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Original article

Efficacy, Anatomical Site Variations, and Compliance Barriers of Narrowband UVB Phototherapy in Libyan Vitiligo Patients

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Abstract
Narrowband ultraviolet B (NB-UVB) remains a first-line therapy for generalized vitiligo, yet real-world outcome data from North Africa are limited. We conducted a retrospective clinical audit of 54 documented Libyan vitiligo cases treated with NB-UVB. Demographic, clinical, anatomical, and follow-up variables were retrospectively collected from the medical records of the dermatology outpatient clinic. Categorical variables were expressed using frequencies alongside their corresponding percentages. Associations with clinically meaningful response (VASI improvement ≥50%) were examined using chi-square testing, Monte Carlo exact p-values where expected counts were small, and Kruskal-Wallis testing for non-parametric group comparisons. Mean age was 34.8 ± 16.4 years; 28 patients (51.9%) were male. Non-segmental disease predominated (45/54, 83.3%). The median VASI improvement was 62.5%, and 38 patients (70.4%) achieved ≥50% improvement. Hands (34/54, 63.0%) and feet (33/54, 61.1%) were the commonest sites, while acral resistance was documented in 22 cases (40.7%). Regular dermatologist follow-up showed numerically better response than irregular follow-up (82.6% vs 46.7%; Monte Carlo exact p=0.053). Treatment fatigue was uncommon (4/54, 7.4%) but strongly linked to poor response (Monte Carlo exact p=0.034). NB-UVB produced meaningful repigmentation in most audited Libyan patients, but residual acral resistance and follow-up barriers limited optimal outcomes. Strengthening continuity of care and early counseling on treatment fatigue may improve effectiveness.
Keywords. Vitiligo; Narrowband Ultraviolet B; Libya; VASI; Compliance; Acral Lesions.

Introduction

Vitiligo manifests as a depigmenting dermatosis driven by autoimmune-mediated melanocyte loss, carrying significant psychosocial morbidity because lesions are visually conspicuous and frequently misinterpreted by communities as contagious infections. Literature consistently defines vitiligo as a multifactorial condition driven by an interplay between autoimmune responses, oxidative stress, neural factors, and impaired melanocyte renewal in genetically predisposed individuals [1, 2]. Individuals with darker skin phototypes experience a significantly higher psychosocial burden due to the striking color contrast of lesions, which often exacerbates social stigma [3]. Despite the high prevalence of vitiligo in routine clinical dermatology across Libya and the wider North African region, documented real-world audits are still noticeably limited.

NB-UVB phototherapy has emerged as one of the most widely accepted treatments for generalized and active non-segmental vitiligo. Its efficacy stems from the ability to suppress cutaneous autoimmunity, stimulate melanocyte proliferation and migration, and promote melanogenesis alongside a comparatively favorable safety profile. Practical guidance from the Vitiligo Working Group positions NB-UVB as a central modality in vitiligo management, especially in cases of extensive involvement or when depigmentation compromises cosmetically vital sensitive regions [4]. Subsequent reviews have reinforced its value in both hospital-based and increasingly home-based treatment pathways [5, 6]. Despite these benefits, treatment responses exhibit considerable variability. Anatomical location plays a critical role: lesions on the face and trunk generally repigment better than acral sites, whereas fingers, toes, and other distal locations frequently show residual resistance because melanocyte reservoirs within hair follicles are sparse or completely lacking [7, 8].

Another primary variable dictating patient prognosis and recovery is the uninterrupted maintenance of the treatment regimen. NB-UVB requires repeated attendance over months, rendering patients vulnerable to fatigue, interrupted follow-up, transportation barriers, and unrealistic expectations. Personalized care models increasingly emphasize adherence counseling, pragmatic scheduling, and shared decision-making, acknowledging that efficacy documented in clinical trials may not be reproduced if real-world patients disengage early [9]. Concurrently, vitiligo commonly coexists with autoimmune disorders such as thyroid disease, alopecia areata, and type 1diabetes, creating additional clinical complexity and reinforcing the necessity for holistic assessment [10, 11].

The present study was designed as a retrospective clinical audit of Libyan patients treated with NB-UVB. Its objectives were threefold: first, to quantify the overall clinical response using documented VASI improvement data; second, to describe anatomical site variations, with particular attention to acral resistance; and third, to identify practical barriers to treatment compliance, including irregular follow-up and treatment fatigue. By focusing on routinely collected clinical data, this audit aims to provide a grounded account of how NB-UVB performs in a real Libyan service context and to generate locally relevant recommendations for improving continuity of care.

