SKINdeep 2: e204442 (2026)
DOI: 10.1553/skindeep.2026.204442

Original Article

A descriptive cross-sectional study on the biological, behavioral, environmental, and clinical characteristics of vitiligo patients at Gampaha Wickramarachchi Ayurveda Teaching Hospital, Yakkala, Sri Lanka

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Abstract

Introduction: Vitiligo is an acquired, chronic dermatological condition characterized by the selective destruction of melanocytes. Although vitiligo has been widely studied globally, epidemiological and clinical data from Sri Lankan patients, particularly those attending Ayurvedic healthcare settings, remain limited.

Objective: To describe the biological, environmental, behavioral, clinical, and comorbidity profiles of patients with vitiligo and to examine associations between selected patient characteristics and disease phenotypes.

Methods: A hospital-based, cross-sectional descriptive study was conducted among 200 consecutive patients with clinically diagnosed vitiligo attending the Gampaha Wickramarachchi Ayurveda Teaching Hospital, Yakkala, Sri Lanka, over a 24-month period. Data were collected using a structured interviewer-administered questionnaire covering sociodemographic, biological, environmental, behavioral, clinical, and comorbidity-related variables.

Results: Among the 200 participants, with a mean age of 45.2 ± 14.2 years, 122 (61%) were female. Non-segmental vitiligo was the predominant clinical subtype (59.5%, n = 119). Chemical and environmental exposures were the most frequently reported perceived precipitating factors. A positive family history was reported by 35 (17.5%) participants and was significantly associated with disease onset before 30 years of age (p = 0.031). Participants with a disease duration of ≤3 years were significantly more likely to present with active lesion morphology (trichrome or confetti-like depigmentation) than those with a disease duration of >3 years (OR = 2.1; 95% CI: 1.4–3.2; p = 0.024). Hyperlipidemia was significantly associated with the generalized non-segmental vitiligo subtype (p = 0.041).

Conclusions: This study provides baseline epidemiological, clinical, and comorbidity data on patients with vitiligo attending a tertiary Ayurvedic healthcare setting in Sri Lanka.

Key words: Vitiligo, Ayurveda, Epidemiology, Comorbidities, Hyperlipidemia, Sri Lanka

OPEN ACCESS

Subject editor: Peter Wolf
Received: 19 June 2026
Accepted: 9 August 2026
Published: 20 October 2026

Citation: Hazari FS, Jayakody JADPP, Daranagama DADA, Sunil-Chandra NP (2026) A descriptive cross-sectional study on the biological, behavioral, environmental, and clinical characteristics of vitiligo patients at Gampaha Wickramarachchi Ayurveda Teaching Hospital, Yakkala, Sri Lanka. SKINdeep 2: e204442. https://doi.org/10.1553/skindeep.2026.204442

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1. Introduction

Vitiligo is a chronic, multifactorial dermatological disorder characterized by the progressive destruction of melanocytes, resulting from complex interactions among genetic susceptibility, autoimmune responses, and oxidative stress [1]. Clinically, the disorder presents as well-demarcated white patches on the body [2], which may be associated with itching and a burning sensation [3]. The condition is often seen early in life, with a large proportion of cases beginning at or before 20 years of age [4]. Various risk factors contribute to the onset and progression of vitiligo, including hereditary predisposition, immune system imbalance, UV exposure, environmental or physical trauma, and lifestyle influences, although the precise etiological pathways are often unclear [5].

The limited success of therapy and the prolonged duration of repigmentation worsen the psychological burden of the disease, with masking behaviors significantly affecting daily functioning, interpersonal relationships, and treatment-seeking behavior among affected individuals [6]. Although numerous studies have investigated the biological, behavioral, and environmental factors associated with vitiligo, most outcomes are context-bound and focus on populations outside the South Asian region [7]. Consequently, the epidemiological and clinical features of vitiligo in the Sri Lankan healthcare setting represent an important research gap, particularly within Ayurvedic healthcare settings, where epidemiological data remain limited. As a result, the generalizability of Western-centric findings to this population is restricted, posing a challenge for practitioners attempting to design culturally and biologically relevant management protocols.

