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A prospective observational study on the efficacy of narrowband UVB phototherapy combined with oral antioxidants in the management of vitiligo.

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Abstract

Background:
Vitiligo is a chronic depigmenting disorder, often requiring prolonged therapy due to slow and variable repigmentation. Narrowband ultraviolet B (NB-UVB) is an established treatment approach, and interest has grown in combining it with oral antioxidant supplementation to enhance melanocyte recovery and reduce oxidative stress.

Aim:
To evaluate the efficacy and tolerability of NB-UVB phototherapy combined with oral antioxidants in patients with vitiligo.

Methods:
This prospective observational study included 50 clinically diagnosed vitiligo patients. All participants received NB-UVB phototherapy three times weekly, along with a daily oral antioxidant regimen, for 24 weeks. Demographic and clinical parameters were recorded. Repigmentation was assessed using the Vitiligo Area Scoring Index (VASI) at baseline, 12 weeks, and 24 weeks. Treatment response was categorized as excellent (>75%), moderate (50–75%), mild (25–49%), or minimal (<25%). Adverse events were documented throughout the study period.

Results:
The mean age of participants was 28.6 ± 9.4 years, with females comprising 56% of the cohort. Non-segmental vitiligo accounted for 74% of cases. The mean baseline VASI score was 6.8 ± 2.1, which reduced progressively to 4.3 ± 1.9 at 12 weeks and 2.7 ± 1.6 at 24 weeks. Excellent repigmentation was achieved in 28% of patients, moderate in 36%, and mild in 24%, while 12% showed minimal improvement. Facial and truncal lesions responded better compared to acral sites. Treatment was well tolerated, with only mild transient erythema and pruritus reported.

Conclusion:
NB-UVB combined with oral antioxidants resulted in meaningful repigmentation with good safety and patient acceptance.

Recommendations:
This combination may be considered as a preferred therapeutic strategy in the routine management of non-segmental vitiligo, especially when aiming for gradual yet sustained repigmentation.

Keywords: *Vitiligo, Narrowband Ultraviolet B phototherapy, Oral antioxidants, Repigmentation, Vitiligo Area Scoring Index, Phototherapy.*
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Introduction

Vitiligo is a chronic pigmentary disorder marked by sharply demarcated depigmented patches resulting from the loss of functional melanocytes in the skin [1]. It can occur at any age and affects individuals across all ethnic backgrounds. While the disease does not impair physical health, its visible nature often leads to psychological distress, lowered self-esteem, and social stigma, impacting quality of life [1]. The clinical course is unpredictable, with alternating phases of stability and progression, which makes long-term management challenging [2].

Increasing evidence indicates that oxidative stress plays a significant role in the pathogenesis of vitiligo. Elevated levels of reactive oxygen species can damage melanocytes, disrupt melanin synthesis, and disturb local immune balance [3]. Narrowband ultraviolet B (NB-UVB) phototherapy is currently considered a standard therapeutic modality due to its ability to stimulate melanocyte proliferation, induce repigmentation from follicular reservoirs, and modulate immune responses in affected skin [4]. However, repigmentation with NB-UVB alone may be gradual and incomplete in many patients, leading to interest in combination therapies that enhance therapeutic outcomes.

Oral antioxidants have been explored as adjuncts because they help counter oxidative stress by neutralizing free radicals and improving melanocyte resilience [1,4]. When combined with NB-UVB, antioxidants may accelerate repigmentation, improve uniformity of pigment spread, and potentially reduce treatment duration required for noticeable improvement [5]. This combined approach offers a rational, patient-centered strategy that addresses both the biological and clinical components of vitiligo.

However, the degree of benefit from combining NB-UVB with antioxidant supplementation varies among patients, and real-world data remain limited. Evaluating the clinical efficacy and tolerability of this regimen in routine practice is necessary to support its broader incorporation into treatment guidelines. Guided by this need, the present study was undertaken to assess repigmentation outcomes and safety profiles in patients receiving NB-UVB phototherapy combined with oral antioxidants over a defined treatment period.

Methodology

Study Design and Setting

This study was conducted as a prospective observational study to evaluate the efficacy and tolerability of narrowband ultraviolet B (NB-UVB) phototherapy combined with oral antioxidant supplementation in patients with vitiligo. The study was carried out in the Department of Dermatology, Venereology, and Leprosy at Government Medical College and Government General Hospital, Nalgonda, Telangana, India, over six months from January 2024 to June 2024.