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Methods

Data collection

This study was a retrospective clinical audit with cross-sectional analysis of 54 documented vitiligo cases managed in Libya. Data were retrospectively retrieved from the medical records of patients attending the dermatology outpatient clinic. Demographic characteristics, clinical features, anatomical distribution of lesions, and follow-up compliance parameters were systematically extracted for analysis. Each row represented one patient record. Available variables included sex, age, nationality, Fitzpatrick skin type, vitiligo type, anatomical distribution, topical and adjunctive therapies, number of NB-UVB sessions, treatment duration, weekly session rate, qualitative response notes, follow-up pattern with a dermatologist, family history of vitiligo, associated diseases, phototherapy side effects, disease activity, and VASI score improvement percentage. All cases were Libyan.

This study complied fully with the ethical tenets of the Declaration of Helsinki. Formal permission to access and evaluate the medical records was officially granted by the medical directorate of the dermatology clinic. Because this project was a retrospective audit utilizing completely de-identified and coded data, the clinic's administration waived the requirement for individual patient consent while ensuring that patient confidentiality was strictly maintained throughout the study.

For data harmonization, inconsistent yes/no entries were standardized, vitiligo type was grouped as non-segmental, segmental, or unspecified, and dermatologist follow-up was categorized as regular, irregular, or none. A composite compliance variable was then derived: regular, irregular/fatigue, or no follow-up. Acral resistance (referred to specifically as digit resistance in clinical notes) and treatment fatigue were captured from clinician notes. Clinically meaningful response was defined a priori as VASI improvement ≥50%, while high response was defined as ≥75%.

Statistical analysis was performed utilizing structured medical computational software. Descriptive variables were summarized as frequencies and percentages for categorical data and as means with standard deviations or medians with interquartile ranges for continuous data, depending on distribution and interpretability.

Associations between categorical variables and response class (VASI improvement ≥50% vs <50%) were tested using chi-square (χ^2) analysis. When small expected cell counts were present in cross-tabulations, Monte Carlo exact p-values were calculated and reported alongside the conventional chi-square statistic. Non-parametric comparisons of VASI improvement across more than two independent groups, particularly skin type and follow-up/compliance categories, were evaluated employing the non-parametric Kruskal-Wallis test. All statistical tests were two-tailed, with significance defined by a p-value below 0.05.

Results

The audit included 54 patients with a mean age of 34.8 ± 16.4 years (median 37.5). Males accounted for 28 cases (51.9%) and females for 26 (48.1%). Skin type IV was most frequent (31, 57.4%), followed by type III (14, 25.9%) and type V (9, 16.7%). Non-segmental vitiligo predominated (45, 83.3%), whereas segmental vitiligo was recorded in 7 cases (13.0%). The median disease duration was 6.55 years, the median treatment duration was 9.0 months, and the median number of NB-UVB sessions was 25.0 (IQR 15.0-60.0). Three sessions weekly were prescribed in 34 cases (63.0%). All details are systematically summarized below in Table 1.

Table 1. Baseline characteristics of the audited cohort (n = 54)

Characteristic	Value / No. (%)
Sex	
Male	28 (51.9%)
Female	26 (48.1%)
Age (years)	
Mean ± SD	34.8 ± 16.4
Median	37.5
Skin Type	
III	14 (25.9%)
IV	31 (57.4%)
V	9 (16.7%)
Vitiligo Type	
Non-segmental vitiligo	45 (83.3%)
Segmental vitiligo	7 (13.0%)
Disease duration (years) (Median)	6.55
NB-UVB sessions (Median, IQR)	25.0 (15.0-60.0)
Weekly session rate: 3/week	34 (63.0%)
Family history of vitiligo	17 (31.5%)
Any associated disease	24 (44.4%)

SD: Standard deviation

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Overall response was favorable. The mean VASI improvement was 53.4% ± 27.4, and the median improvement was 62.5%. Qualitative assessment classified 39 patients (72.2%) as improved, 14 (25.9%) as poor/weak responders, and 1 (1.9%) as having no improvement. Using the predefined threshold, 38 patients (70.4%) achieved ≥50% VASI improvement, while 16 (29.6%) achieved ≥75% improvement.

Anatomically, the commonest affected sites were the hands (34, 63.0%), feet (33, 61.1%), legs (22, 40.7%), other recorded sites such as scalp, chest, neck, elbow, or knee (21, 38.9%), and the face (17, 31.5%). Despite generally acceptable whole-patient VASI outcomes, acral resistance was explicitly documented in 22 cases (40.7%). Furthermore, site-specific analysis (Table 2) revealed notable variations; while acral sites showed moderate repigmentation (hands median 66.0%, feet median 66.0%), the breast region exhibited the lowest median improvement (13.0%), underscoring that therapeutic resistance is not exclusively an acral phenomenon (Table 2).