The study was conducted at the dermatology outpatient clinic of Gampaha Wickramarachchi Ayurveda Teaching Hospital, Yakkala, Sri Lanka, a tertiary Ayurvedic healthcare institution. This hospital provides an opportunity to investigate the clinical characteristics of patients attending an Ayurvedic dermatology service. The primary objective of this investigation is to describe the biological, environmental, behavioral, clinical, and comorbidity profiles of patients with vitiligo and to examine associations between selected patient characteristics and disease phenotypes. The findings are expected to provide baseline epidemiological and clinical evidence to support future research and contribute to a better understanding of vitiligo among patients attending Ayurvedic healthcare settings in Sri Lanka.

2. Patients and methods

2.1 Study design and setting

A total of 200 consecutive patients were recruited over a 24-month (2024–2026) study period, following ethical approval from the Ethics Review Committee, Faculty of Medicine, University of Kelaniya, Ragama, Sri Lanka (Ref: P/127/09/2024). The study was conducted at the dermatology outpatient clinic of Gampaha Wickramarachchi Ayurveda Teaching Hospital, Yakkala, Sri Lanka. The recruitment period allowed for the inclusion of both recent-onset and long-standing vitiligo, providing a representative cross-section of patients attending a tertiary Ayurvedic dermatology outpatient clinic in Sri Lanka.

2.2 Selection and description of participants

The study population comprised consecutive patients clinically diagnosed with vitiligo. Eligibility criteria included patients aged 15–72 years of either sex who exhibited clinical features of vitiligo. The diagnosis was confirmed through clinical examination conducted by the principal investigator together with the consultant responsible for the specialist clinic. Exclusion criteria were restricted to pregnancy or lactating mothers and individuals unwilling to provide informed consent.

2.3 Sample size and sampling technique

Based on outpatient clinic records from the preceding year, the accessible population was estimated at approximately 192 eligible patients, assuming an average of eight new patients per month over a 24-month recruitment period. The minimum required sample size was calculated using the Yamane formula for finite populations, yielding a minimum sample of 133 participants at a 95% confidence level. As this was a descriptive cross-sectional study, the sample size calculation was based on the estimated accessible population rather than a predefined primary outcome.

To maximize representativeness, consecutive sampling was used, and all eligible patients presenting during the study period were screened for participation. During the recruitment period, 210 patients were assessed for eligibility. Of these, 10 patients were excluded for not meeting the eligibility criteria, resulting in a final analytical sample of 200 participants. The final sample exceeded the calculated minimum sample size, thereby improving the precision and representativeness of the descriptive analyses.

2.4 Data collection

Data were collected using a structured, interviewer-administered standard questionnaire, which allowed clarification of responses and minimized information bias. The questionnaire consisted of two core sections:

(1) Socio-demographic, environmental, and lifestyle data:

This section collected biological characteristics (age, gender, religion), socio-demographic factors (residence, marital status, employment, family structure), self-reported environmental exposures (physical/biological trauma, chemical/environmental irritants, photosensitivity, iatrogenic events), dietary and nutritional habits (dietary composition, daily hydration status), dietetic and hydration profiles, and physical activity and lifestyle habits (e.g., betel quid chewing).

(2) Clinical information:

Clinical information was recorded according to both conventional dermatological assessment and Ayurvedic clinical principles. The following variables were documented. Evaluated parameters included disease onset and duration, anatomical distribution of lesions, clinical subtype according to

the Vitiligo Global Issues Consensus Conference (VGICC) classification, lesion morphology (well-defined borders, trichrome patterns, confetti-like depigmentation, Koebner phenomenon), and total body surface area (BSA) involvement. Prior medical history, including allergic history and systemic comorbidities, along with previous conventional or traditional treatment history (modalities used, treatment duration, and clinical responsiveness), was documented. Previous treatment history included whether participants had received conventional Western therapy before presentation or sought primary Ayurvedic care directly. Detailed Ayurvedic treatment regimens and treatment outcomes were not collected because they were beyond the scope of this cross-sectional epidemiological study. Conventional Western therapies reported by participants included topical corticosteroids, topical calcineurin inhibitors, and phototherapy. Treatment history was obtained from participant interviews, while comorbidity status was verified using available medical records whenever possible.

