Dermatology Practical & Conceptual

Dermoscopy of Cutaneous Neoplasms in Skin of Color – A Systematic review by the International Dermoscopy Society "Imaging in Skin of Color" Task Force

Nkechi Anne Enechukwu[1], Biswanath Behera[2], Delaney D Ding[3], Aimilios Lallas[4], Payal Chauhan[5], Soumil Khare[6], Martyna Sławińska[7], Bengu Nisa Akay[8], Balachandra S Ankad[9], Yasmeen J Bhat[10], Abhijeet Kumar Jha[11], Feroze Kaliyadan[12], Awatef Kelati[13], Shekhar Neema[14], Nisha V Parmar[15], Jennifer Stein[16], Richard P Usatine[17], Keshavamurthy Vinay[18], Adebola Olufunmilayo Ogunbiyi[19], Enzo Errichetti[20]

1 Nnamdi Azikiwe University/Nnamdi Azikiwe Teaching Hospital Nnewi, Anambra State, Nigeria
2 Department of Dermatology and Venereology, AIIMS, Bhubaneswar, India
3 University of Florida College of Medicine, Gainesville, FL, USA
4 First Department of Dermatology, School of Medicine, Faculty of Health Sciences, Aristotle University, Thessaloniki, Greece
5 Department of Dermatology, All India Institute of Medical Sciences (AIIMS), Bilaspur, Himachal Pradesh, India
6 Department of Dermatology, Venereology and Leprosy, AIIMS, Raipur, India
7 Department of Dermatology, Venereology and Allergology, Faculty of Medicine, Medical University of Gdańsk, Poland
8 Department of Dermatology, School of Medicine, Ankara University, Ankara, Turkey
9 Department of Dermatology, Venereology and Leprosy, SN Medical College, Bagalkot, Karnataka, India
10 Department of Dermatology, Venereology and Leprology, Government Medical College, University of Kashmir, Srinagar, Jammu and Kashmir, India
11 Department of Dermatology & STD, Patna Medical College & Hospital, Patna, India
12 Department of Dermatology, Sree Narayana Institute of Medical Sciences, Ernakulum, India
13 Dermatology Department, Cheikh Khalifa International University Hospital, Mohammed VI University of Health Sciences (UM6SS), Casablanca, Morocco
14 Department of Dermatology, Venereology and Leprology, Armed Force Medical College, Pune, Maharashtra, India
15 Department of Dermatology, Rashid Hospital, Dubai Health Authority, Dubai, United Arab Emirates
16 The Ronald O. Perelman Department of Dermatology, New York University School of Medicine, New York, NY, USA
17 Department of Dermatology and Cutaneous Surgery, Department of Family and Community Medicine, University of Texas Health San Antonio, San Antonio, TX, USA
18 Department of Dermatology, Venereology and Leprology, Postgraduate Institute of Medical Education and Research, Chandigarh, India
19 College of Medicine, University of Ibadan, Oyo State, Nigeria
20 Institute of Dermatology, "Santa Maria della Misericordia" University Hospital, Udine, Italy

Key words: dermoscopy, dermatoscopy, epiluminescence, tumors, neoplasia, skin of color, dark skin, black skin, ethnic skin, dark phototype, african skin, systematic review

Citation: Enechukwu NA, Behera B, Ding DD, et al. Dermoscopy of Cutaneous Neoplasms in Skin of Color – a systematic review by the International Dermoscopy Society "Imaging in Skin of Color" Task Force. *Dermatol Pract Concept.* 2023;13(4)S1:e2023308S. DOI: https://doi.org/10.5826/dpc.1304S1a308S

Accepted: September 26, 2023; **Published:** October 2023

Copyright: ©2023 Enechukwu et al. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (BY-NC-4.0), https://creativecommons.org/licenses/by-nc/4.0/, which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original authors and source are credited.

Funding: None.

Competing Interests: None.

Authorship: All authors have contributed significantly to this publication.

Corresponding Author: Emmanouil Karampinis MD,MSc, Phd, Second Dermatology Department, School of Health Sciences, Aristotle University of Thessaloniki, Greece. Naxos Island, Cyclades, tel: 6980420401 Email: emankarampinis@gmail.com

ABSTRACT Over the last few decades, dermoscopy has been showed to facilitate the non-invasive diagnosis of both benign and malignant skin tumors, yet literature data mainly comes from studies on light phototypes. However, there is growing evidence that skin neoplasms may benefit from dermoscopic assessment even for skin of color. This systematic literature review evaluated published data in dark-skinned patients (dermoscopic features, used setting, pathological correlation, and level of evidence of studies), also providing a standardized and homogeneous terminology for reported dermoscopic findings. A total of 20 articles describing 46 different tumors (four melanocytic neoplasms, eight keratinocytic tumors, 15 adnexal cutaneous neoplasms, seven vascular tumors, four connective tissue tumors, and eight cystic neoplasms/others) for a total of 1724 instances were included in the analysis. Most of them showed a level of evidence of V (12 single case reports and six case series), with only two studies featuring a level of evidence of IV (case-control analysis). Additionally, this review also underlined that some neoplasms and phototypes are underrepresented in published analyses as they included only small samples and mainly certain tones of "dark skin" spectrum (especially phototype IV). Therefore, further studies considering such limitations are required for a better characterization.

Introduction

Cutaneous neoplasms are among the most relevant diseases in dermatologist's clinical practice as they may cause significant issues, ranging from aesthetic/functional problems to fatal outcomes, hence a timely diagnosis is of utmost importance [1,2]. In this regard, over the last decades, dermoscopy has been showed to be helpful in assisting the early recognition of both benign and malignant skin tumors, mainly in fair-skinned patients [1,2]. However, although some cutaneous neoplasms are less frequent in skin of color (Fitzpatrick's phototypes IV-VI) as the result of photoprotection provided by the higher melanin content, there is growing evidence that skin tumors may benefit from dermoscopic assessment even for darker phototypes [3]. This is of relevant interest as clinical diagnosis of such lesions may be particularly challenging in dark-skinned patients due to the lack of some clues, such as lesion shade or surface changes (e.g., pigmentation and telangiectasias) [3,4].

This review by the *International Dermoscopy Society* (IDS) Task Force on "Imaging in Skin of Color" systematically evaluated for the first time literature data on dermoscopy of both benign and malignant cutaneous neoplasms in skin of color, also attempting to correlate reported dermoscopic terminology with a standardized methodology.

Materials and Methods

This systematic review was performed in accordance with the *PRISMA* (Preferred Reporting Items for Systematic Reviews and MetaAnalyses) guidelines. A search of the papers published up to 30th June 2022 was carried out through the *PubMed* electronic database with the use of the following search terms: "dermoscopy" OR "epiluminescence" OR "dermatoscopy" AND "skin of color" OR "dark skin" OR "black skin" OR "ethnic skin" OR "dark phototype" OR "african skin" OR "indian skin". Titles and abstracts were screened by two independent reviewers to identify articles reporting dermoscopic findings of both benign and malignant skin tumors; papers on mucosal and nail neoplasms were not considered and non-English articles, reviews, personal opinions/editorials and duplicates were excluded. A manual search was also carried out by assessing the reference sections of all significant studies or reviews on the topic.

Articles considered not relevant and those not mentioning dermoscopic structures according to specific tumor were excluded after full-text reading. Only articles specifically dealing with Fitzpatrick's phototypes IV-VI were included. If information on the skin phototype was not provided, decision on inclusion was made based on a title/abstract/full text showing that the manuscript concerned "dark skin" or "skin of color" and for single cases also according to the attached figures. We also included papers from African, Indian subcontinent, and Caribbean countries as most of patients from these areas belong to IV-VI skin phototypes. Of note, studies grouping light and dark phototypes with no specific subanalyses were ruled out.

All of the retrieved studies were classified based on standard definitions for diagnostic accuracy studies [5,6] and their level of evidence was assigned according to *The Oxford*

2011 Levels of Evidence [7]. Dermoscopic findings, histopathological background (if available), dermoscopic setting (polarized *vs* non-polarized/magnification degree), skin type of the patient (if specified), and number of cases were assessed and summarized. Additionally, standardized terminology based on the IDS dermoscopic criteria for cutaneous neoplasms validated for skin of color was specified for each dermoscopic finding reported in the literature [8].

