Can a smartphone application support the general practitioner in detecting skin cancer?

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Can a smartphone application support the general practitioner in detecting skin cancer?

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ABSTRACT

Objectives: This pilot study explores whether the mHealth app SkinVision (Amsterdam, Netherlands) can support general practitioners (GP) in decision-making regarding lesions suspected for skin cancer.

Methods: From December 14, 2023, to January 25, 2024, 50 participants were recruited from the early access consultation for suspicious lesions at the dermatology department of the Ghent University Hospital. After an initial assessment by dermatologists, a general practitioner in training examined the skin lesion. After this first evaluation by the researcher, the participant was asked to photograph the skin spot using the SkinVision app. After the risk assessment given by the app, the GP could review the diagnosis and treatment. Diagnosis and treatment plan before and after using SkinVision were compared to the clinical diagnosis from the dermatologist or a histopathological diagnosis, if available.

Results: Before app support, the GP achieved a sensitivity of 87,5% and a specificity of 90% for detection of malignancy. The overall SkinVision app service (evaluation with teledermatology advice) achieved a sensitivity of 87,5% and specificity of 76% after two days. The app led to a change in diagnosis by the GP in training in 8% of cases, but none of these changes were correct. After app support, the GP sensitivity increased from 87,5% to 100% while specificity decreased from 90% to 85,7%.

Conclusion: The SkinVision app has not yet shown sufficient evidence to support general practitioners (GP) in decision-making regarding lesions suspected for skin cancer.

INTRODUCTION

Skin cancer is the most common cancer worldwide and will affect one in five Belgians by the age of 75. (1) Although, the global incidence of skin cancer is rapidly increasing (2), systematic skin cancer screening for the general population is considered not cost-effective. (3)

Early detection in individuals presenting with a suspicious lesion is crucial, especially for melanoma. Lesion Directed Screening (LDS) or 'early access consultation', a targeted analysis of one or two suspicious skin lesions by a dermatologist, may be an effective way to optimize early detection of skin cancer in the general population. (4) This provides a similar detection rate for skin cancer compared to a Total Body Examination (TBE) but is 5 times less time-consuming. (5)

An increasing number of AI technologies are being developed to enhance early detection of skin cancer. These apps might help in pre-selecting individuals for timely medical evaluation. These apps are often criticized for their limited scientific evidence. (6, 7) SkinVision, however, has some small-scale validation studies that produce the highest estimates of accuracy. SkinVision is a CE-certified app with an observed sensitivity of 80% (95% confidence interval 63% to 92%) and a specificity of 78% (67% to 87%). (8)
AI-technologies are on the rise and could be integrated at various points in the diagnostic chain: for patients to select skin lesions needing medical attention, for general practitioners supporting diagnosis, and for specialists supporting follow-up in high risk patients. AI support may be most beneficial in primary care, as non-experts might gain the greatest advantage from AI assistance, and triage plays a crucial role in healthcare systems with a gatekeeper model. (9)

This study is a pilot project investigating whether an CE-marked smartphone app for skin cancer detection can support GPs in decision-making in skin spots with alarming signs.

METHOD

Study design and participants

This study investigates whether the mHealth app SkinVision (Amsterdam, Netherlands) can support a general practitioner (GP) in detecting skin cancer. The app was tested during the early access consultation at the skin cancer unit of the Ghent University Hospital (ARTIS trial, ClinicalTrials.gov Identifier: NCT05246163). Results are reported following updated STARD guidelines (10). This study approved by the Medical Ethics Committee of Ghent University Hospital (EC/2017/0823 BC-1191) and required written informed consent from all participants.

From December 14, 2023, to January 25, 2024, participants were recruited consecutively from the early access consultation for suspicious lesions, which could be accessed either on their own initiative or through a referral from a non-dermatologist. All adults (≥18 years of age) with one or two skin lesions that had at least one alarming feature (new mole, changing mole, "ugly duckling" lesion, non-healing lesion, rapidly growing lesion) or referral by a healthcare professional were eligible for inclusion. Patients with lack of Dutch proficiency, with already treated or healed lesions, or patients who were unable or unwilling to participate in the study were excluded.

