Dermatology Practical & Conceptual

Dermoscopic Image Digital Post-Processing Perception and Use Among Members of the International Dermoscopy Society: Results of a Web-based Survey

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ABSTRACT

Introduction: Speculatively, digital image post-processing (DIPP) enhances diagnostic accuracy in dermoscopy.

Objective: We aimed to investigate the advantages and limitations of DIPP, as well as its perceived reliability and safety.

Methods: In this study we investigated the perception and use of DIPP among members of the International Dermoscopy Society through a web-based survey with 17 questions focusing on: (i) demographics (sex, age, nationality, specialty, professional experience in dermoscopy), (ii) application of digital dermoscopy, (iii) imaging devices, (iv) DIPP software usage, (v) area of DIPP application (e.g., neoplastic dermatoses or inflammoscopy), preference over manual or automatized DIPP, (vi) personally adjusted parameters, (vii) perceived reliability and safety of DIPP, and (viii) an open comment section.

Results: A total of 360 respondents (64 countries) completed the survey. While 91.7% of respondents reported capturing dermoscopic images during examination, only 22.4% of them declared using DIPP. We have demonstrated that DIPP was used more commonly with smartphones rather than video dermatoscopes or digital cameras and for dermoscopy of neoplastic dermatoses rather than inflammoscopy. Respondents tended to adjust image parameters manually. The perceptions of its usefulness and safety were good, even though slight variability across geographic regions was observed.

Conclusion: Given that no regulations for DIPP exist, healthcare professionals involved with dermoscopic image acquisition and archiving may require special training to responsibly implement DIPP in their practices.

Introduction

Digital cameras have revolutionized diagnostics and medical recording in the past decade, recently facilitating the implementation of deep-learning models in dermatology. Most dermoscopists use dermatoscopic cameras or dermatoscopes coupled to smartphones to capture clinical and dermoscopic images in everyday practice. All these devices use their own software to process the analog images of skin lesions into digital files. It has been speculated that the use of manual or automated digital image post-processing (DIPP) may highlight certain diagnostic clues for both human raters and machine learning models, increasing the diagnostic accuracy [1–4], but the extent of such an application in a real-world setting, the perceived reliability of the obtained data, and the limitations of this process have not yet been studied. The patterns of use and specific scenarios in which dermoscopists utilize DIPP remain largely unexplored.

Objectives

The study aimed to investigate the advantages and limitations of DIPP as well as its perceived reliability and safety.

Methods

To fill this knowledge gap, we designed a web-based survey with 17 questions divided into eight sections focusing on: (i) demographics (sex, age, nationality, specialty, professional experience in dermoscopy), (ii) application of digital dermoscopy, (iii) imaging devices, (iv) DIPP software usage, (v) area of DIPP application (e.g., neoplastic dermatoses or inflammoscopy), preference over manual or automatized DIPP, (vi) personally adjusted parameters, (vii) perceived reliability and safety of DIPP (Likert scale), and (viii) an open comment section (Original survey form available as a Supplementary material). Prior to distribution, a pilot study

involving a group of 10 volunteers was performed before the revision to validate the survey. The final version of the survey was sent to 4,195 active email addresses of the International Dermoscopy Society (IDS) members. A fixed 3-month period (15 December 2023 – 15 February 2024) was used to collect all survey responses. Parameters of perceived usefulness and safety were compared across age groups, experience levels, and geographic regions (Africa, Australia and Oceania, Asia, Europe, North America, and South America) with ANOVA, whereas the differences in geographic distribution of survey respondents and IDS members were assessed with paired t-tests using Python v3.11.4 (SciPy v1.11.4, Seaborn v0.13.2). *P*-values of <0.05 were considered statistically significant for all tests.

Results

A total of 360 surveys (8.6% response rate) from 64 countries were collected. The dataset can be accessed through Harvard Dataverse at the following link: https://doi.org/10.7910/DVN/ZKPUPZ. Demographic data of the respondents are presented in Table 1. There were no significant differences in the geographic distribution of survey respondents and IDS members (accessed on 22 July 2024) (paired t-test; *P*=1.0). The rationale for using DIPP, the key diagnostic devices used for capturing images, and the areas of application given by the respondents are shown in Table 2. Results concerning respondents' assessment of the usefulness and safety of DIPP are presented in Table 2 and Table 3. The majority of participants considered the usefulness and safety of DIPP to be "good". No significant difference was noted between the mean usability and safety scores by either age group or years of experience in dermoscopy. No significant difference between the continents was observed between the total study group and the ones using DIPP (paired t-test; *P*=1.0). The mean usefulness in Europe was assessed as "good" and safety assessed as "fair". Usefulness was perceived as highest by South Americans ("good") and lowest by North Americans ("fair"). Nonetheless, even though skepticism towards DIPP's usefulness and safety was observed for North America and that it was a more trusted approach in Asia (2.46±0.53 [95% CI: 1.93–2.99] vs. 3.30±0.66 [95% CI: 2.64–3.96], and 2.38±0.52 [95% CI: 1.86–2.90] vs. 3.40±0.73 [95% CI: 2.68–4.13]), analysis of variance did not prove any statistically significant difference in either mean across the geographic areas (*P*=0.07 and *P*=0.28, respectively).