Results

The initial *PubMed* search yielded 1287 publications which were screened for relevance to the subject of review, while 10 studies were added after additional reference screening. A total of 29 items were admitted for full-text reading after title and abstract screening and excluding duplicates. Of these, nine papers were ruled out according to the exclusion criteria, with final selection of 20 articles for the review process. Figure 1 shows the flow chart summarizing the study selection procedure.

The full-text review included six single case-reports, 12 case-series, and two case-control studies, thus a proportion of 10% of the studies showed a level of evidence of IV, while the rest of the studies displayed a level of evidence of V. Fourty-six different tumors were evaluated (also considering relevant subtypes with clinical/dermoscopic peculiarities), including four melanocytic neoplasms, eight keratinocyte tumors, 15 adnexal cutaneous neoplasms, seven vascular tumors, four connective tissue tumors, and eight cystic neoplasms/others; a total of 1724 instances were retrieved. Table 1 displays the number of studies and total number of included patients for each condition.

Dermoscopic setting (polarised *vs* non-polarised) was reported in 8/20 records (3 polarized; 3 non-polarized; 2 both), magnification in 7/20 records (6: x10 magnification; 1: x20 magnification), and dermoscopic-pathological correlation in 4/20 records. Supplemental Table summarizes all such data, along with analytical description of each of the study evaluated in the review (number of patients, type of study and level of evidence), dermoscopic features, skin type of the patient, and corresponding terminology according to the IDS dermoscopic criteria for cutaneous neoplasms validated for skin of color. Table 1 also shows the general prevalence (calculated from all data reported in the literature) of dermoscopic findings of included tumors for which a standardized terminology was available. Relevant findings for each neoplasia are reported as follows; for practical purpose, we have grouped them according to the cellular/tissue origin. Figures 2-6 show dermoscopic clues of such conditions.

Melanocytic Neoplasms

Melanocytic Nevi

Dermoscopy of melanocytic nevi has been reported to vary based on the histological subtype, localization, and skin tone (in the spectrum of Fitzpatrick's phototypes IV-VI) [9-13]. According to a case-control study by Lallas *et at* involving 300 patients (excluding facial and acral lesions), the main morphological patterns of common acquired melanocytic nevi included reticular, globular and structureless, whereas the most frequent pigment arrangements turned out to be uniform and "central hyperpigmentation" [9]. Such findings are consistent with data coming from other studies (a case-control study [10] and a case-series [11]) including a total of 455 lesions. Of note, structureless pattern and black,

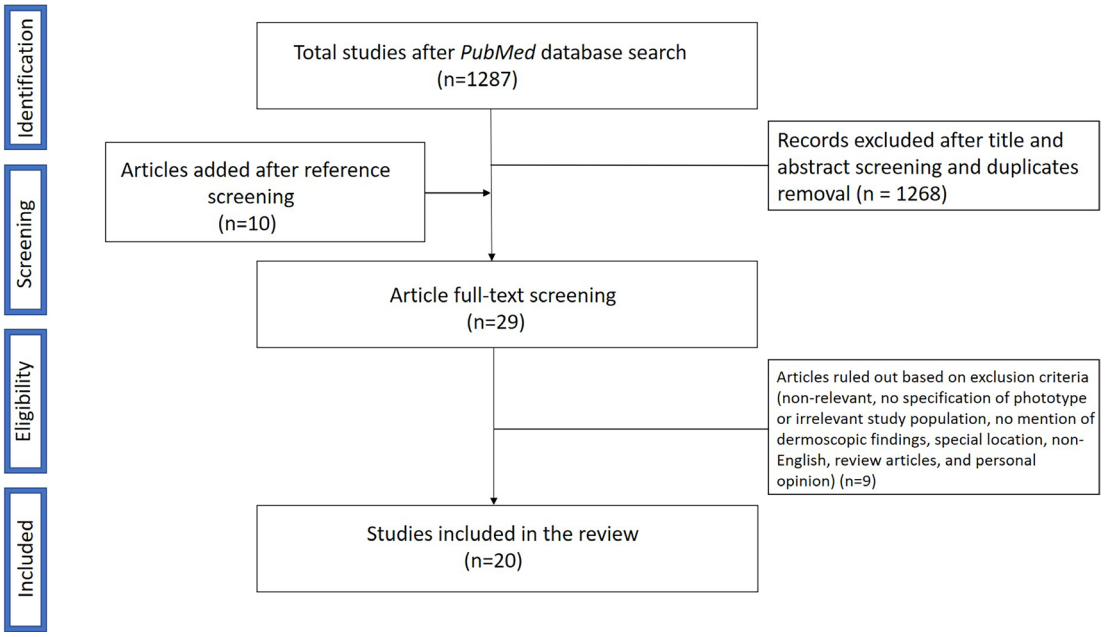

Figure 1. PRISMA flowchart displaying the selection process for study inclusion in the systematic review.

Table 1. Total number of studies, patients and prevalence of standardized dermoscopic findings of cutaneous tumors in skin of color.

Tumor	Total number of studies	Total number of instances [instances with dermoscopy prevalence data]	Dermoscopic findings* (total prevalence)**
Melanocytic neoplasms			
Melanocytic nevi			
Acral melanocytic nevi	1	396 [396]	*Common findings:* - *Less common findings:* Lines, parallel, thin, in the furrows (43%); Lines, parallel, thin, in the furrows and crossing the ridges (13%); Lines, parallel, short, crossing ridges (7%); Structureless (10%); Lines, parallel, thick, on the ridges (1%)
Blue nevus	1	4 [4]	*Common findings:* Structureless, blue (100%) *Less common findings:*
Melanocytic nevi (not considering specific sites or histological types)	3	755 [755]	*Common findings:* Color: brown (76%) *Less common findings:* Lines, reticular (48%); Black color (20%); Structureless (16%); Lines, reticular (10%); Clods, small, round or oval (7%); Lines, reticular/structureless (7%); Grey color (7%); Blue-gray color (7%); Blue color (6%); Clods, small, round or oval + lines, reticular (3%); Lines, reticular + structureless (3%); Clods, small, round or oval/lines, reticular (3%); Clods, small, round or oval + structureless (1%); Lines reticular/clods, small, round or oval (1%); Pseudopods, circumferential or lines, radial, circumferential (0.6%); Red color (0.4%); White color (0.3%)
Melanoma (acrolentiginous, excluding nails)	2	9 [9]	*Common findings:* Lines, parallel, thick, on the ridges (100%); Structureless, brown, blue, black (89%); Lines, parallel, short, crossing ridges (51%) *Less common findings:* Erosion/ulceration (22%); Structureless zone, blue (11%); Irregular clods, small (11%); Lines, radial (always at periphery) (11%)
Keratinocytic tumors			
Basal cell carcinoma (BCC)	4	109 [109]	*Common findings:* Dots, gray, blue or black (62%) *Less common findings:* Erosion/ulceration (46%); Lines, radial, connected to a common base (43%); Blue-white veil (29%); Lines, reticular, hypopigmented, around brown clods (28%); Structureless zone, red-white (22%); Lines, radial, converging to a central dot or clod (19%); Clods, blue to brown, large, clustered (18%); Dots or clods, white, clustered or disseminated (17%); Structureless zone, brown or black (11%); Clods, brown, yellow, or orange (rarely black) (11%); Branched vessels (11%); Clods, brown-blue, small (10%); Lines, reticular and thick (perilesional) (9%); Clods, blue, large, clustered (8%); Dots, blue and clods, blue, small (8%); Clods, white, shiny (8%); Circles, concentric (7%); Lines, radial (always at periphery) (6%); Structureless zone, white, central (5%); Looped vessels (3%); Follicular plugs (2%); Serpentine vessels (2%); Dot, non-specified color (2%); Structureless zone, blue (2%); Structureless zone, white (0.9%); Dots, brown (0.9%); Lines, white, perpendicularly (0.9%)
Keratoacanthoma	1	3[0]	*Common findings:* - *Less common findings:* -