2.5 Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as means ± standard deviations (SD), while categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using the chi-square test. For statistically significant associations, odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. A two-sided p value < 0.05 was considered statistically significant.

3. Results

3.1 Participant flow, baseline characteristics, and healthcare setting

A total of 210 patients were screened. Ten patients were excluded due to pregnancy (n = 3), refusal (n = 2), and incomplete screening data (n = 5). The final analytical cohort consisted of 200 participants with clinically diagnosed vitiligo.

The study population was predominantly female (61%, n = 122), with a mean age of 45.2 ± 14.2 years. Most participants (82%, n = 164) identified as Buddhists. Geographically, 82.5% (n = 165) resided in the Western Province, 78% (n = 156) were married, and 56% (n = 112) lived in nuclear family units (Table 1).

3.2 Environmental and iatrogenic triggers

Environmental determinants were identified as important precipitating factors for lesion onset or exacerbation. Mechanical and physical trauma, consistent with the isomorphic Koebner phenomenon in predisposed individuals, including physical injuries and biological trauma (e.g., snake, dog, or scorpion bites), were reported in 22.5% (n = 45) of participants. Exposure to chemical and environmental irritants such as cement dust, petrol smoke, and rat-contaminated food represented the most frequent trigger category (34.5%, n = 69). Photosensitivity (UV exposure) was a contributing factor in 8.5% (n = 17) of the cohort.

Table 1. Socio-demographic and baseline characteristics (*n* = 200).

Category	Subcategory	Number of patients (%)
Age, in years*	15–24	26 (13)
	25–34	16 (8)
	35–44	62 (31)
	>44	96 (48)
Gender	Female	122 (61)
	Male	78 (39)
Religion	Buddhist	164 (82)
	Other	36 (18)
Marital status	Married	156 (78)
	Unmarried/widowed/divorced	44 (22)
Family structure	Nuclear	112 (56)
	Extended	88 (44)
Province of residence	Western province	165 (82.5)
	Other provinces	35 (17.5)

*Mean age of cohort: 45.2 ± 14.2 years.

Psychosocial stress and iatrogenic triggers were also reported as distinct precipitating factors based on patient recall during interviews. Specifically, participants noted the appearance of depigmented patches immediately following medical treatments for wheezing or physiological interventions during pregnancy. Overall, 161 (80.5%) participants reported one or more environmental or precipitating factors, whereas 39 (19.5%) reported no identifiable trigger (Table 2). These patient-reported associations reflect perceived chronological onset rather than verified clinical causality; they highlight the potential role of systemic pharmacological stressors or physiological changes as acute triggers in susceptible individuals.

Table 2. Patient-reported environmental triggers and precipitating factors (*n* = 200).

Trigger Category	Specific Factors	Number of patients (%)
Mechanical/physical trauma	Physical injuries, biological trauma (animal/insect bites)	45 (22.5)
Chemical/environmental	Cement dust, petrol smoke, particulate matter, rat contaminated food	69 (34.5)
Photosensitivity	UV/Sunlight exposure	17 (8.5)
Iatrogenic/pharmacological	Medication-induced onset (post asthma/wheezing or pregnancy interventions)	12 (6)
Psychogenic	Psychosocial stress	18 (9)

Participants could report more than one perceived precipitating factor.