Government Medical College and Government General Hospital, Nalgonda, is a tertiary care teaching hospital that serves a large population from urban, semi-urban, and predominantly rural areas of Nalgonda district and adjoining regions. The dermatology outpatient department caters to a high patient load of pigmentary disorders and other chronic dermatoses, offering a suitable clinical setting for the assessment, treatment, and follow-up of patients with vitiligo undergoing phototherapy.

Study Population:

A total of **50 patients** with clinically diagnosed vitiligo attending the dermatology outpatient clinic during the study period were enrolled.

Sample Size Determination:

The sample size was calculated based on the expected improvement in repigmentation reported in earlier studies evaluating NB-UVB phototherapy with adjunctive antioxidant therapy. Using the formula

$n = Z^2 \times p \times q / d^2$,

Where $Z = 1.96$ at 95% confidence interval, p = anticipated response proportion of 70%, q = 30%, and d = allowable error of 13%, the minimum sample size was estimated to be approximately 48. Considering feasibility, outpatient attendance, and possible attrition, a final sample size of 50 patients was included in the study.

Inclusion Criteria:

Patients aged 10 years and above.
Clinically confirmed vitiligo (segmental or non-segmental).
Willingness to undergo regular NB-UVB sessions.
Written informed consent obtained.

Exclusion Criteria:

History of photosensitivity disorders.
Patients are currently on systemic immunosuppressive therapy.
Pregnant or lactating women.
Uncontrolled systemic illness or acute dermatological infection.

Treatment Protocol:

All participants received **NB-UVB phototherapy three times per week** on non-consecutive days. Initial dosing

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followed standard phototherapy guidelines, and dose increments were adjusted according to patient tolerance and erythema response. Alongside phototherapy, each patient was prescribed a **daily oral antioxidant supplement** containing Vitamin C, Vitamin E, Zinc, and Beta-carotene.

Assessment Criteria:

Repigmentation was evaluated using the **Vitiligo Area Scoring Index (VASI)**.
Measurements were recorded at:
Baseline (before treatment)
12 weeks
24 weeks
Clinical photographs were taken at each visit for visual documentation. Treatment response was categorized as:
Excellent: >75% repigmentation
Moderate: 50–75%
Mild: 25–49%
Minimal/None: <25%

Safety Evaluation:

Patients were monitored at each session for local or systemic adverse effects. Any phototherapy-related discomfort or intolerance was documented and managed appropriately.

Bias and Its Control:

Selection bias was minimized by enrolling consecutive eligible patients attending the dermatology outpatient clinic during the study period. Measurement bias was reduced by using a standardized and validated scoring system (Vitiligo Area Scoring Index) for assessing repigmentation at predefined intervals. Observer variability was limited by consistent clinical evaluation and photographic documentation. As this was an observational study, residual confounding could not be eliminated.

Statistical Analysis:

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software. Descriptive statistics were used to summarize demographic and clinical variables. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Changes in VASI scores over time were analyzed descriptively. A p-value of <0.05 was considered statistically significant where applicable.

Ethical Considerations:

Institutional Ethics Committee approval was obtained before the initiation of the study from the Institutional Ethics Committee, Government Medical College and Government General Hospital, Nalgonda, Telangana, India. Written informed consent was obtained from all participants or their legal guardians where applicable. Confidentiality of patient information was strictly maintained throughout the study in accordance with ethical standards.

Results

Participant Flow

During the study period, 58 patients with clinically suspected vitiligo were assessed for eligibility at the dermatology outpatient department. Of these, 8 patients were excluded: 3 did not meet the inclusion criteria, 2 declined to participate, and 3 were excluded due to irregular follow-up or inability to comply with phototherapy schedules.
A total of 50 eligible patients were enrolled and initiated on narrowband UVB phototherapy combined with oral antioxidant supplementation. All enrolled participants completed the planned 24-week follow-up, and their data were included in the final analysis. No participants were lost to follow-up after enrollment.