Seborrheic keratosis(SK)			
Classic SK	2	30[0]	*Common findings:* - *Less common findings:* -
Dermatosis papulosa nigra	1	100 [100]	*Common findings:* Lines, curved and thick (59%) *Less common findings:* Clods, brown, yellow, or orange (rarely black) (27%); Dots or clods, white, clustered or disseminated (8%)
Squamous cell carcinoma in situ (Bowen's disease)	4	11[11]	*Common findings:* Dots, gray, blue (in a peripheral clustered or linear arrangement) (64%) *Less common findings:* Dots, brown, gray, blue (36%); Clods, brown (36%) Structureless zone, grey-white (36%); Coiled vessels, clustered (27%); Erosions/ulcerations (18%); Lines, radial (always at periphery) (18%); Coiled vessels (peripheral) (9%); Lines, blue-grey (radial) (9%); Looped vessels (9%); Lines, white (9%); Vessels (9%); Structureless, brown, and blue-grey (9%); Coiled vessels (9%); Clods (9%); Structureless, gray-black (9%)
Squamous cell carcinoma (SCC)			
Pigmented	1	3[3]	*Common findings:* - *Less common findings:* Circles, white (33%)
Non-pigmented	1	4[4]	*Common findings:* Circles, white (75%); Erosions, ulcerations (75%); Dots, vessels (50%) *Less common findings:* Linear, irregular (25%); Clods, white, shiny (25%)
Not specified	1	4[0]	*Common findings:* - *Less common findings:* -
Adnexal cutaneous neoplasms			
Apocrine hidrocystoma	2	10[8]	*Common findings:* Structureless, gray (100%) *Less common findings:* Dots, brown (13%); Branched vessels (13%)
Dilated pore of Winer	1	2[2]	*Common findings:* Follicular plug (100%); Structureless zone, blue (100%) *Less common findings:* -
Eccrine hidrocystoma	1	6[6]	*Common findings:* Structureless area, brown (100%) *Less common findings:* -
Eccrine syringofibroadenoma	1	1[1]	*Common findings:* Clods, brown or skin colored, large and polygonal (100%); Structureless zone, gray, white, or yellow (100%); Dots, white (100%) *Less common findings:* -
Nevus comedonicus	1	1[1]	*Common findings:* Clods, brown, yellow, or orange (rarely black) (100%); Follicular plugs (100%) *Less common findings:* -
Nevus sebaceous	1	7[7]	*Common findings:* - *Less common findings:* Structureless, yellow-gray (43%); Structureless, yellow, yellow- white (43%); Clods, large (43%); Lines, curved and thick, in combination with clods (29%); Dots or clods, white, clustered or disseminated (14%); Lines, curved and thick (14%); Looped vessels (14%); Linear vessels (14%)

Table 1 continues

Table 1. Total number of studies, patients and prevalence of standardized dermoscopic findings of cutaneous tumors in skin of color. *(continued)*

Tumor	Total number of studies	Total number of instances [instances with dermoscopy prevalence data]	Dermoscopicfindings* (total prevalence)**
Nodular hidradenoma	1	1[1]	*Common findings:* Structureless, white-gray (100%); Erosions/ulcerations (100%); Dots, gray or blue (100%); Polymorphous vessels (100%) *Less common findings:* -
Pilomatrixoma	1	1[1]	*Common findings:* Structureless, brown/yellow (100%); Lines, reticular (100%) *Less common findings:* -
Poroma	1	4[4]	*Common findings:* Branched vessels (100); Structureless area, white (100%); Structureless, yellow/yellow-brown (50%); Linear vessels (50%); Looped vessels (50%); Polymorphous vessels (50%) *Less common findings:* Structureless zone, brown or blue-gray (25%)
Reactive eccrine syringofibroadenoma	1	2[2]	*Common findings:* Structureless, gray/gray-white (100%); Clods, large and polygonal (100%) *Less common findings:* -
Sebaceous adenoma	1	1[1]	*Common findings:* Structureless, yellow/yellow-brown (100%); Clods, small, round or oval (blue-grey) (100%); Dots, brown (100%); Linear vessels (100%) *Less common findings:* -
Sebaceous hyperplasia	2	28[26]	*Common findings:* Structureless yellow/yellow-brown (100%) *Less common findings:* Linear vessels, radial (46%); Dots, gray or blue (31%); Branched vessels (4%)
Trichoblastoma	1	1[1]	*Common findings*: Structureless, brown (100%) Dots or clods, white (100%); Structureless, white (100%) *Less common findings:* -
Trichoepithelioma (familial)	1	4[4]	*Common findings:* Structureless zone, brown + dots or clods, white, clustered or disseminated (100%); Dots, brown (100%); Linear vessels (75%); Structureless zone, white (50%); Branched vessels (50%) *Less common findings:* Linear vessels, radial (25%)
Trichoepithelioma (solitary)	1	6[6]	*Common findings:* Structureless, brown/white (100%); Dots or clods, white, clustered or disseminated (100%) *Less common findings:* Dots, brown (33%); Linear vessels (17%))
Vascular tumors			
Angiofibroma			
Facial	3	9[5]	*Common findings:* Dots, yellow/white (100%); Structureless, brown, red-brown (80%); Dots, brown (80%) *Less common findings:* -
Penile	1	4[0]	*Common findings:* - *Less common findings:* -

Angiokeratoma	1	1[1]	*Common findings:* Clods, red-purple (100%); Lines, white (100%) *Less common findings:* -
Cherry angioma	1	10[10]	*Common findings:* Clods, red or purple (100%) *Less common findings:* Lines, reticular (peripheral), brown (20%)
Infantile hemangioma	1	1[1]	*Common findings:* Clods, red or purple (100%); Lines, white (100%) *Less common findings:*
Lymphangioma circumscriptum	1	3[0]	*Common findings:* - *Less common findings:* -
Pyogenic granuloma	1	39[0]	*Common findings:* - *Less common findings:* -
Connective tissue tumors			
Dermatofibroma	4	112[112]	*Common findings:* Lines, reticular (71%); Structureless zone, white (63%) *Less common findings:* Lines: peripheral (41%); Structureless zone, white: central (36%); Structureless zone, brown (32%); Vessels (27%); Structureless zone, white: multifocal (27%); Structureless zone, brown: central (24%); Vessels: curved (21%); Vessels: dots (21%); Clods, small, round or oval (16%); Lines, white, perpendicularly (16%); Lines: multifocal (16%); Lines: uniform (14%); Vessels: linear (12%); Erosions/ulcerations (5%); Lines, radial (5%); Structureless zone, brown: peripheral (5%); Lines, reticular and thin (peripheral) (5%); Structureless zone, brown (central) (3%); Structureless zone, brown: eccentric (3%); Clods, brown, yellow, orange (rarely black) (3%); Lines, reticular, hypopigmented, around brown clods (3%); Dots or clods, white, clustered or disseminated (2%); Lines, reticular and thick or reticular lines that vary in color (1%); Structureless zone, blue-white (central) (1%); Lines, reticular and thin (1%); Structureless zone, white (central) (1%)
Dermatofibrosarcoma protuberans	2	2[1]	*Common findings:* Lines, reticular and thick or reticular lines that vary in color (100%); Lines, white, perpendicularly (100%); Serpentine vessels (100%) *Less common findings:* -
Fibrokeratoma	1	5[0]	*Common findings:* - *Less common findings:* -
Neurofibroma	1	4[0]	*Common findings:* - *Less common findings:* -

Table 1 continues

Table 1. Total number of studies, patients and prevalence of standardized dermoscopic findings of cutaneous tumors in skin of color. *(continued)*

Tumor	Total number of studies	Total number of instances [instances with dermoscopy prevalence data]	Dermoscopic findings* (total prevalence)**
Cystic neoplasms and others			
Epidermal cyst	2	11[4]	*Common findings:* - *Less common findings:* Structureless, yellow (25%); Structureless, gray (25%); Structureless zone, brown (25%)
Milia	1	3[0]	*Common findings:* - *Less common findings:* -
Trichilemmal cyst	1	5[5]	*Common findings:* - *Less common findings:* Structureless, brown (40%); Structureless, white + branched vessels (20%); Structureless zone, white (central or uniform) +/- structureless zone, brown/ lines, brown, curved, parallel, thin (20%); Structureless zone, white (central) +/- lines, brown, curved, parallel, thin (20%); Dots, gray, blue or black (20%)
Steatocytoma multiplex	1	1[0]	*Common findings:* - *Less common findings:* -
Mycosis fungoides (MF)			
Classic MF	1	4[0]	*Common findings:* - *Less common findings:* -
Hypopigmented MF	1	4[0]	*Common findings:* - *Less common findings:* -
Folliculotropic MF	1	1[0]	*Common findings:* - *Less common findings:* -
Verrucous MF	1	2[0]	*Common findings:* - *Less common findings:* -

