To Estimate Serum Vitamin D Levels in Alopecia Areata at Tertiary Care Hospital

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Abstract: *Introduction: Alopecia Areata (AA) is a prevalent autoimmune disorder that results in non-scarring hair loss and carries a significant psychological burden. While its pathogenesis involves a complex interplay of genetic and immune factors, recent evidence points towards a potential role for vitamin D, an important immunomodulator, in various autoimmune diseases. Vitamin D deficiency has been linked to impaired hair follicle function and immune dysregulation, suggesting it may contribute to the development or severity of AA. This study was designed to assess the serum vitamin D levels in patients with AA at a tertiary care centre in India and to explore the relationship between these levels and the clinical characteristics of the disease. Objectives: 1) To study the clinical and demographic profile of patients diagnosed with Alopecia Areata. 2) To estimate the prevalence of vitamin D deficiency and insufficiency in this patient cohort. Methods: A cross-sectional observational study was conducted on 67 clinically diagnosed AA patients at F.H. Medical College, Agra. After obtaining informed consent, a detailed history and clinical examination were performed. The severity of hair loss was quantified using the Severity of Alopecia Tool (SALT) score. Serum 25-hydroxyvitamin D [25(OH)D] levels were measured using the chemiluminescence method. Data were analysed using SPSS version 26.0, and correlations were assessed, with a p-value < 0.05 considered statistically significant. Results: The study included 67 patients with a mean age of 32.68 ± 9.87 years and a slight male predominance (56.72%). The majority of patients (44.78%) presented with a disease duration of less than three months. Patchy alopecia was the most common presentation, with 49.25% of patients having 1-2 patches. A significant portion of patients exhibited vitamin D deficiency (32.84%) or insufficiency (44.78%). The mean serum vitamin D level for the cohort was 19.37 ± 7.55 ng/mL. Although lower vitamin D levels showed a trend of association with longer disease duration and greater severity (higher SALT score), these correlations were not statistically significant (p > 0.05). Conclusion: A high prevalence of vitamin D deficiency and insufficiency was observed in patients with alopecia areata. This finding suggests a potential underlying link between vitamin D status and the pathophysiology of AA. While a statistically significant correlation with disease severity or duration was not established in this cohort, the data warrants further, larger-scale research, including controlled trials, to investigate the therapeutic potential of vitamin D supplementation in the management of alopecia areata.*

Keywords: Alopecia Areata, Vitamin D, Vitamin D Deficiency, Autoimmune Disorder, Hair Loss, SALT Score, Immune Regulation

1. Introduction

Alopecia areata (AA) is a chronic, immune-mediated disorder characterized by non-scarring hair loss that can affect the scalp, face, and other hair-bearing areas of the body. With a lifetime incidence risk estimated at around 2% globally, AA represents a significant dermatological and psychosocial concern. The condition arises from a collapse of the immune privilege of the hair follicle, leading to a T-cell-mediated autoimmune attack on anagen-phase hair follicles, which halts the hair growth cycle. Clinical presentations are variable, ranging from small, well-defined patches of hair loss to more extensive forms such as alopecia totalis (complete scalp hair loss) and alopecia universalis (complete scalp and body hair loss). The etiology of AA is multifactorial, involving a complex interaction of genetic predisposition, environmental triggers, and immunological pathways. A strong genetic link is evidenced by familial cases and associations with specific human leukocyte antigen (HLA) class I and II genes. Furthermore, AA is frequently comorbid with other autoimmune conditions, including vitiligo, autoimmune thyroid disease, and systemic lupus erythematosus, reinforcing its autoimmune basis.

In recent years, the role of vitamin D in health and disease has expanded beyond its classical functions in calcium homeostasis and bone metabolism. Vitamin D is now recognized as a potent immunomodulator capable of influencing both innate and adaptive immune responses by affecting T and B lymphocytes, macrophages, and dendritic cells. Vitamin D receptors (VDR) are expressed in numerous tissues, including keratinocytes within the hair follicle, where they are essential for maintaining a normal hair cycle. This has led to the hypothesis that vitamin D deficiency, a widespread issue in India and globally, could be a contributing environmental factor in the pathogenesis of autoimmune diseases like AA.

Several studies have explored the association between serum vitamin D levels and AA, yielding mixed results. While multiple meta-analyses and case-control studies have reported significantly lower vitamin D levels and a higher

prevalence of deficiency in AA patients compared to healthy controls, other studies have found no statistically significant difference. Some research also suggests an inverse correlation between vitamin D levels and disease severity, though this finding is not universal. Given the high prevalence of vitamin D deficiency in the Indian population and the conflicting international data, this study was undertaken to evaluate the vitamin D status in a cohort of AA patients in India and to analyse its relationship with the clinical parameters of the disease.