3.3 Dietary, lifestyle, and behavioral determinants

Assessment of dietary, lifestyle, and behavioral determinants revealed a high prevalence of suboptimal lifestyle practices among the study population. The majority reported inadequate hydration (<1.5 L/day), which was observed in 78.5% (*n* = 157; 95% CI: 72.5–84.1), and imbalanced dietary habits in 69.5% (*n* = 139; 95% CI: 63.1–75.9). Sedentary behavior was reported by 82.5% (*n* = 165), and only 17.5% (*n* = 35) reported engaging in regular exercise. Habitual betel chewing was practiced by 17.5% (*n* = 35) of participants.

3.4 Clinical characteristics and vitiligo morphology

Chronic disease duration exceeding 3 years was present in 39% (*n* = 78; 95% CI: 32.3–45.9) of the cohort. In accordance with international consensus criteria (VGICC guidelines), the predominant clinical presentation was non-segmental vitiligo (NSV) at 59.5% (*n* = 119), comprising the generalized subtype (45%, *n* = 90) and the acrofacial subtype (14.5%, *n* = 29). Focal/unclassified vitiligo accounted for 28.5% (*n* = 57), while segmental or other distribution patterns comprised 12% (*n* = 24). The lower limbs (74%, *n* = 148) and upper limbs (62%, *n* = 124) were the most frequently affected anatomical sites. Stable lesions with well-defined borders were observed in 66.5% (*n* = 133) of participants, whereas active trichrome patterns, confetti-like depigmentation, and Koebner phenomenon were observed in 20.5% (*n* = 41), 6.5% (*n* = 13), and 6.5% (*n* = 13), respectively (Table 3).

3.5 Medical history

Clinical assessment showed a high prevalence of allergic and systemic comorbidities among the study population. Among the 200 participants, 120 (60%) reported at least one allergic sensitivity, with mosquito bite hypersensitivity (30%, *n* = 60), nickel allergy (21.5%, *n* = 43), and food allergy (8.5%, *n* = 17) being the most frequently reported conditions. In addition, 160 (80%) participants reported at least one systemic comorbidity. Respiratory disorders (wheezing/asthma) were reported by 26% (*n* = 52), followed by rheumatoid arthritis (21.5%, *n* = 43), hyperlipidemia (18.5%, *n* = 37), and hypertension (14%, *n* = 28).

Table 3. Clinical profile, distribution (VGICC Standards), and morphology of lesions (*n* = 200).

Clinical variable	Category	Number of patients (%)	95% Confidence interval (CI)
Duration of disease in months	1–6	26 (13)	8.3–17.7
	7–12	35 (17.5)	12.2–22.8
	13–36	61 (30.5)	24.1–36.9
	> 36	78 (39)	32.2–45.8
Distribution pattern (VGICC Standards)	Non-segmental vitiligo (NSV)	119 (59.5)	52.7–66.3
	Generalized subtype	90 (45)	38.1–51.9
	Acrofacial subtype	29 (14.5)	9.6–19.4
	Unclassified/undetermined	57 (28.5)	22.3–34.7
	Focal subtype	57 (28.5)	22.3–34.7
	Segmental or other Distributions	24 (12)	7.5–16.5
Anatomical involvement	Lower Limbs	148 (74)	67.9–80.1
	Upper limbs	124 (62)	55.3–68.7
	Head and neck	86 (43)	36.1–49.9
	Trunk	64 (32)	25.5–38.5
Lesion morphology and activity	Well-defined border (stable)	133 (66.5)	60.0–73.0
	Trichrome pattern (active)	41 (20.5)	14.9–26.1
	Confetti-like depigmentation (active)	13 (6.5)	3.1–9.9
	Koebner phenomenon (active)	13 (6.5)	3.1–9.9

VGICC, Vitiligo Global Issues Consensus Conference.

Regarding prior treatment background, 43.5% (*n* = 87) of participants had a history of refractory conventional Western therapies (defined as <25% clinical repigmentation or active disease progression after ≥6 months of continuous treatment with topical corticosteroids, calcineurin inhibitors, or phototherapy). The remaining 56.5% (*n* = 113) were naïve to conventional Western treatments and sought primary traditional care directly at the Ayurvedic facility (Table 4).