*Dermoscopic findings for which a standardized terminology was available; these are divided into common (prevalence ≥ 50%) and less common (prevalence < 50%)

**Total prevalence is calculated only considering studies for which prevalence data of dermoscopic findings was available

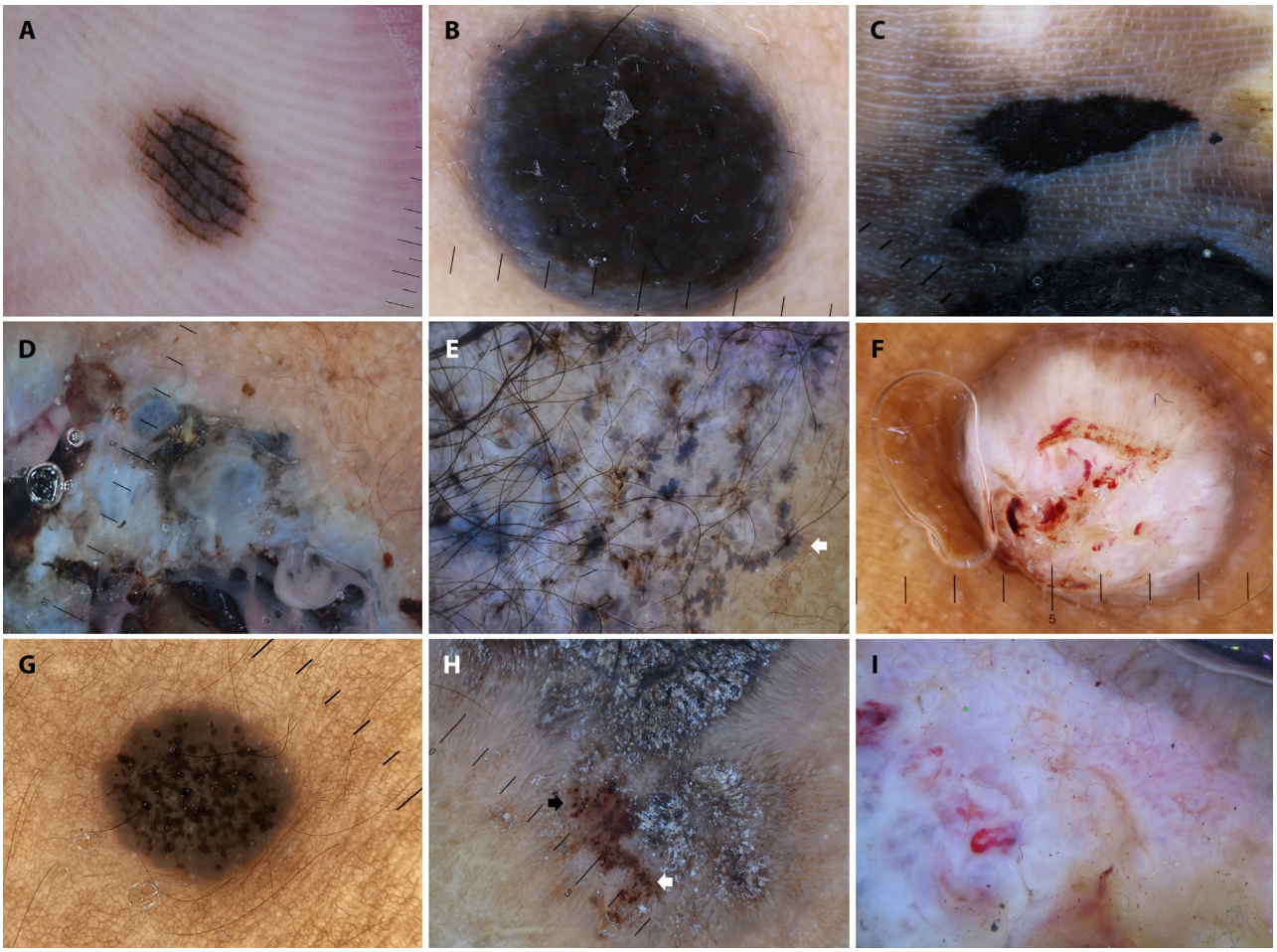

Figure 2. Examples of dermoscopic clues of melanocytic neoplasms/keratinocytic tumors in dark-skinned patients: Brown lines (parallel, thin) in the furrows in acral melanocytic nevus (A); Structureless blue and black areas in blue nevus (B); Structureless blue and black areas along with brown lines (parallel, thick) on the ridges in acrolentiginous melanoma (C); White, black and blue structureless areas along with ulceration/erosions in nodular basal cell carcinoma (D); Numerous radial lines connected to a common base (spoke wheel-like areas) (arrow) and a diffuse white structureless area in superficial basal cell carcinoma (E); Central hyperkeratosis and hemorrhagic areas over a diffuse white structureless area surrounded by a brown halo in keratoacanthoma (F); Multiple brown and black dots and clods in seborrheic keratosis (G); Multiple brown dots (white arrow) and few dotted vessels (black arrow) along with diffuse white-brown hyperkeratosis in Bowen's disease (H); Linear, irregular vessels over a diffuse white structureless area in squamous cell carcinoma (I).

blue and grey color were observed more common in Fitzpatrick skin type VI patients, while skin type V individuals mainly showed dark brown reticular pattern [9].

Moving to special sites, Madankumar *et al* found parallel furrow pattern to be the most common presentation of acral melanocytic nevi in a case-series on 369 lesions [12]. On the other hand, pigmented pseudonetwork was reported as the pattern of facial melanocytic nevi in a case-series by De Giorgi *et al*, yet no specification on the number of included lesions was mentioned [11]. The same study reported blue homogeneous pattern as a constant finding in four instances of blue nevi [11].

Melanoma

All the data retrieved from the literature concerned acral lentiginous melanoma (ALM). Most of the information comes from the study (case-series) by Manci *et al* involving a total of eight dermoscopic instances, that constantly showed structureless areas with multiple shades of brown, blue, black, and pink colors [13].

Other common findings (more than two-thirds of cases) included parallel ridge pattern, diffuse plantar lentigines, and parallel ridge pattern of surrounding skin [13]. Fibrillar pattern of surrounding skin, peripheral hypopigmentation, ulceration, and atypical fibrillar pattern were less frequent features [13]. No specification about melanoma thickness was reported for all the above-mentioned instances [13].

Finally, irregular streaks, irregular globules, and blue-whitish veil were detected in a case of invasive ALM (Breslow's thickness: 1.2 mm) by De Giorgi *et al* [11].

Keratinocytic Tumors

Basal Cell Carcinoma

The main study on dermoscopy of basal cell carcinoma (BCC) is a retrospective observational analysis (case-series)