Table 1. Demographic Data of Survey Participants (n=360).

Sex	n (%)
Male	141 (39.2)
Female	219 (60.8)
Specialty	**n, (%)**
Dermatologist	291 (80.8)
General Practitioner	52 (14.4)
Surgeon	3 (0.8)
Oncologist	2 (0.6)
Internal medicine specialist	1 (0.3)
Other medical professional (nurse, assistant, clinical photographer)	11 (3.1)
Age group (years)	**n (%)**
21-30	25 (6.9)
41-50	96 (26.7)
31-40	91 (25.3)
51-60	74 (20.6)
>60	74 (20.6)
Years of experience in dermoscopy	**n (%)**
<5	77 (21.4)
5-10	107 (29.7)
11-20	100 (27.8)
>20	76 (21.1)
Geographic distribution of respondents	**n (%)**
Europe	179 (49.7)
Asia	53 (14.7)
South America	53 (14.7)
Australia and Oceania	33 (9.1)
North America	24 (6.7)
Africa	18 (5.0)

Discussion

Electronic medical records are an indispensable part of modern healthcare systems, facilitating easy access to a patient's medical history. In general, skin diseases are easily accessible for visual inspection, and the majority of dermatological conditions can be diagnosed, or at least differentiated, based on the basic lesion morphology and distribution. Thus, digital photography may play an important role in documenting the history of the evolution of skin symptoms. Dermoscopy is an auxiliary examination complementing the clinician's diagnostic armamentarium. Knowledge about the correlations between the dermoscopic clues (colors, structures, and their spatial relation) and pathology ensures a better understanding of the nature of the lesion and narrows the range of differential diagnoses[5,6]. The rise of digital medical photography, especially using easily accessible smartphones, was accelerated by the COVID-19 pandemic[7–9]. Although the perception of teleconsultation or teledermoscopy has been investigated among physicians[10], little is known about

Table 2. Respondents' Attitudes towards Digital Image Post-Processing in Dermoscopy.

Capturing images during dermoscopy (n=360)	n (%)
Yes	330 (91.7)
No	30 (8.3)
Primary device used for capturing dermoscopic images (n=330)	**n (%)**
Smartphone	187 (56.7)
Digital camera	79 (23.9)
Video dermatoscope	64 (19.4)
Application of photo enhancing software (n=330)	**n (%)**
Yes	74 (22.4)
No	256 (77.6)
Reasons given for abstaining from image post-processing (n=256)	**n (%)**
Never heard of it	124 (48.4)
Seems unnecessary	51 (19.9)
Too time-consuming/ complicated	42 (16.4)
Doubts regarding reliability	39 (15.2)
Reasons given for image post-processing (n=74)	**n (%)**
Extraction of features that are normally obscured	42 (56.8)
Superior image quality	37 (50.0)
Enhanced diagnostic confidence	31 (41.9)
Applications for image post-processing (n=74)	**n (%)**
Neoplastic dermatoses	68 (91.9)
Non-neoplastic dermatoses	44 (59.5)
Image adjustment (n=74)	**n (%)**
Manual	30 (40.5)
Automatic followed by manual	22 (29.7)
Automatic (HDR or auto-adjustment)	22 (29.7)

Parameters adjusted manually (n=52)	n (%)
Brightness	34 (65.4)
Contrast	32 (61.5)
Hue	29 (55.8)
Sharpness	29 (55.8)
Exposure	17 (32.7)
Saturation	11 (21.2)
Perceived reliability of dermoscopic clues after photo enhancement (n=113)	**n (%)**
Vascular clues	71 (62.8)
Pigment clues	55 (48.7)
Polarizing-specific white clues	55 (48.7)
Non-polarizing dependent white clues	42 (37.2)
Clues of color	32 (28.3)
Scale	26 (23.0)
None are reliable	14 (12.4)
Perceived usefulness of photo enhancement in dermoscopy (n=113)	**n (%)**
Perfect	9 (8.0)
Very good	28 (24.8)
Good	42 (37.2)
Fair	23 (20.4)
Poor	11 (9.7)
Perceived safety of photo enhancement in terms of potentially incorrect decisions in dermoscopy (n=113)	**n (%)**
Perfect	6 (5.3)
Very good	24 (21.2)
Good	41 (36.3)
Fair	30 (26.6)
Poor	12 (10.6)

physicians' perspectives on the usefulness and reliability of DIPP in dermoscopy.