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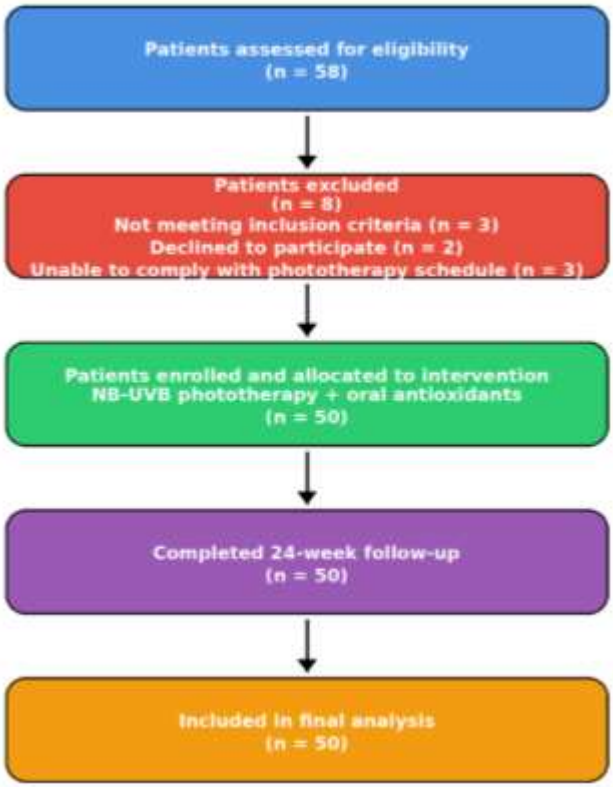

Figure 1: Participant Flow Diagram

A total of 50 patients diagnosed with vitiligo were included in the final analysis. The mean age of the study population was 28.6 ± 9.4 years, with most participants belonging to the 21–40-year age group. Females were slightly more represented than males. The demographic profile of the participants is summarized in **Table 1**.

Table 1: Demographic Profile of Study Participants (N = 50)

Parameter	Category	Number (n)	Percentage (%)
Age (years)	Mean ± SD	28.6 ± 9.4	—
Age Group	10–20 years	12	24
	21–40 years	29	58
	>40 years	9	18
Gender	Male	22	44
	Female	28	56

Non-segmental vitiligo was the predominant clinical type, observed in nearly three-fourths of the study population. The average duration of the disease at presentation was 3.2 ± 1.7 years. The face and neck region was the most frequently involved site, followed by the trunk and upper limbs. These clinical characteristics are outlined in **Table 2**.

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Table 2: Clinical Characteristics of Vitiligo

Characteristic	Category	Number (n)	Percentage (%)
Type of Vitiligo	Non-segmental	37	74
	Segmental	13	26
Duration of Disease	Mean ± SD (years)	3.2 ± 1.7	—
Most Common Sites	Face/Neck	18	36
	Trunk	14	28
	Upper Limbs	11	22
	Hands/Feet	7	14

Baseline VASI scores were recorded before initiating treatment with narrowband UVB phototherapy combined with oral antioxidants. A steady decline in VASI score was observed over the course of therapy. At 12 weeks, there was a noticeable reduction in depigmented area, and by 24 weeks, a more pronounced repigmentation response was achieved. The decrease in mean VASI score from baseline to 24 weeks represented a reduction of over 60% in depigmented body surface area. The progressive improvement in VASI scores is displayed in **Table 3**.

Table 3: Change in VASI Score During Treatment

Time Point	Mean VASI Score ± SD	Mean % Reduction from Baseline
Baseline	6.8 ± 2.1	—
12 Weeks	4.3 ± 1.9	36.8%
24 Weeks	2.7 ± 1.6	60.3%

On evaluation of overall treatment response, 28% of patients achieved excellent repigmentation (>75% improvement), while 36% exhibited moderate improvement (50–75%). Mild improvement was observed in 24% of participants, and a minority (12%) showed minimal or no repigmentation response. Treatment was generally well tolerated. Mild erythema and transient pruritus were the only commonly reported adverse effects, neither of which required treatment interruption. No serious systemic side effects were noted. The distribution of treatment response and adverse effects is shown in **Table 4**.

Table 4A: Overall Treatment Response

Response Category	Criteria (Repigmentation %)	Number (n)	Percentage (%)
Excellent	>75%	14	28
Moderate	50–75%	18	36
Mild	25–49%	12	24
Minimal / None	<25%	6	12

Table 4B: Adverse Effects Observed During Treatment

Adverse Effect	Number (n)	Percentage (%)	Remarks
Mild erythema	10	20	Settled without stoppage
Pruritus	7	14	Transient and self-limiting
Systemic effects	0	0	None noted

Discussion

Vitiligo remains a therapeutic challenge due to its unpredictable course and the psychological weight that visible depigmentation carries for affected individuals. Successful treatment requires not only inducing repigmentation but also maintaining pigment stability over

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time. In this study, the combination of narrowband UVB (NB-UVB) phototherapy with oral antioxidants resulted in sustained and progressive repigmentation, as evidenced by the steady reduction in VASI scores. This observation is consistent with earlier reports indicating that NB-UVB stimulates residual melanocytes, encourages their proliferation, and assists in the redistribution of pigment from follicular reservoirs to depigmented epidermis [7,14].