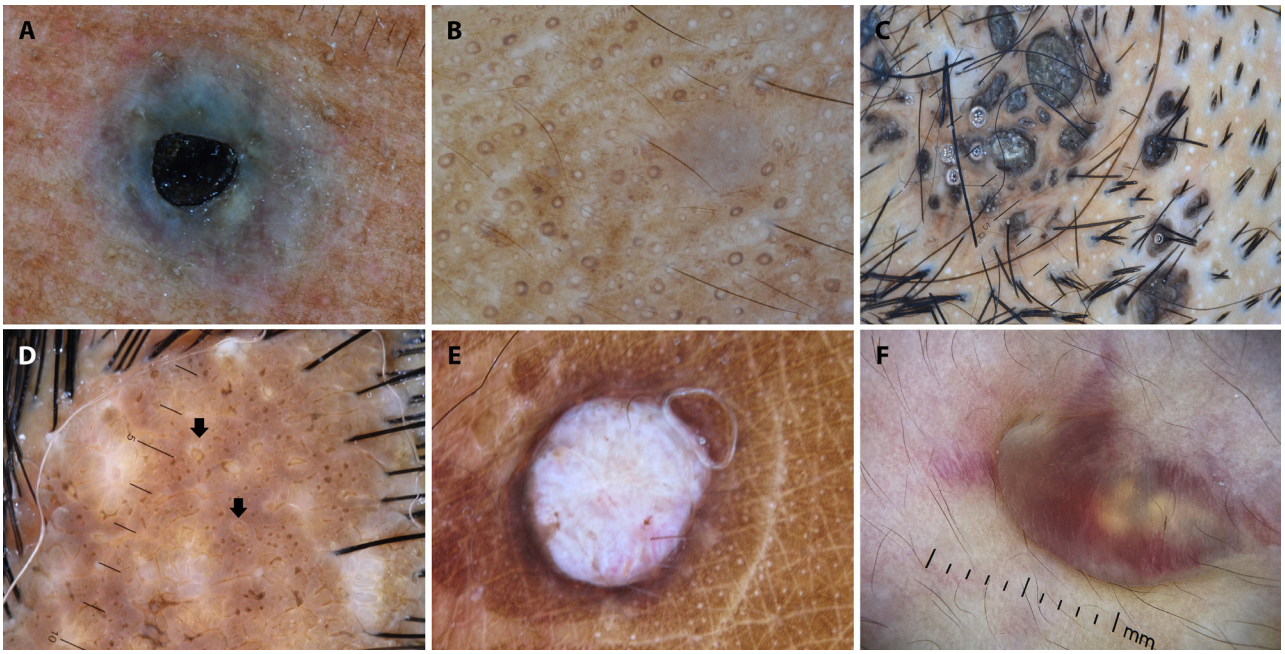

Figure 3. Examples of dermoscopic clues of adnexal tumors in dark-skinned patients: Central black follicular plug surrounded by a blue structureless zone in dilated pore of Winer (A); Brown-blue structureless area in eccrine hidrocystoma (B); Multiple brown-black follicular plugs in nevus comedonicus (C); Yellow-brown and white structureless areas (in some point featuring lines, curved and thick – "cerebriform pattern") along with white-yellow clods (arrows) in sebaceous nevus (D); White structureless area in nodular hidradenoma (E); Yellow-white structureless areas over a red-brown diffuse structureless area in pilomatrixoma (F).

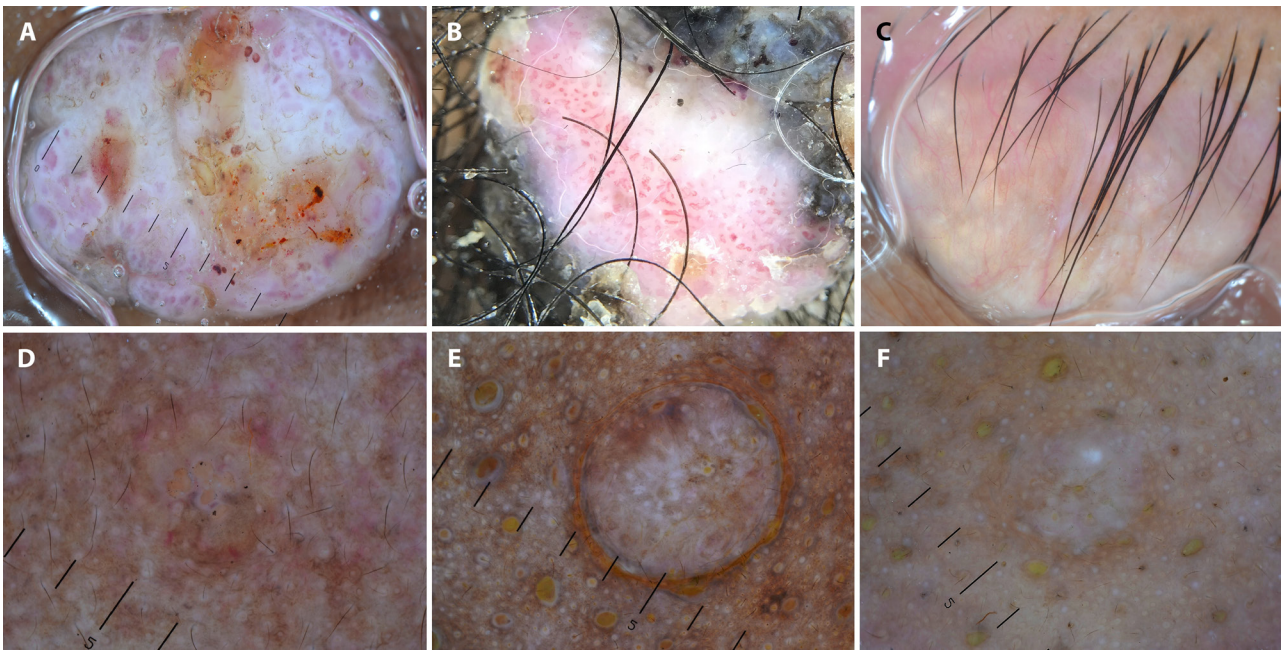

Figure 4. Examples of dermoscopic clues of adnexal tumors in dark-skinned patients: Erosions and dotted vessels surrounded by white halo in eccrine poroma (A); Dotted and looped vessels surrounded by white halo in eccrine poroma (B); Yellow structureless areas and linear vessels in sebaceous adenoma (C); Yellow clods and yellow-brown structureless area in sebaceous hyperplasia (D); White structureless areas in trichoblastoma (E); White structureless area along with a white clod in trichoepithelioma (F).

by Behera *et al* on 60 lesions (32 nodular, 27 superficial and 1 infiltrative subtype) [14]. The most common features of nodular BCC were ulceration (84.3%) and blue-white veil (81.2%), followed by brown to blue-gray ovoid nests (40.6%), whereas maple leaf-like area (92.5%), red-white homogenous area (66.6%), multiple small erosions (59.2%), short fine telangiectasia (59.2%), spoke wheel-like areas (55.5%) turned out to be the main findings of superficial

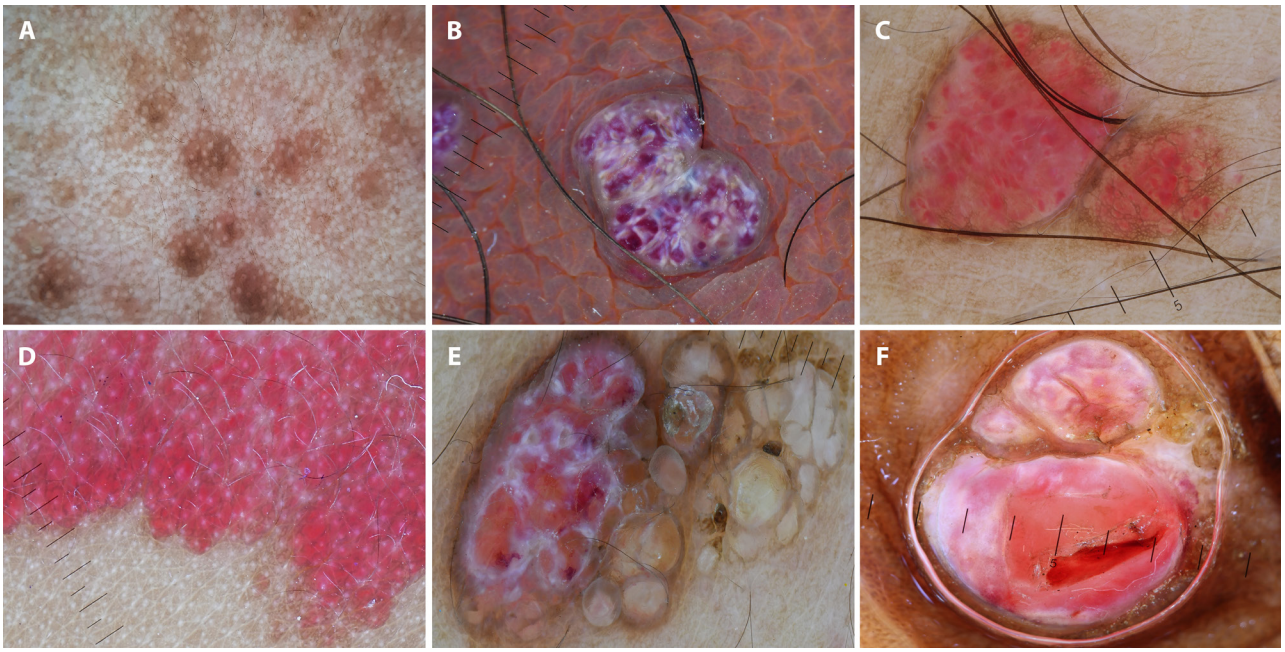

Figure 5. Examples of dermoscopic clues of vascular tumors in dark-skinned patients: Brown structureless area with white dots in facial angiofibroma (A); Red-purple clods separated by white lines in angiokeratoma (B); Red clods with reticular white lines and peripheral brown reticular lines in cherry angioma (C); Red clods separated by brown lines in infantile hemangioma (D); Yellow and red-brown clods separated by white or brown lines in lymphangioma circumscriptum (E); Red structureless areas along with white structureless areas in pyogenic granuloma (F).

