	941	84.85	333	87.17	431	82.57	177	86.34
Sufficiency	168	14.15	49	12.83	91	17.43	28	13.66

**Table 1: Vitamin D status in north Gujarat Indian population - age group distribution.**



**Figure 1: Graphical representation of study population by age group.**

The prevalence of vitamin D level of <30 ng/ml was found marginally higher in males than females. Out of 584 males, 501 (85.78%) had Vitamin D deficiency (level <30 ng/ml) while just 83 (14.21%) had Vitamin D sufficiency (level >30 ng/ml). Similarly, out of 525 females, 440 (83.81%) had Vitamin D deficiency (level < 30 ng/ml) while just 85 (16.19%) had Vitamin D sufficiency (level >30 ng/ml). Vitamin D status in the north

Gujarat Indian population overall distribution as per sex is summarized in Table 2, Table 3 and depicted in Figure 2.

Thyroid profile and its correlation with Vitamin D status in the north Gujarat Indian population is summarized in Table 4 and Table 5 as well depicted in Figure 3.

Gender	Frequency N	Percent %
Female	525	47.3
Male	584	52.7
Total	1109	100.0

**Table 2: Vitamin D status in north Gujarat Indian population - overall distribution as per sex.**

Vitamin D Status	SEX		Total
	F	M	
Deficient N (%)	440 (83.81%)	501 (85.78%)	941 (84.85%)
Sufficient N (%)	85 (16.19%)	83 (14.21%)	168 (15.15%)
Total	525	584	1109

**Table 3: Vitamin D status in north Gujarat Indian population - overall distribution as per sex.**

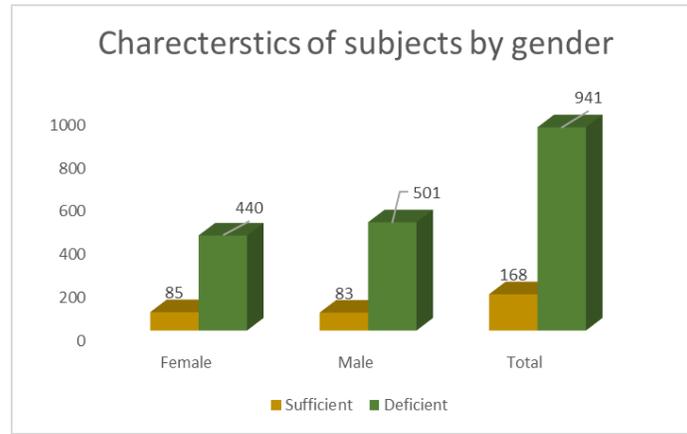


Figure 2: Graphical representation of study population by sex group.

Thyroid profile	Frequency	Percent
Abnormal	109	9.8
normal	1000	90.2
Total	1109	100.0

Table 4: Thyroid status in north Gujarat Indian population

VD	Thyroid profile		Total
	Abnormal	Normal	
deficient	93	848	941
sufficient	16	152	168
Total	109	1000	1109

Table 5 Correlation of Vitamin D status with Thyroid profile.

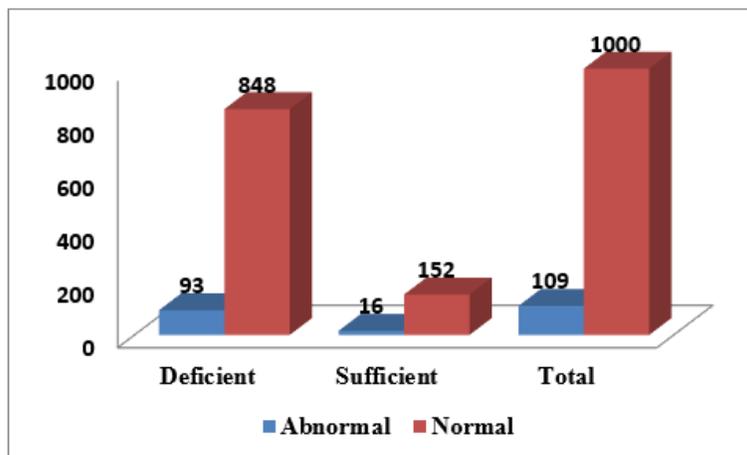


Figure 3: Graphical representation of Thyroid profile and its correlation with Vitamin D.

**Discussion**

The global prevalence of vitamin D deficiency/ insufficiency is increasing irrespective of age, gender, race, and geography, and India is no exception. The intent of the present retrospective study was to conduct a systematic evaluation of vitamin D status with thyroid in North Gujarat, Indians, in order to provide a comprehensive picture of the vitamin D status with thyroid among North Gujarat Indians.