Table 4. Medical history (*n* = 200).

Variable	Category	Number of patients (%)	95% CI
Allergic sensitivities	Mosquito bite hypersensitivity	60 (30.0)	23.7–36.3
	Nickel allergy	43 (21.5)	15.8–27.2
	Food allergies	17 (8.5)	4.6–12.4
Systemic conditions	Respiratory (wheezing/asthma)	52 (26.0)	19.9–32.1
	Rheumatoid arthritis	43 (21.5)	15.8–27.2
	Hyperlipidemia	37 (18.5)	13.1–23.9
	Hypertension	28 (14.0)	9.2–18.8
Prior treatment History	History of failed / refractory conventional (Western) Therapy	87 (43.5)	36.6–50.4
	Naïve to conventional care / Direct traditional therapy seeking	113 (56.5)	49.6–63.4

3.6 Disease stability and temporal progression

Participants with a disease duration of ≤3 years were significantly more likely to present with active lesion morphology (trichrome or confetti-like depigmentation) than those with a disease duration of >3 years (42.6% vs. 25.6%; $\chi^2 = 5.12$, $p = 0.024$; OR = 2.1, 95% CI: 1.4–3.2) (Table 5). These findings suggest that active disease morphology is more common during the earlier stages of vitiligo.

3.7 Genetic predisposition and clinical onset

A positive family history was reported by 17.5% (*n* = 35) of participants and was significantly associated with disease onset before 30 years of age ($\chi^2 = 4.66$, $p = 0.031$). Among participants with a positive family history (*n* = 35), 54.3%

Table 5. Associations between clinical variables.

Variable	Subgroup	Outcome variable	Number of patients (%)	χ^2 value	P-value
Disease duration	**≤ 3 years**	Active lesion morphology (Trichrome, Confetti)	52 (42.6)	**5.12**	**0.024**
		Non-active lesion morphology	70 (57.4)		
	> 3 years	Active lesion morphology (Trichrome, Confetti)	20 (25.6)		
		Non-active lesion morphology	58 (74.4)		
Family history	**Yes**	Age of onset (<30 years)	19 (54.3)	**4.66**	**0.031**
		Age of onset (≥30 years)	16 (45.7)		
	No	Age of onset (<30 years)	50 (30.3)		
		Age of onset (≥ 30 years)	115 (69.7)		
Hyperlipidemia	**Yes**	Generalized vitiligo subtype	22 (59.5)	**4.18**	**0.041**
		Other	15 (40.5)		
	No	Generalized vitiligo subtype	68 (41.7)		
		Other	95 (58.3)		

* Statistical difference was calculated by chi-square test and statistical significance set at $p < 0.05$.

(n = 19) developed vitiligo before 30 years of age, compared with 30.3% (n = 50) among those without a family history (n = 165) (χ^2 = 4.66, p = 0.031) (Table 5). These findings may support the contribution of genetic susceptibility to earlier disease onset in this study population.

3.8 Association with systemic comorbidities

Hyperlipidemia was significantly associated with the generalized non-segmental vitiligo subtype (χ^2 = 4.18, p = 0.041). Specifically, generalized NSV was observed in 59.5% (n = 22) of participants with hyperlipidemia, compared with 41.7% (n = 68) of those without hyperlipidemia (Table 5).

4. Discussion

Biological determinants such as age, gender, family history, and psychological status indicate a fundamental role in the pathogenesis and development of vitiligo [8, 9]. A previous clinical survey conducted at an Ayurveda hospital in Sri Lanka corroborated this gender distribution, reporting a higher prevalence among female patients (57%), who were more affected by vitiligo than males (43%) [10]. In the current cohort, participants ranged from 15 to 72 years, with nearly half being over 44 years old, and females comprising 61%. However, most global studies, which were conducted primarily in Western medical practice settings, have reported inconsistent findings in terms of gender prevalence, with some showing higher rates in males, others in females, and some showing no significant difference [11]. The predominance of female patients in the Sri Lankan context may reflect a greater concern for cosmetic appearance among women, whereas men may be less likely to seek healthcare services for cosmetic-related issues. Vitiligo onset can occur at any age and frequently shows a bimodal distribution, with peaks around 7 and 40 years [12]. The majority of participants in this study were Buddhist (82%), reflecting Sri Lanka's demographics, although religion has no direct influence on vitiligo pathogenesis.