BCC [14]. Notably, the prevalence of all the aforementioned features was found to be statistically significant for the corresponding subtype (nodular *vs* superficial) [14]; arborizing vessels were also indicative of nodular BCC, though they were seen only in 37.5% of cases [14].

Besides the detection of shiny white blotches/strands and pigmented structures (mainly leaf-like areas, blue-gray ovoid nests, and multiple blue-gray dots/globules) in half lesions (9/18), Manci *et al* also commonly observed loss of normal background pigmentation/network (72.2%), milky red area (66.7%), and accentuated normal background pigmentation/network surrounding the lesion (55.6%) [13]. Importantly, no specification about the histological subtype was provided in this dermosopic analysis [13].

Additional dermoscopic findings retrieved from the two above-mentioned studies [13,14] and other analyses (one case-series on 30 patients [15] and one single case-report [16]) included negative pigment network, concentric structures, brown to blue to blue-gray aggregates, coarse peppering, peripheral striations, follicular plugging, peri-follicular white rings, brown to black blotch, adherent fabric fibers, milia-like cyst, comedo-like opening, in-focus dots, central or peripheral hypopigmentation, atypical vessel running across the lesion, hemorrhages, hairpin vessels, linear-irregular vessels, chrysalis-like structures, multiple aggregated yellow/white, and scales/crusts.

Keratoacanthoma

The only available data on keratoacanthoma comes from a case-series including three lesions that displayed keratin-related structures, including white scales/crusts, yellow/orange crusts and central white areas, along with radially arranged hairpin vessels, linear-irregular vessels, hemorrhages, and brown areas [15]. Of note, no specific data on their prevalence of such findings was provided [15].

Seborrheic Keratosis

Dermoscopy of seborrheic keratosis has been investigated in two descriptive studies (case-series) involving a total of 30 instances (15 for each analysis) [11,15]. Reported findings included "moth eaten" borders, comedo-like openings, milia-like cysts, "fat fingers", cerebriform pattern, "finger print" pattern, surface white scaling, and "parchment-like" thick crust [11,15]. Of note, prevalence of each of the aforementioned findings was not specified; vessels were absent in all cases [11,15].

Moving to dermatosis papulosa nigra (a variant of seborrheic keratosis commonly seen in dark phototypes), an observational study (case-series) on 100 patients by Bhat *et al* found cerebriform pattern to be the main feature (59% of cases), followed by comedo-like openings (27% of cases), while milia-like cysts were observed only in 8% of instances [17].

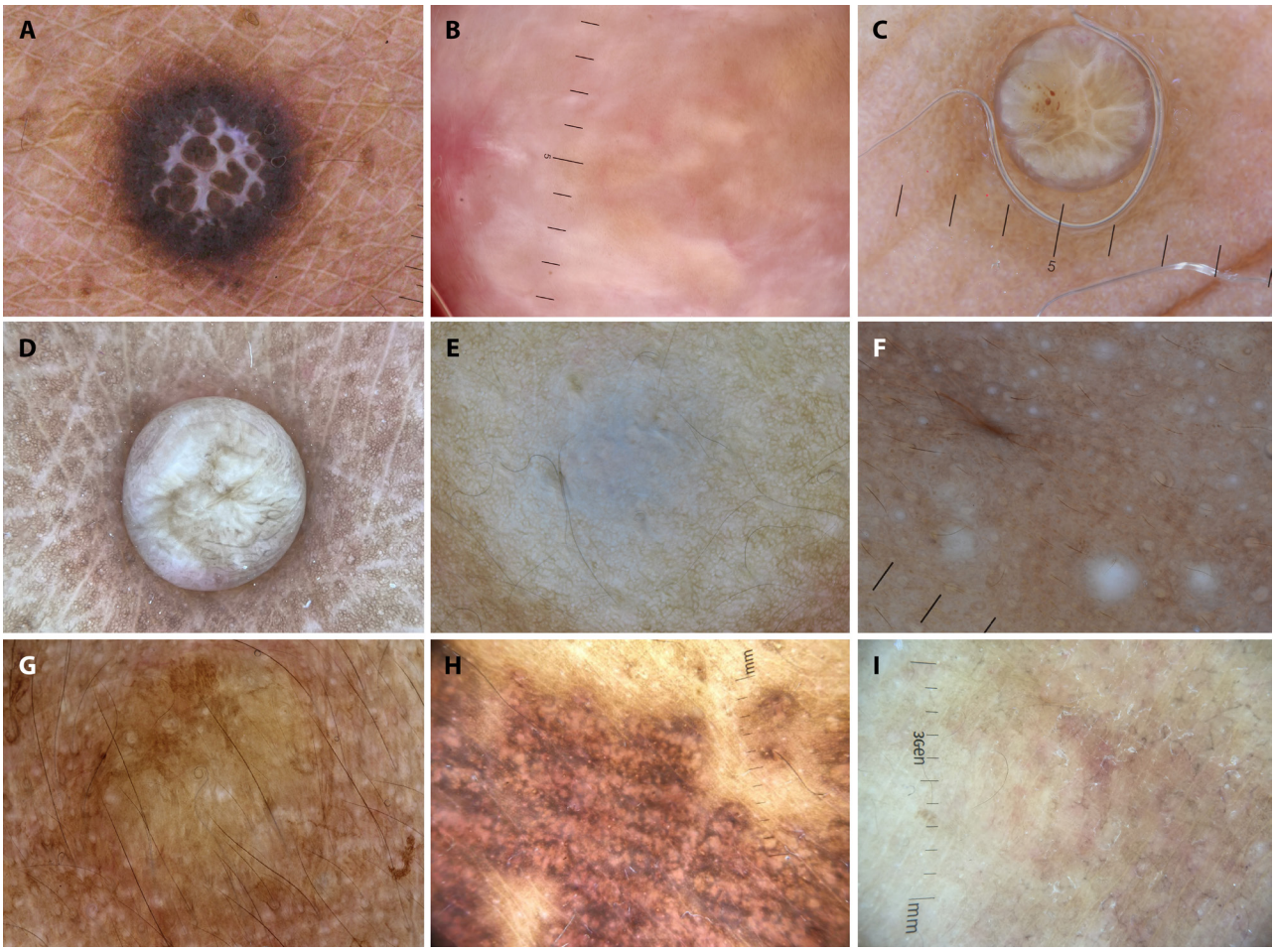

Figure 6. Examples of dermoscopic clues of connective tissue tumors, cystic neoplasms and others in dark-skinned patients: Brown structureless area with perpendicular white lines in dermatofibroma (A); White as well as brown structureless areas in dermatofibrosarcoma protuberans (B); Brown structureless areas and white structureless areas and lines in fibrokeratoma (C); White structureless areas in neurofibroma (D); Blue-grey structureless area in epidermal cyst (E); White structureless areas/clods in milia (F); Yellow structureless area in sebaceous cyst (steatocytoma multiplex) (G); Brown thick reticular lines in patch-stage mycosis fungoides (H) (adapted from *Dermoscopy in General Dermatology for Skin of Color*, Errichetti E, Lallas A, eds. CRC Press 2021); White structureless area with a few brown lines in hypopigmented mycosis fungoides (I).

Squamous Cell Carcinoma in Situ (Bowen's Disease)

The main study on dermoscopy of Bowen's disease is a case-series including eight lesions (seven pigmented and one non-pigmented) by Behera *et al*, who found brown to blue-gray dots/globules (in a peripheral clustered or linear arrangement) to be the main finding (7 lesions), followed by scales (6 lesions) and light to dark brown keratotic structureless areas (5 lesions) [18]. Such structures were also detected in other three single reports [15,19,20].