2. Aims and Objectives

The primary aim of this study was to estimate serum vitamin D levels in patients with alopecia areata at a tertiary care hospital. The specific objectives were:

- To study the clinical and demographic profile of patients with alopecia areata.
- To estimate the prevalence of vitamin D deficiency and insufficiency among patients suffering from alopecia areata.

3. Material and Methods

2.1 Study design

This cross-sectional observational study was conducted in the Department of Dermatology at F.H. Medical College and Hospital, Agra, a tertiary care center in Uttar Pradesh, India. The study was carried out over a period of two years, from May 2023 to April 2025.

2.2 Study Population

A total of 67 patients clinically diagnosed with alopecia areata were enrolled in the study. The sample size was calculated based on the prevalence of AA from a previous study, using a standard formula for sample size calculation with a 95% confidence level and a 2% margin of error.

Inclusion Criteria: All patients clinically diagnosed with AA (based on features and trichoscopy) who provided informed consent were included.

Exclusion Criteria: Patients with other types of hair loss (e.g., scarring alopecia, androgenic alopecia, telogen effluvium), those who had used topical or oral medications for AA within the preceding four weeks, and pregnant or lactating females were excluded from the study.

2.3 Methodology

The study was initiated after receiving clearance from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to their inclusion. A detailed proforma was used to collect data on patient demographics, personal and family medical history, and clinical characteristics of the disease. A thorough clinical examination was performed to document the pattern of hair loss, site of involvement, and disease severity. The severity of scalp hair loss was assessed using the Severity of

Alopecia Tool (SALT) score, classifying patients into five categories from S1 (<25% hair loss) to S5 (100% hair loss).

Vitamin D Level Analysis: A venous blood sample was collected from each participant. Serum was separated and sent to the Department of Biochemistry for the analysis of 25-hydroxyvitamin D [25(OH)D] levels, which were measured using a chemiluminescence immunoassay method. Vitamin D status was categorized as follows:

Deficiency: < 20 ng/mL
Insufficiency: 21–29 ng/mL
Sufficiency: 30–100 ng/mL

Statistical Analysis: The collected data was entered into a master chart and analyzed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. The correlation between serum vitamin D levels and other variables like disease duration and severity was assessed using Spearman's correlation. A p-value of less than 0.05 was considered statistically significant.

4. Results

4.1 Demographic and Clinical Profile

The study comprised 67 patients, with 38 (56.72%) males and 29 (43.28%) females (table 1). The mean age of the participants was 32.68 ± 9.87 years, with the largest group (49.25%) being in the 12-30 year age bracket. The mean Body Mass Index (BMI) was 24.36 ± 3.57 kg/m².

Table 1: Demographic characteristics of the patients in the study group

Variables	No of cases	Percentage
Age		
12-30	33	49.25%
31-40	21	31.34%
41-50	9	13.43%
>50	5	7.46%
Total	67	100.00%
Mean ± SD	32.68 ± 9.87	
Sex		
Female	29	43.28%
Male	38	56.72%
BMI (Kg/m2)	24.36 ± 3.57	

Regarding disease duration (table 2), the majority of patients (44.78%) had a duration of less than 3 months, followed by 37.31% with a duration of 3 to 12 months. The most common clinical presentation was patchy alopecia. Nearly half of the patients (49.25%) presented with 1–2 patches, while more severe forms like alopecia totalis (AT) and alopecia universalis (AU) were seen in 8.96% and 4.48% of patients, respectively. The scalp was the most predominantly affected site (70.15% of patients).

Table 2: Duration of disease in alopecia areata patients
Duration of disease No of cases Percentage

Duration of disease	No of cases	Percentage
<3 months	30	44.78%
(3-12) months	25	37.31%
(1-3) year	8	11.94%
>3 year	4	5.97%
Total	67	100.00%

Assessment of severity using the SALT score revealed that most patients had mild to moderate disease (table 3). The largest proportion (37.31%) was classified as S1 (<25% hair loss), followed by S2 (26.87%) and S3 (17.91%).

Table 3: SALT score in alopecia areata patients SALT score No of cases Percentage

SALT score	No of cases	Percentage
S1	25	37.31%
S2	18	26.87%
S3	12	17.91%
S4	8	11.94%
S5	4	5.97%

4.2 Serum Vitamin D Status

The analysis of serum 25(OH)D levels revealed a high prevalence of suboptimal vitamin D status in the study cohort (table 4). A total of 32.84% of patients were found to have vitamin D deficiency (<20 ng/mL), while 44.78% had insufficiency (21-29 ng/mL). Only 22.39% of patients had sufficient vitamin D levels. The mean serum vitamin D level for the entire group was 19.37 ± 7.55 ng/mL, which falls into the deficient range.