In the present study, 17.5% of patients reported a positive family history of vitiligo. Scientific evidence indicates a strong genetic basis, with approximately 50 loci contributing to disease risk and associations with other autoimmune disorders [13]. In this cohort, a positive family history was significantly associated with an earlier age of clinical onset (p = 0.031), suggesting that genetic susceptibility may contribute to earlier clinical onset of vitiligo in this study population. There are no well-established differences in vitiligo prevalence among ethnic groups within Sri Lanka; however, vitiligo lesions tend to be more noticeable in individuals with darker skin tones (Fitzpatrick skin types IV–VI), including those of South Asian and African descent, which may contribute to a greater psychosocial burden in these populations [14].

Environmental and behavioral factors significantly influence the onset and progression of vitiligo [15]. In this study, most patients resided in the Western Province, reflecting the hospital's geographical location, while relatively few participants attended from other provinces. Previous Sri Lankan studies reported general skin disease prevalence but lacked detailed vitiligo-specific or regional data [16]. Ayurvedic literature also associates skin conditions with geographic regions, noting higher prevalence in hot, coastal areas (Anūpa Desha) [17].

Globally, vitiligo prevalence is nonuniformly distributed and has been reported to be higher in regions such as Africa and India [18].

Potential environmental triggers of vitiligo were identified based on participants' clinical histories. Physical trauma and biological injuries (e.g., snake, dog, or scorpion bites) were reported by 22.5% of participants. These exposures may act as triggers through the Koebner phenomenon in susceptible individuals [19]. Chemical exposure was the most frequent trigger category. Psychosocial stress and iatrogenic events, including the onset of depigmented lesions following treatment for wheezing or physiological changes during pregnancy, were also reported. Although these observations were based on patient recall and do not establish causality, they suggest that systemic pharmacological stressors or physiological changes may contribute to disease onset in susceptible individuals. Socioeconomic and demographic factors, including marital status, family structure, and education, can affect disease perception, prevention, and psychosocial impact [20]. Furthermore, occupational exposure to ultraviolet radiation, chemicals, and certain skin treatments may trigger vitiligo, in agreement with both modern medical literature and Ayurvedic texts.

Dietary, lifestyle, and behavioral determinants revealed common dietetic differences, poor hydration practices, and lifestyle habits such as limited physical activity and habitual betel quid chewing, which may increase oxidative stress and immune dysfunction and thereby contribute to disease progression [21, 22]. A high prevalence of sedentary behavior (82.5%) was observed in this cohort. Although the present study did not assess the relationship between sedentary behavior and disease severity or compare outcomes between sedentary and physically active individuals, previous studies suggest that physical inactivity may promote systemic oxidative stress and chronic low-grade inflammation, which have been implicated in melanocyte destruction [23]. From an Ayurvedic perspective, sedentary behavior may contribute to Agnimāndya (impaired digestive and metabolic function) and Āma (toxin) formation, potentially increasing tissue susceptibility (Dhātu Śaithilya). Although these traditional concepts require further scientific validation, they provide a complementary framework for understanding disease progression [3, 17].

According to the clinical characteristics data of this study, a proportion of participants reported pruritus before the appearance of depigmented lesions, which may have contributed to cutaneous trauma and subsequent Koebnerization. According to clinical criteria (VGICC standards), Non-segmental Vitiligo (NSV) was the predominant clinical presentation (59.5%), led by the generalized subtype (45%) and acrofacial subtype (14.5%), followed by unclassified/focal vitiligo (28.5%). Most patients (66.5%) presented with well-defined, stable lesion borders.