Additional findings included clustered (and less commonly peripheral) glomerular vessels, brown to blue-gray peppering (fine and coarse), blue-grey radial lines, ulcerations/erosions, blood spots/crusts, hairpin vessels, ring-like pattern, ill-defined gray outer border, well-defined thin brown outer border, interconnecting white lines, and grey-white/red-white areas [18].

Squamous Cell Carcinoma

Most of data on dermoscopic findings of squamous cell carcinoma (SCC) comes from a case-series by Manci *et al* on seven instances, including three pigmented and four non-pigmented lesions [13]. In detail, adherent scales with pigment and peripheral hypopigmentation with loss of pigmented network in surrounding skin were constant findings of pigmented SCC, while non-pigmented mainly showed adherent white scale (100%) along with white circles and ulceration (both 75%) [13].

Further features for pigmented SCC included milky-red areas and white circles, while dotted vessels, serpentine vessels, shiny white strands, peripheral hypopigmentation with loss of pigmented network seen in surrounding skin, and peripheral islands of hyperpigmentation turned out to be additional findings of non-pigmented SCC [13].

In a descriptive analysis (case-series) including four SCCs, Ankad *et al* observed white and red structureless areas, along with ulcerations, blood spots and polymorphic vascular pattern (i.e., dotted, linear-irregular, arborizing, atypical, unspecific and hairpin vessels); no specification about subtype (pigmented *vs* non-pigmented) and prevalence of dermoscopic findings was available [15].

Adnexal Cutaneous Neoplasms

Apocrine Hidrocystoma

A total of 10 lesions have been assessed by two case-series [15, 21]. Grey homogenous area was found to be a constant finding by Behera *et al* in a series of 8 lesions, whereas peripheral erythema, light brown peppering and arborising vessels were observed less commonly [21].

On the other hand, Ankad *et al* by analyzing two lesions reported yellowish-brown homogeneous area covering whole lesion, linear irregular vessels running across the lesion, and white globules, yet specific data on their prevalence were not specified [15].

Dilated Pore of Winer

Two instances of dilated pore of Winer have been retrieved, with central black keratotic plug and bluish white homogenous areas being described in both the cases [21].

Eccrine Hidrocystoma

Data on dermoscopy of eccrine hidrocystoma comes from the observational study (case-series) by Behera *et al*, who assessed six lesions from a single patient and constantly found a skin-colored homogenous area [21].

Nevus Sebaceous

Seven instances of nevus sebaceous (without secondary tumors) were evaluated by dermoscopy, with the main features being papillary to knob-like pattern with a yellow to grey background and yellow to yellow-white homogenous area/ovoid nest (both observed in three lesions) [21]. Additional findings included linear irregular crypts, cerebriform pattern, milia-like cysts, hairpin vessels, and linear vessels [21].

Poroma

Four cases reporting dermoscopic findings of poroma have been retrieved from the literature. In detail, diffuse white structureless area and branched vessels with a round ending were seen in all lesions, while further features included focal yellow to yellow-brown structureless area, linear or hairpin vessels, polymorphous vascular pattern, and brown to blue-grey blotch [21].

Sebaceous Hyperplasia

The main dermoscopic study on sebaceous hyperplasia is an observational analysis (case-series) including 26 lesions from six patients [21]. Yellow/yellow-brown homogenous area and single to multiple puncta were seen in all instances, whereas fine brown to blue-grey peppering, crown vessels, linear-branching vessels were additional findings [21]. Besides yellow globules and crown vessels, pale white septae and patulous follicles were also found in another series of two instances [15].

Syringoma

Most of data on dermoscopy of syringomas comes from the analysis (case-series) by Behera *et al* including 119 lesions (1 chondroid syringoma, 24 non-pigmented syringomas, 64 pigmented syringomas, 10 milium-like syringomas, and 20 eruptive syringomas) from 16 patients [21]. The main finding shared by all the subtypes (apart from chondroid syringoma) was the presence of milia-like cysts [21]. Other common general features included yellow/yellow-brown homogeneous area and pigment network [21]. Such findings are in line whit what observed by Ankad *et al* in five instances of syringoma [15].

Trichoepithelioma

One study assessing dermoscopy of ten trichoepitheliomas (six solitary and four familial) from nine patients is available [21]. Skin-colored to white homogenous area with milia-like cysts was a constant finding in both solitary and familial lesions; additionally, fine brown peppering was also detected in all familial instances [21]. Further features included focal white homogenous area and linear, arborizing and crown vessels [21].

Other Adnexal Cutaneous Neoplasms

This group includes adnexal cutaneous tumors retrieved in the review analysis whose dermoscopic data is based on single reports/small series, i.e., eccrine syringofibroadenoma, nevus comedonicus, nodular hidradenoma, pilomatrixoma, reactive eccrine syringofibroadenoma, sebaceous adenoma, and trichoblastoma [21]. Reported dermoscopic findings are showed in Table 1/Supplemental Table.

Vascular Tumors

Angiofibroma

A total of nine instances from three analyses (two case series and a single report) were assessed by dermoscopy [15,21,22]. The most common feature reported by all the studies included white/yellow-white dots [15,21,22]; other frequent findings were, brown/reddish-brown background, unfocused vessels, and brown dots [22].

Angiokeratoma

Only one instance of angiokeratoma reporting dermoscopic findings is available, with description of pink to purplish lagoons, whitish ground glass film, and thick septa separating each lacuna [15].

Cherry Angioma

Knowledge on dermoscopy of cherry angioma comes from the descriptive analysis (case-series) by Ankad *et al* including 10 instances [15]. In all cases, red to purplish lagoons were seen, while milky-white veil was prominent in older lesions and a rim pigment network was noted in two lesions [15].

Infantile Hemangioma

Only one case of infantile hemangioma has been investigated from a dermoscopic point of view, with red lacunae and white septa being reported [23].

Lymphangioma Circumscriptum

Information on dermoscopy of lymphangioma circumscriptum comes from a series of three cases, that showed pale yellow/pale pink lacunae (with some of them filled with purplish globules) and white septa; no prevalence data was provided [15].

Pyogenic Granuloma

A total of 39 lesions were analyzed by dermoscopy in the only available study (case-series). In this analysis, reddish homogeneous areas, white collarette, white rail line and vascular structures were observed, yet specific data on their prevalence were not provided [15].

Connective Tissue Tumors

Dermatofibroma

The main study on dermoscopy of dermatofibroma is the analysis (case-series) by Kelati *et al* including a total of 100 lesions from 95 patients (mainly phototype IV) [24]. According to this study, the most common dermoscopic features (more than two-thirds of cases) included pigmented network (mainly located at the periphery) and white patches ("central scar-like" or "eccentric multiple") [24]. Moreover, central homogeneous pigmentation was also frequently reported (36% of cases) [24], in line with a small case-series by Giddens *et al* [25]. Many other additional findings have been described and are displayed in the Supplemental Table [11, 15, 24, 25].

Dermatofibrosarcoma Protuberans

Two case-reports described dermoscopy of dermatofibrosarcoma protuberans [26,27]. In detail, both instances showed atypical/interrupted network [26,27]; additionally, hyper/hypo-pigmented structureless areas, shiny white streaks and unfocused linear-irregular vessels were noted in the first case [26] and a pinkish background in the second case [27].

Fibrokeratoma

The only analysis on dermoscopy of fibrokeratoma included five cases, with the following findings being reported (no prevalence data was available): homogeneous brownish-white and rosy-white area, white structureless areas (tree branches-like arrangement), and dotted/linear vessels [15].

Neurofibroma

Dermoscopic findings based on the analysis of four instances included in a study by Ankad *et al* were pink-red homogeneous areas, peripheral pigment network and fissures, and scar-like white areas with star burst appearance, yet they prevalence was not specified [15].

Cystic Neoplasms and Others

Epidermal Cyst, Milia and Trichilemmal Cyst

Two case-series investigated dermoscopy of such lesions for a total of three milia, 11 epidermal cysts, and five trichilemmal cysts [15,21]. In detail, white to yellow homogeneous area was the main finding for all of them; linear (milia) or branching (epidermal and trichilemmal cysts) vessels were also reported [15,21]. Additionally, brownish peripheral rim was found in milia and trichilemmal cysts, while central pore/punctum was described in epidermal cyst [15,21].