Data of 1109 North Gujarat Indian subjects (Male: Female-584:525) with the mean (SD) age of 46.97 (13.39) years, was considered for this retrospective analysis. Data revealed that in the North Gujarat Indian population, the prevalence of vitamin D level <30ng/ml and >30 ng/ml was 84.9% and 15.1% respectively. The rate of vitamin D deficiency (<30 ng/ml) reported in this study is comparatively more or less similar reported in other studies, conducted amongst apparently healthy Indians [8,32]. Countrywide studies

have reported vitamin D deficiency as high as 70%–100% in ostensibly healthy individuals [8]. A pan India study among healthcare professionals revealed that 94% of the subjects had vitamin D levels <30 ng/ml and 79% of the subjects were vitamin D deficient (<20 ng/ml) [34].

Vitamin D deficiency in adults was previously thought to be limited to older persons [43]. But the result of this retrospective analysis revealed that the prevalence of vitamin D level of <30 ng/ml was highest in the age-group of 21 – 40 years (87.17%). Bone mineral density (BMD) studies in healthy Indians also showed that a significant proportion of younger Indians too are suffering from this silent disease [8]. In a study by Shivane et al, out of 1137 patients in the age group of 25-35 years, 70% had vitamin D levels of <20ng/ml [41]. Likewise, in a study by Garg et al, 65.5% of females in the age group of <30 years were found to be vitamin D deficient [42]. Similarly, even healthy young soldiers with adequate consumption of calcium,

adequate sun exposure, and regular exercise regimen were found to be vitamin D deficient [8,29].

Out of 1109 North Gujarat Indian subjects (Male: Female - 584:525) with the mean (SD) age of 46.97 (13.39) years, was considered for this retrospective analysis. Data revealed that in the North Gujarat Indian population, 1000 (90.2%) of North Gujarat Indians had T3, T4, TSH level (T3 58 - 159 ng/dl, T4 4.5-12 µg/dl and TSH 0.35 - 4.94 µIU/ml) are within the stated values while 109 (9.8%) subjects had low or more than the stated values respectively hence 1000 (90.2%) subjects are having normal and 109 (9.8%) subjects are having abnormal thyroid profile. Further to see the correlation of vitamin D with Thyroid disorder/abnormality, this study revealed that Firstly, out of 1000 normal thyroid profile subjects, 848 are vitamin D deficient while 152 subjects are having vitamin D sufficiency. Secondly, out of 109 abnormal thyroid profile subjects, 93 are vitamin D deficient while 16 subjects are having vitamin D sufficiency. Chi square test is used to find the correlation between vitamin D and thyroid profile hence P value is obtained as 0.885 and P value shows that there is no correlation between vitamin D and thyroid profile in North Gujarat Indian.

Few studies have been conducted in order to find any significant association between the levels of vitamin D and abnormal thyroid function and to determine whether vitamin D deficiency involves in the pathogenesis of abnormal thyroid function or rather a consequence of the disorder and those that yielded conflicting results. Holick MF showed the prevalence of vitamin D insufficiency in Hashimoto's cases (92%) was significantly higher than that observed in healthy controls (63%,  $p < 0.0001$ ) [47].

Byron Richards (2008) [48] studied the effect of Vitamin D deficiency on thyroid gland in experimental study; he reported that a lack of vitamin D contributed to the possibility of low thyroid hormones. Talaei et al. found that supplementation of 50,000 IU vitamin D to hypothyroid subject lowered TSH and parathormone levels without any significant effect over serum thyroxine (T3 and T4) levels [49]. In another scenario, Ucan et al. observed that a similar vitamin D oral supplementation to autoimmune Hashimoto's thyroiditis subjects significantly improved thyroid status concurrent with a decrease in autoimmune antibodies and an increase in free T4 (fT4) levels [50].

## Conclusion

The global prevalence of vitamin D deficiency/ insufficiency is increasing irrespective of age, gender, race, and geography, and India is no exception. Despite the close link of Vitamin D with human health, Vitamin D deficiency is still not widely recognized as a problem in India. Greater awareness about the multiple consequences of Vitamin D deficiency is required among clinicians and patients to enable them to foresee the burden of this silent epidemic. Additionally, a concerted effort on the policy, medical, and social fronts will be required to combat this preventable epidemic. The present retrospective study was to conduct a systematic evaluation of vitamin D status with thyroid profile in North Gujarat, Indians. The study revealed that the subjects have no correlation between vitamin D deficiency and thyroid hormones.

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