Inferential analysis demonstrated a statistically significant association between disease duration and lesion morphology ($p = 0.024$). Patients with a disease duration of ≤3 years had an OR of 2.1; 95% CI: 1.4–3.2) of presenting with active, unstable morphologies (trichrome or confetti-like depigmentation) compared with patients whose disease duration exceeded 3 years. While global real-world analyses indicate that a large majority of patients present with long-standing disease (≥4 years in 85.5% of cases) [24], our hospital-based study captured a higher frequency of active care-seeking among patients with recent-onset vitiligo.

Regarding systemic comorbidities, and consistent with the high prevalence of allergic manifestations observed in this cohort, our patients demonstrated allergic sensitivities, including mosquito bite hypersensitivity (30%), nickel allergy

(21.5%), food allergies (8.5%), and ahistory of respiratory wheezing/asthma (26%). Rather than indicating a structural epidermal barrier defect, this overlapping presentation points to systemic immune hyperreactivity. The chronic pro-inflammatory milieu in atopic individuals may lower the threshold for autoimmune activation, rendering melanocytes vulnerable to CD8+ T-cell-mediated destruction [25]. Vitiligo is associated with broad systemic conditions involving autoimmune, metabolic, and psychological disorders. A 10-year study involving 3,280 patients found that 23% had concurrent autoimmune diseases. These included thyroid disorders (9%), followed by rheumatoid arthritis (2%) [26]. Similarly, population-based real-world data have demonstrated that vitiligo is associated with systemic immune-mediated comorbidities (29.7% overall prevalence reported by Ramot et al. [24]., including atopic dermatitis (12.5%), psoriasis (5.8%), and Hashimoto's thyroiditis (2.9%).

In contrast, our primary data revealed a distinct regional comorbidity profile within this Sri Lankan cohort. Specifically, participants reported concurrent treatment for rheumatoid arthritis in 21.5%, hyperlipidemia in 18.5%, wheezing (respiratory hyperreactivity) in 26% and hypothyroidism in 4% of the patients. The substantially higher prevalence of rheumatoid arthritis (21.7%) and respiratory wheezing (25.8%) compared with previous reports may reflect referral and catchment bias inherent to this specialized Ayurvedic hospital, where patients with chronic musculoskeletal and respiratory disorders commonly seek integrative care in addition to dermatological management. Conversely, the lower prevalence of hypothyroidism compared with Western studies may be attributable to differences in routine screening practices, as asymptomatic thyroid function testing is not routinely performed in many regional healthcare settings.

Studies have identified associations between vitiligo and elevated low-density lipoprotein (LDL) cholesterol as well as altered lipid profiles, suggesting a potential role of lipid metabolism in disease pathogenesis and progression [27]. However, associations with other autoimmune and cardiovascular diseases remain inconsistent across studies [28]. In the present study, hyperlipidemia was significantly associated with generalized vitiligo. Although causal inferences cannot be drawn from this cross-sectional study, these findings suggest that lipid profile assessment may be considered, particularly in patients with generalized vitiligo, to facilitate early identification and management of metabolic risk factors.

Analyzing these findings requires considering study limitations in conjunction with current evidence. The higher prevalence of females and a positive family history imply that genetic and psychosocial elements may contribute to the development of vitiligo in this group. Behavioral and environmental determinants highlight the complex, interrelated nature of the disease and the possible involvement of factors inherent to the concept of Ayurvedic etiopathogenesis. The observed association between hyperlipidemia and vitiligo suggests a contribution of metabolic dysregulation to disease pathophysiology.