The pathogenesis of vitiligo is closely linked to oxidative stress, and this underpins the rationale for antioxidant supplementation. Reactive oxygen species can impair melanocyte survival and trigger immune-mediated cytotoxicity. The inclusion of antioxidants in the treatment regimen likely helped stabilize oxidative balance and support melanocyte function, enhancing the clinical benefits of phototherapy. Prior clinical investigations have similarly shown that antioxidants can improve repigmentation outcomes when used alongside NB-UVB by reducing cellular stress and supporting melanocyte repair mechanisms [9,11].

Regional response patterns observed in this study were also notable. Lesions on the face and trunk responded more rapidly, reflecting the abundance of active melanocyte reservoirs and better UV penetration in these areas. Acral surfaces, including hands and feet, showed comparatively slower improvement, a finding repeatedly demonstrated in targeted NB-UVB and whole-body phototherapy evaluations [7,14]. This emphasizes the need to individualize treatment counseling, especially when treating patients concerned with lesions in cosmetically prominent or acral zones.

Beyond antioxidants, other adjunctive approaches, including statins, immunomodulators, mini-pulse corticosteroid regimens, and JAK inhibitors, have been evaluated to enhance NB-UVB therapeutic outcomes [6,8,10,12,13]. The convergence of evidence suggests that combination therapy is not only more biologically rational but may also help reduce treatment duration and improve long-term pigment retention.

Safety remains a critical factor in chronic dermatologic therapy. The combination approach in our study was well tolerated, with only transient erythema and mild pruritus reported findings similar to previously documented safety profiles for NB-UVB-based protocols [7,14]. No systemic adverse events were observed, reinforcing the suitability of this approach for long-term outpatient care.

Overall, the findings support the use of NB-UVB phototherapy in conjunction with oral antioxidants as a practical, well-tolerated, and effective strategy in vitiligo management. The approach aligns with current therapeutic trends favoring combination regimens that target multiple pathophysiological pathways while maintaining patient comfort and compliance.

Generalizability

The findings apply to patients with stable, non-segmental vitiligo receiving outpatient care in similar clinical settings. Response patterns may vary in populations with different skin types, disease duration, or prior treatment exposure. Larger multicenter studies are needed to confirm the consistency of outcomes across broader demographic and geographic groups.

Conclusion

The present study demonstrates that combining narrowband UVB phototherapy with oral antioxidant supplementation can produce steady and meaningful repigmentation in patients with vitiligo. A clear reduction in VASI scores over the treatment period reflects gradual restoration of melanocyte function and improved pigment distribution. Most patients achieved excellent to moderate response, particularly those with non-segmental vitiligo and lesions on the face or trunk. The treatment was generally well tolerated, with only mild, temporary local side effects that did not interfere with therapy continuation. These findings support the use of this combined approach as a practical, non-invasive, and patient-acceptable option in routine dermatological practice, particularly when aiming for sustained and cosmetically satisfactory outcomes.

Limitations

This study was conducted in a single tertiary care hospital with a relatively small sample size of 50 patients, which may limit the wider applicability of the findings. The observational design did not include a control group, making it difficult to isolate the specific contribution of oral antioxidants to the overall response. Treatment adherence and sun exposure outside therapy sessions were self-reported and may have influenced outcomes. A longer follow-up is also needed to assess relapse rates and the durability of repigmentation.

Recommendations

The combined use of narrowband UVB phototherapy with oral antioxidants may be considered a practical first-line option for patients with non-segmental vitiligo, especially when aiming for gradual yet visible repigmentation. Counseling regarding treatment duration, session regularity, and realistic expectations should be emphasized to improve

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adherence. Facial and trunk lesions tend to respond better, and this may be explained to patients to enhance motivation. Further research with larger, multi-center, randomized controlled trials is recommended to confirm the synergistic benefits of antioxidant supplementation. Long-term follow-up studies are also needed to evaluate the stability of repigmentation and the likelihood of recurrence after therapy completion.

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Abbreviations
NB-UVB – Narrowband Ultraviolet B
VASI – Vitiligo Area Scoring Index
SD – Standard Deviation
UV – Ultraviolet
OPD – Outpatient Department
ROS – Reactive Oxygen Species

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The study had no funding.

Conflict of interest
The authors declare no conflict of interest.

Author contributions
GM-Concept and design of the study, results interpretation, review of literature, and preparation of the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. **SN**-Design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript, revision of the manuscript. **RM** -Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation.

Data availability
Data available on request

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