Table 2. Anatomical distribution and site-specific summary of VASI improvement (n = 54)

Site	No. (%)	Mean VASI improvement (%)	Median VASI improvement (%)
Face	17 (31.5%)	54.2	62.0
Hands	34 (63.0%)	59.6	66.0
Legs	22 (40.7%)	58.5	69.5
Feet	33 (61.1%)	54.5	66.0
Thighs	15 (27.8%)	49.5	55.0
Abdomen	1 (1.9%)	9.0	9.0
Back	6 (11.1%)	41.8	45.0
Genital area	1 (1.9%)	65.0	65.0
Shoulder	4 (7.4%)	47.2	56.5
Breast	5 (9.3%)	33.2	13.0
Other sites	21 (38.9%)	59.2	65.0

Follow-up continuity varied substantially: regular dermatologist follow-up was recorded in 23 patients (42.6%), irregular follow-up in 15 (27.8%), and no follow-up in 16 (29.6%). In cross-tabulation, ≥50% improvement was achieved by 19/23 patients with regular follow-up (82.6%), 7/15 with irregular follow-up (46.7%), and 12/16 with no documented follow-up (75.0%); this association approached significance (χ^2=5.86, Monte Carlo exact p=0.053). Kruskal-Wallis analysis showed lower median VASI improvement in the irregular group than in the regular and no-follow-up groups (H=2.39, p=0.303). Treatment fatigue was documented in only 4 cases (7.4%), but it was clinically important: only 1/4 fatigued patients achieved ≥50% improvement compared with 37/50 patients without fatigue (χ^2=4.26, Monte Carlo exact p=0.034).

Autoimmune or endocrine comorbidity was documented in 24 patients (44.4%). The commonest associated disorders were alopecia areata (9, 16.7%), hypothyroidism (8, 14.8%), Hashimoto thyroiditis (4, 7.4%), and type 1 diabetes (3, 5.6%). Comorbidity status was not significantly associated with response class (χ^2=3.22, Monte Carlo exact p=0.555). Skin type was likewise not significantly associated with responder status (χ^2=1.97, Monte Carlo exact p=0.384; Kruskal-Wallis H=2.35, p=0.309). Adverse effects were predominantly mild, with pruritus in 15 patients (27.8%), mild erythema in 14 (25.9%), and xerosis in 5 (9.3%); no severe toxicity was documented in the dataset. Inferential tests are detailed in Table 3.

Table 3. Inferential Statistics for Response and Compliance Analyses

Comparison	Statistic	P-value
Follow-up category vs responder (≥50% VASI)	χ^2 = 5.86	Monte Carlo p = 0.053
Skin type vs responder (≥50% VASI)	χ^2 = 1.97	Monte Carlo p = 0.384
Associated disease vs responder (≥50% VASI)	χ^2 = 3.22	Monte Carlo p = 0.555
Treatment fatigue vs responder (≥50% VASI)	χ^2 = 4.26	Monte Carlo p = 0.034
Skin type vs VASI improvement	H = 2.35	p = 0.309
Follow-up category vs VASI improvement	H = 2.39	p = 0.303
Composite compliance group vs VASI improvement	H = 2.27	p = 0.321

Abbreviations: NB-UVB, narrowband ultraviolet B; VASI, Vitiligo Area Scoring Index. Monte Carlo exact p-values were reported where expected frequencies were small.

Discussion

The findings of this clinical audit demonstrate that a significant percentage of Libyan vitiligo patients achieved noteworthy repigmentation following NB-UVB phototherapy. More than seventy percent of the cohort achieved at least 50% VASI improvement, and nearly one-third achieved at least 75% improvement. These findings are clinically encouraging because they originate from routine practice rather than a tightly controlled trial environment. They align with international recommendations that place NB-UVB at the center of vitiligo treatment pathways and with broader review literature showing that repeated exposure can produce worthwhile repigmentation while maintaining a comparatively acceptable

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safety profile [4, 5, 6]. The predominance of only mild erythema, pruritus, and xerosis in our audit further supports the practical tolerability of NB-UVB.

The anatomical findings require nuanced interpretation. Hands and feet were the most frequently involved sites in this cohort, which is clinically relevant because acral disease is usually the most frustrating to both physicians and patients. Within our patient cohort, clear records of acral resistance (specifically digit resistance) were frequent, occurring in approximately 40% of cases, despite these individuals maintaining a satisfactory overall VASI improvement. This underscores a critical clinical nuance: site-specific persistence can coexist with satisfactory whole-body response. Importantly, our data also demonstrated that non-acral regions, specifically the breast area, exhibited profound resistance (median VASI improvement of 13.0%). This highlights that therapeutic recalcitrance is not exclusively an acral phenomenon. Current literature supports the biological plausibility of residual acral resistance, especially on fingers and toes, where follicular melanocyte reservoirs are limited, and repigmentation potential is therefore reduced [7, 8]. For refractory lesions, whether acral or truncal, longer treatment courses, adjunctive topical therapy, or procedurally intensified strategies may be warranted [12].