To address these intersecting pathways in clinical practice, the Ayurvedic patient-centered management protocol serves as a personalized, multidimensional clinical framework tailored to an individual's constitutional characteristics (Prakriti) and current pathological state (Vikriti). Rather than relying on a single therapeutic approach, the protocol incorporates internal purification therapies (Śodhana), when clinically indicated, oral herbal formulations selected according to the patient's clinical presentation, and localized external therapies, including

medicated oils and carefully supervised sunlight exposure, based on classical Ayurvedic principles [3, 17]. In addition, individualized dietary recommendations, lifestyle modifications, and psychosocial support form integral components of the management strategy, aiming to improve patient adherence, health literacy, and quality of life. Although further high-quality comparative studies are required to establish the effectiveness of this integrated approach, combining Ayurvedic and biomedical management may provide a comprehensive framework for addressing both the metabolic and psychosocial dimensions of vitiligo.

The primary limitation of this study is its single-center design. Although the Western Province of Sri Lanka has multiple healthcare facilities, including public Ayurvedic hospitals and secondary and tertiary biomedical institutions, this study was conducted at a single specialized Ayurvedic regional hospital. Therefore, the findings may not be representative of all patients with vitiligo in the region. Patient populations across these healthcare settings may differ with respect to referral patterns, disease characteristics, previous treatment histories, and healthcare preferences. Patients attending specialized Ayurvedic clinics may be more likely to seek holistic or integrative care, or may present after unsuccessful conventional treatment; however, these factors were not specifically evaluated in the present study. Consequently, while these findings provide valuable epidemiological information for patients attending a specialized Ayurvedic dermatology clinic, multicenter studies involving both biomedical and Ayurvedic outpatient settings are needed to improve the generalizability of these findings and better characterize regional variations in patient demographics and clinical characteristics.

Furthermore, although serum lipid profiles were systematically analyzed to evaluate metabolic status, anthropometric measurements such as body weight and body mass index (BMI) were not collected. Therefore, the relationship between hyperlipidemia, BMI, and generalized vitiligo could not be assessed. While the absence of anthropometric data limits adjustment for BMI as a potential confounding factor, the observed association between hyperlipidemia and generalized vitiligo was based on objective serum lipid measurements. Future studies incorporating both metabolic biomarkers and anthropometric assessments are warranted to further clarify this relationship.

5. Conclusions

This study provides baseline epidemiological, clinical and comorbidity data on patients with vitiligo attending a tertiary Ayurvedic healthcare setting in Sri Lanka. Non-segmental vitiligo was the predominant clinical subtype, and patient-reported environmental exposures were common. A positive family history was significantly associated with disease onset before 30 years of age, while participants with disease duration of ≤3 years were more likely to present with active lesion morphology. Hyperlipidemia was significantly associated with the generalized non-segmental vitiligo subtype, highlighting a potential relationship between metabolic health and disease phenotype. These findings may assist clinicians in the early clinical assessment of patients with vitiligo and provide baseline data for future analytical and longitudinal studies. Multicenter studies involving diverse geographical regions of Sri Lanka are recommended to improve the generalizability of these findings.

Acknowledgements

I would like to thank the directors of the Gampaha Wickramarachchi Ayurveda Teaching Hospital in Yakkala, Sri Lanka, for her support in allowing me to conduct my study in the skin clinic.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

Ethics clearance was granted by the Ethics Review Committee, Faculty of Medicine, University of Kelaniya, Ragama, Sri Lanka (Ref: P/127/09/2024). Written consent was obtained from each participant prior to data collection.

Artificial Intelligence (AI) use

The authors accept full responsibility for the content of the manuscript, including the disclosure of any use of AI. No AI tools were used in the preparation of this manuscript. InstaText (https://instatext.io/editor/) was used to improve the language after the manuscript was accepted.

Funding

Self-funded.

Author contributions

FSH was responsible for study conception and design, literature search, experimental studies, data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing, and manuscript review. JADPPJ contributed to study conception, definition of intellectual content, manuscript editing, and manuscript review, and served as guarantor of the study. DADAD contributed to the definition of intellectual content, manuscript editing, and manuscript review. SCNP contributed to the definition of intellectual content, manuscript editing, and manuscript review.

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Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

Supplementary material 1

English translation of the standardized interviewer-administered questionnaire

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Link: https://doi.org/10.1553/skindeep.2026.204442.suppl1