Table 4: Distribution of Vitamin D deficiency, insufficiency, and sufficiency

Serum Vitamin D status	No of cases	Percentage
Deficiency	22	32.84%
Insufficiency	30	44.78%
Sufficiency	15	22.39%
Mean ± SD	19.37 ± 7.55	

4.3 Correlation of Vitamin D with Clinical Parameters

The study explored the correlation between serum vitamin D levels and various clinical parameters.

Correlation with Disease Duration: There was a trend towards lower vitamin D levels in patients with longer disease duration. The lowest mean level (12.31 ± 4.89 ng/mL) was observed in patients with AA for >3 years. However, this negative association was very weak and not statistically significant (Spearman's correlation = -0.082, p = 0.680).

Correlation with Extent of Alopecia: A decreasing trend in vitamin D levels was noted with an increasing number of patches. Patients with 1-2 patches had a mean level of 18.58 ± 5.01 ng/mL, which decreased to 11.16 ± 4.10 ng/mL in those with alopecia totalis. This moderate negative correlation did not reach statistical significance (Spearman's correlation = -0.421, p = 0.081).

Correlation with Disease Severity (SALT Score): Similarly, mean vitamin D levels tended to decrease as the SALT score increased, from 18.36 ± 5.00 ng/mL in the S1 group to 13.97 ± 1.52 ng/mL in the S5 group. This weak negative association was also not statistically significant (Spearman's correlation = -0.325, p = 0.301).

5. Discussion

This study investigated the relationship between serum vitamin D levels and alopecia areata in a tertiary care setting in India. The key finding was the remarkably high prevalence of vitamin D deficiency (32.84%) and insufficiency (44.78%) among patients with AA, with a mean serum level of 19.37 ± 7.55 ng/mL. This suggests that more than three-quarters of the AA patients in this cohort had suboptimal vitamin D status. This finding is consistent with broader reports of widespread vitamin D deficiency across the Indian subcontinent but also aligns with several studies that have specifically identified low vitamin D as a common finding in AA patients. For instance, a study by Gupta et al. reported a significantly lower mean vitamin D level in AA patients (17.15 ± 5.01 ng/mL) compared to controls, and Rehman et al. also found a significantly higher prevalence of vitamin D deficiency in their patient group.

The demographic profile of our cohort, with a mean age of onset in the early thirties and a slight male predominance, is comparable to findings from other Indian studies by Siddappa et al. and Gupta et al. The clinical presentation was dominated by recent-onset (<1 year), patchy alopecia of the scalp, which represents the most common form of the disease seen in clinical practice.

A critical aspect of this research was to determine if a correlation exists between the degree of vitamin D deficiency and the clinical severity of AA. In our study, while there was a discernible trend where lower vitamin D levels were associated with longer disease duration, a greater number of patches, and a higher SALT score, these correlations failed to achieve statistical significance. This particular finding is in agreement with some previous research. Dasankunju et al. and Cerman et al. also reported no significant relationship between vitamin D levels and disease duration or pattern. However, our results contrast with studies by Rehman et al. and Gade et al., who found a significant inverse correlation between vitamin D levels and disease severity as measured by the SALT score.

The lack of a statistically significant correlation in our study could be attributed to several factors. The relatively small sample size of 67 patients may have lacked the statistical power to detect a weaker association. Additionally, the cross-sectional design of the study provides only a snapshot in time and cannot establish causality or track the influence of fluctuating vitamin D levels on the disease course over time. The absence of a healthy control group is another limitation, making it difficult to definitively state whether the observed vitamin D deficiency is significantly more prevalent in AA patients than in the general local population, which is known to have a high background rate of

hypovitaminosis D.

The pathogenic link between vitamin D and AA is thought to be rooted in its immunomodulatory functions and its role in the hair follicle cycle. VDRs are expressed on follicular keratinocytes, and their activation is crucial for hair follicle differentiation. Reduced VDR expression, as has been noted in AA lesions, may impair this process. Furthermore, as an immunomodulator, vitamin D can suppress the pro-inflammatory T-cell responses implicated in the autoimmune attack on the hair follicle. Therefore, a deficient state might compromise these protective mechanisms, potentially acting as a trigger or an exacerbating factor in genetically susceptible individuals.

6. Conclusions

This study confirms a high prevalence of vitamin D deficiency and insufficiency among patients with alopecia areata in a tertiary care hospital in North India. The majority of patients had suboptimal serum vitamin D levels, highlighting a potential area for clinical intervention. Although a decreasing trend in vitamin D levels was observed with increasing disease severity and duration, the correlations were not statistically significant in this cohort. These findings underscore the complex relationship between vitamin D status and AA. Further large-scale, multi-center, case-control studies are warranted to establish a more definitive link. Prospective interventional studies are also needed to clarify whether correcting vitamin D deficiency through supplementation can serve as an effective adjuvant therapy in the management of alopecia areata, potentially improving treatment outcomes and the quality of life for these patients.

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