Compliance barriers also emerged clearly. Irregular dermatologist follow-up was associated with a lower proportion of responders and a lower median VASI improvement than regular follow-up, although the overall association was only borderline significant after Monte Carlo correction. The unexpectedly high rate of clinically meaningful response observed in the 'no-recorded follow-up' group (75.0%) compared to the irregular group (46.7%) warrants a cautious epidemiological interpretation. This paradox most likely reflects a retrospective documentation bias rather than a genuine therapeutic trend. In routine clinical registries, patients who achieve rapid, satisfactory repigmentation early in their course frequently self-discontinue care, leading to their administrative misclassification as 'lost to follow-up' despite an optimal outcome. Conversely, those with non-responsive or worsening disease frequently return to the clinic on a sporadic basis, motivated by an ongoing search for complementary or alternative therapeutic options. Future prospective designs utilizing strict missing-data frameworks (such as intention-to-treat analysis with last-observation-carried-forward) are necessary to eliminate this classification artifact. In contrast, treatment fatigue, while recorded in only four patients, showed a statistically meaningful relationship with poorer outcome. This observation should be taken seriously because fatigue is likely under-documented in routine files; if explicitly noted in a minority of charts yet already associated with worse response, its true clinical importance may be even greater. Personalized care frameworks increasingly argue that the success of vitiligo therapy depends not only on drug or light exposure but also on expectation-setting, practical scheduling, and sustained clinician contact [9]. In a Libyan context, travel constraints, service fragmentation, or competing family responsibilities may plausibly intensify these adherence challenges, although these contributing factors remained largely unrecorded in the clinical database.

The distribution and nature of patient comorbidities in this audit offer important clinical context. Nearly half of the patients had a recorded associated autoimmune or endocrine disorder, with alopecia areata and thyroid disease leading the list. This broadly matches contemporary epidemiologic studies showing that vitiligo is frequently embedded within a wider autoimmune landscape rather than occurring as an isolated skin finding [10, 11]. The lack of a statistically significant association between comorbidity status and short-term phototherapy response in our sample should not be overinterpreted. Due to a restricted sample size and the heterogeneous nature of the coexisting diseases, this evaluation was underpowered to uncover definitive associations within the clinical subgroups. Nonetheless, the descriptive pattern is sufficient to reinforce the need for careful clinical screening, especially for thyroid dysfunction and alopecia areata in everyday dermatology practice.

When comparing this Libyan cohort with international data, a few key distinctions emerge. Our population uniquely comprised entirely Libyan patients, predominantly with darker skin types (III-V). Moreover, unlike tightly controlled clinical trials, this real-world audit highlights how attendance patterns and charting consistency can introduce wide variations in therapeutic outcomes. Finally, the frequent involvement of acral sites explains why clinician notes highlighted stubborn areas despite overall VASI progress. This underscores the need for early patient counseling; informing individuals that facial lesions respond sooner than those on fingers and toes is crucial to maintain motivation.

This evaluation is subject to the typical drawbacks of retrospective designs, most notably a limited sample scale comprising only 54 documented cases. Second, the data relied entirely on routine medical charts, meaning that detailed site-specific VASI subscores, socioeconomic barriers, and long-term relapse rates were missing. Additionally, the 'no-follow-up' group likely included both patients who stopped treatment and those with documentation gaps. Despite these limitations, this study has an important practical strength: it provides real-world clinical data on NB-UVB phototherapy outcomes in an underreported Libyan vitiligo population, highlighting key areas for clinical improvement.

Conclusion

Narrowband UVB phototherapy yielded meaningful clinical repigmentation in most evaluated cases within this Libyan cohort, proving to be a generally well-tolerated therapeutic option. However, the audit also showed that treatment success was modified by residual acral resistance, unexpected truncal resistance (specifically the breast region), and by practical barriers to continuity of care, particularly irregular follow-up and treatment fatigue.

Based on these findings, future clinical services should implement proactive pre-treatment counseling regarding the delayed response of acral lesions, alongside structured follow-up recalls to minimize patient attrition. Furthermore,

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establishing routine screening for comorbid thyroid diseases and standardizing prospective VASI documentation are essential to optimize care. Ultimately, a large-scale prospective Libyan registry is warranted to validate these observations and refine regional phototherapy pathways.

Conflict of Interest

The authors declare no conflicts of interest.

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