Steatocytoma Multiplex

A single description of this entity was retrieved, with yellow homogeneous area covering the entire lesion, linear vessels, and peripheral brown rim being reported [15].

Mycosis Fungoides

Only one observational study (case-series) on dermoscopy of mycosis fungoides (MF) was available. In this analysis, Nakamura *et al* assessed 33 images from 11 patients (four classic MF, four hypopigmented MF, one folliculotropic MF, and two verrucous MF), yet no data on prevalence of dermoscopic findings was provided [28].

Classic MF was reported to show striking pigmentary change, thick black lines, white rosettes, and geometric white lines, while hypopigmented MF was characterized by the loss of natural pigment network [28]. On the other hand, follicular plugging along with hyperpigmented to violaceous perifollicular halos and yellow-gray amorphous structures coupled with yellow-gray ridges/comedo-like openings within hyperkeratotic areas were observed in folliculotropic and verrucous MF, respectively [28].

Conclusions

This review emphasizes that many skin neoplasias have been investigated from a dermoscopic point of view in dark-skinned patients with description of potentially useful diagnostic features, though most of available data comes from inhomogeneous/unstructured studies either including small samples (especially case reports/series) or lacking

comparative analyses, thereby results have to be confirmed through studies with a more robust statistical design. Moreover, available information for some tumors concerns only some tones of "dark skin" spectrum (especially phototype IV). Nevertheless, the possible correspondence between histopathological changes of cutaneous tumors and dermoscopic findings even in skin of color makes oncological dermoscopy a potential useful aid in dark phototypes too [8]. Future comprehensive studies using a homogeneous/standardized approach will help in this regard.

References

1. Williams NM, Rojas KD, Reynolds JM, Kwon D, Shum-Tien J, Jaimes N. Assessment of Diagnostic Accuracy of Dermoscopic Structures and Patterns Used in Melanoma Detection: A Systematic Review and Meta-analysis. *JAMA Dermatol.* 2021;157:1078-1088.
2. Reiter O, Mimouni I, Gdalevich M, et al. The diagnostic accuracy of dermoscopy for basal cell carcinoma: A systematic review and meta-analysis. *J Am Acad Dermatol.* 2019;80:1380-1388.
3. Ezenwa E, Stein JA, Krueger L. Dermoscopic features of neoplasms in skin of color: A review. *Int J Womens Dermatol.* 2021;7:145-151.
4. Errichetti E, Lallas A. *Dermoscopy in General Dermatology for Skin of Color*. London: CRC Press; 2021.
5. Campbell JM, Kulgar M, Ding S, et al. Chapter 9: diagnostic test accuracy systematic reviews. In: *Joanna Briggs Institute reviewer's manual* (Aromataris E, Munn Z, eds). The Joanna Briggs Institute, 2017. https://reviewersmanual.joannabriggs.org . Accessed 13 April 2023.
6. Rutjes AW, Reitsma JB, Vandenbroucke JP, et al. Case–control and two-gate designs in diagnostic accuracy studies. *Clin Chem* . 2005;51:1335-1341.
7. Oxford Centre for Evidence-Based Medicine. *The Oxford 2011 levels of evidence*. https://www.cebm.net/wp-content /uploads/2014/06/CEBM-Levels-of-Evidence-2.1.pdf. Accessed 13 April 2023.
8. Ankad BS, Behera B, Lallas A, et al. International Dermoscopy Society (IDS) Criteria for Skin Tumors: Validation for Skin of Color Through a Delphi Expert Consensus by the "Imaging in Skin of Color" IDS Task Force. *Dermatol Pract Concept.* 2023;13:e2023067.
9. Lallas A, Reggiani C, Argenziano G, Kyrgidis A, Bakos R, Masiero NC, Scheibe AB, Cabo H, Ozdemir F, Sortino-Rachou AM, Turk BG, Moscarella E, Longo C, Zalaudek I. Dermoscopic nevus patterns in skin of colour: a prospective, cross-sectional, morphological study in individuals with skin type V and VI. *J Eur Acad Dermatol Venereol.* 2014;28:1469-74.
10. Tuma B, Yamada S, Atallah ÁN, Araujo FM, Hirata SH. Dermoscopy of black skin: A cross-sectional study of clinical and dermoscopic features of melanocytic lesions in individuals with type V/VI skin compared to those with type I/II skin. *J Am Acad Dermatol.* 2015;73:114-9.
11. de Giorgi V, Trez E, Salvini C, et al. Dermoscopy in black people. *Br J Dermatol.* 2006;155:695-9.
12. Madankumar R, Gumaste PV, Martires K, et al. Acral melanocytic lesions in the United States: Prevalence, awareness, and dermoscopic patterns in skin-of-color and non-Hispanic white patients. *J Am Acad Dermatol.* 2016;74:724-30.
13. Manci R, Dauscher M, Marchetti MA et al. Features of skin cancer in black individuals: a single-institution retrospective cohort study. *Dermatol Pract Concept.* 2022;12:e2022075.
14. Behera B, Kumari R, Thappa DM, Gochhait D, Srinivas BH, Ayyanar P. Dermoscopic features of basal cell carcinoma in skin of color: A retrospective cross-sectional study from Puducherry, South India. *Indian J Dermatol Venereol Leprol.* 2023;89: 254-260.
15. Ankad BS, Sakhare PS, Prabhu MH. Dermoscopy of non-melanocytic and pink tumors in brown skin: A descriptive study. *Indian J Dermatopathol Diagn Dermatol.* 2017;4:41-51.
16. Kinnera B, Devi VN, Satyanarayana VVV. The Dermoscopy of Pigmented Basal Cell Carcinoma. *J Cutan Aesthet Surg.* 2020;13:365-367.
17. Bhat RM, Patrao N, Monteiro R, Sukumar D. A clinical, dermoscopic, and histopathological study of Dermatosis Papulosa Nigra (DPN) - An Indian perspective. *Int J Dermatol.* 2017;56: 957-960.
18. Behera B, Kumari R, Thappa DM, Gochhait D, Srinivas BH, Ayyanar P. Dermoscopy of Bowen's disease: A case series of five patients. *Indian J Dermatol Venereol Leprol.* 2021;87:576-580.
19. Gutiérrez-Mendoza D, Narro-Llorente R, Karam-Orantes M, et al. Dermoscopy Clues in Pigmented Bowen's Disease. *Dermatol Res Pract.* 2010;2010:464821.
20. Vivan MM, Hirata SH, Nascimento LS, Enokihara MM. A case of pigmented Bowen's disease. *An Bras Dermatol.* 2017;92: 124-125.
21. Behera B, Chandrashekar L, Thappa DM, Gochhait D, Srinivas BH, Ayyanar P. Dermoscopic features of benign cutaneous adnexal tumours in dark skin: A retrospective study from South India. *Australas J Dermatol.* 2021;62:e249-e255.
22. Jindal R, Sethi S, Chauhan P. Dermoscopy of Facial Angiofibromas in Four Patients of Skin of Color with Tuberous Sclerosis Complex: A Case-Series. *Dermatol Pract Concept.* 2021;11: e2021036.
23. Kusari A, Reiley H, Seiverling E. A lesion on the abdomen in an infant. *Pediatr Dermatol.* 2021;38:117-118.
24. Kelati A, Aqil N, Baybay H, Gallouj S, Mernissi FZ. Beyond classic dermoscopic patterns of dermatofibromas: a prospective research study. *J Med Case Rep.* 2017;11:266.
25. Giddens T, Seiverling E, Marghoob A, Usatine R. Absence of central white patch in dermatofibromas presenting in darker skin. *JAAD Case Rep.* 2022;21:63-65.
26. Piccolo V, Russo T, Staibano S, et al. Dermoscopy of dermatofibrosarcoma protuberans on black skin. *J Am Acad Dermatol.* 2016;74:e119-20.
27. Escobar GF, Ribeiro CK, Leite LL, Barone CR, Cartell A. Dermoscopy of Dermatofibrosarcoma Protuberans: What Do We Know? *Dermatol Pract Concept.* 2019;9:139-145.
28. Nakamura M, Huerta T, Williams K, Hristov AC, Tejasvi T. Dermoscopic Features of Mycosis Fungoides and Its Variants in Patients with Skin of Color: A Retrospective Analysis. *Dermatol Pract Concept.* 2021;11:e2021048.