Our study demonstrates that the vast majority of respondents use some form of dermoscopic image acquisition, particularly smartphones. There may be several reasons for this trend. In 2024, it was estimated that 17.72 billion smartphones were used worldwide[11], which makes the devices readily and easily accessible to connect dermatoscopes to and to use as portable video dermatoscopes. From a user's perspective, it is easier to manipulate image parameters directly within the smartphone's image browser software, whereas images captured with digital cameras and professional video dermatoscopes need to be downloaded/exported prior to processing. The respondents found DIPP more useful for neoplastic dermatoses than for inflammatory ones, possibly because the pigment clues (which can be enhanced by adjusting brightness and contrast) play a more important role in dermoscopy of neoplastic dermatoses. Likely due to variability in individual perception of color, manual adjustment tailored to individual needs dominated over automatic adjustment. Over 50% of respondents relied on the DIPP-enhanced vascular clues, whereas over 25% trusted pigment clues, both polarizing-dependent and -independent white clues, and color clues.

Table 3. Assessment of Usefulness and Safety of Digital Image Post-Processing in Dermoscopy (n=113).

	n (%)	Usefulness (mean Likert score±SD, 95% CI)	Safety (mean Likert score±SD, 95% CI)	ANOVA Usefulness	ANOVA Safety
Age group (years)					
21-30	5 (4.4)	2.80±0.45 [2.24 – 3.36]	2.80±1.64 [0.76 – 4.84]	F=0.24, *P*=0.91	F=0.76, *P*=0.55
31-40	39 (34.5)	2.92±1.18 [2.54 – 3.31]	2.79±0.92 [2.50 – 3.09]		
41-50	23 (20.4)	3.17±1.19 [2.66–3.69]	2.57±0.95 [2.16 – 2.97]		
51-60	21 (18.6)	3.05±1.12 [2.54–3.56]	3.00±1.26 [2.42 – 3.58]		
>60	25 (22.1)	3.00±0.91 [2.62–3.38]	3.04±1.02 [2.62 – 3.46]		
Years of experience in dermoscopy					
<5	17 (15.0)	2.76±0.97[2.27 – 3.26]	2.59±1.18 [1.98 – 3.19]	F=1.13, *P*=0.34	F=1.00, *P*=0.40
5-10	36 (31.9)	3.17±1.23 [2.75 – 3.58]	2.78±0.96 [2.45 – 3.10]		
11-20	30 (26.6)	2.80±1.03 [2.42 – 3.18]	2.80±1.00 [2.43 – 3.17]		
>20	30 (26.6)	3.17±0.99 [2.80 – 3.53	3.10±1.12 [2.68 – 3.52]		
Continent					
Europe	60 (53.1)	3.13±0.27 [2.86 – 3.40]	2.92±0.26 [2.66 – 3.18]	F=2.08, *P*=0.07	F=1.28, *P*=0.28
North America	13 (11.5)	2.46±0.53 [1.93 – 2.99]	2.38±0.52 [1.86 – 2.90]		
Australia and Oceania	12 (10.6)	2.67±0.61 [2.07 – 3.28]	2.75±0.69 [2.06 – 3.44]		
South America	11 (9.7)	3.45+±0.55 [2.90 – 4.00]	2.73±0.47 [2.26 – 3.20]		
Asia	10 (8.9)	3.30±0.66 [2.64 – 3.96]	3.40±0.73 [2.68 – 4.13]		
Africa	7 (6.2)	3.30±0.84 [2.46 – 4.14]	2.57 ±0.84 [1.73 – 3.41]		

Abbreviations: ANOVA, analysis of variance; SD, standard deviation; CI, confidence interval; *P*, significance.

Limitations

One of the main study limitations is the low response rate, comparable to previous studies among IDS members[8]. However, the low response rate in this case does not necessarily indicate a bias in the results since the geographical distribution of IDS members and respondents overlaps significantly. It is possible that the non-respondents were not interested in the topic of DIPP and dismissed the invitation. Even though 91.7% of respondents used some device to capture the digital dermoscopic image, few considered that the method may compromise image quality. Moreover, about half of the respondents who declared never having used DIPP had never heard of it. On the other hand, it is possible that the positive attitude towards DIPP shown here is biased by the sampling method, as those uninformed about DIPP or more skeptical may have declined the invitation. The variability in approach towards perceived usefulness and safety across the geographic regions (even though statistically insignificant) may reflect the different pace and extent of application of image manipulation. As expected, the majority of survey respondents originated from Europe, which has a long and strong tradition of dermoscopy. Lower interest in dermoscopy among typically fair-skinned populations can be explained by the relatively recent rise of dermoscopy use in patients with skin of color.

Conclusions

The role of DIPP in medicine (dermatology, pathology, ophthalmology, and others) is expected to increase. Being adopted by humans and AI software, the question of its reliability remains relevant. In this study, we investigated the perceived advantages and limitations of DIPP. Despite low awareness of DIPP, it can be applied to images of neoplastic and non-neoplastic dermatoses. We have demonstrated that image processing is regarded as safe and reliable and is used by a significant portion of respondents in their daily practice. Knowing the extensive use of digital dermoscopy, scientific societies and centers of excellence should be encouraged to develop special training programs for all healthcare professionals involved with dermoscopic image acquisition and archiving to ensure its responsible implementation.

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