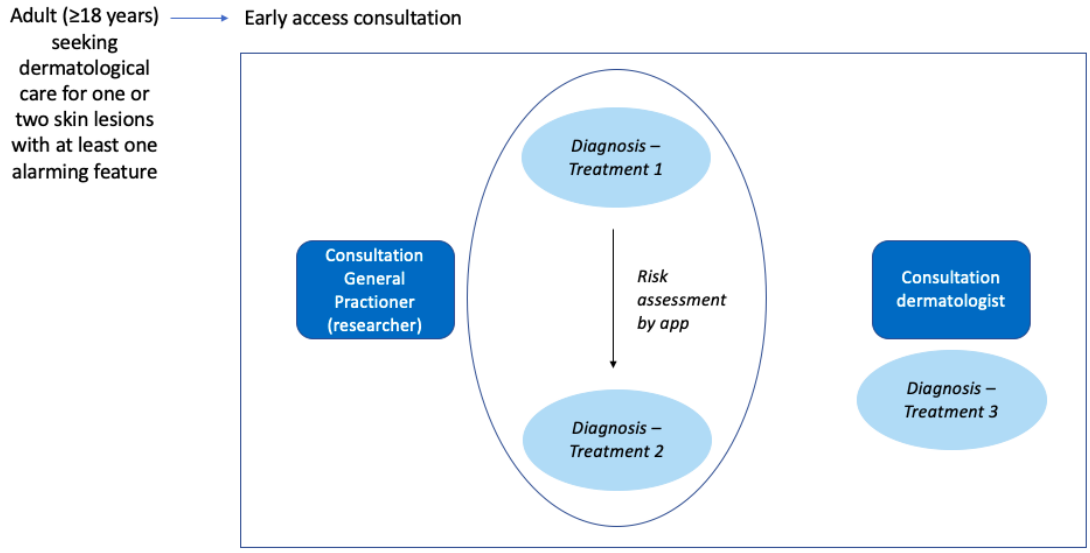


Figure 1. Study design

Procedures

Included participants first consulted one of three senior dermatologists (LB, EV, IH) to determine a clinical diagnosis and treatment or decision to biopsy or excise (diagnosis/treatment 3) (fig 1). After this, the participant visited the researcher, a 26-year old female general practitioner in training with 2 years of experience. After an intake using a standardized questionnaire (see Appendix 1), the skin lesion was examined by the researcher without a dermatoscope (as in the general practice) and a working diagnosis and treatment was established (diagnosis/treatment 1). After this first evaluation by the researcher, the participant was asked to photograph the skin spot using the SkinVision app. In this way, the ambulatory setting (for which the app was designed) was simulated as much as possible. If the patient failed to perform a correct analysis, the researcher assisted in photographing the skin lesion. After observation of the color code and the advice of the app, the investigator reviewed the diagnosis and treatment if the app had influenced her decision (diagnosis/treatment 2).

Afterwards, both the diagnosis and treatment plan of the GP before and after using SkinVision were compared to the final diagnosis (either clinical diagnosis from the dermatologist or, if available, the histopathological diagnosis).

Test Methods

The examined mHealth app (SkinVision, Amsterdam, The Netherlands) is a digital dermatology service for self-monitoring skin lesions. Skin lesions were assessed by the app on an iOS device (Iphone 13), a study account was created and set for fair skin types. The app uses Convolutional Neural Network (CNNs) that classifies photos of skin lesions as low or high risk. The app has an in-build quality check (sharpness, lesions distinguishability, centering) to ensure a photo is suitable for assessment by the CNN. (11) The module also prevents the camera from taking images that cannot be assessed by the algorithm (eg, lesions in the hairs, under a nail or in a skin fold). (12) If the app fails to capture an image after two attempts, the researcher took a “classic” photo and sent it to the teledermatologist of SkinVision.

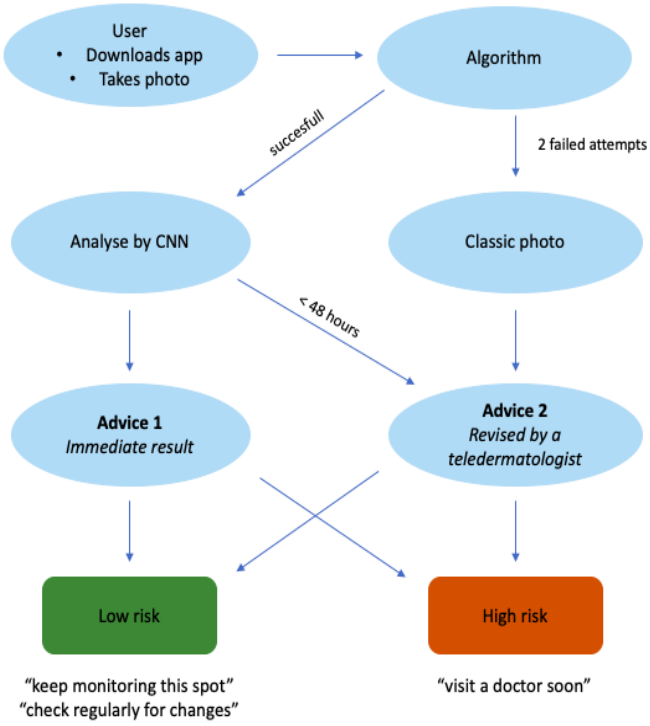


Figure 2. Flowchart of the SkinVision app

The app displays the risk of skin cancer using a binary color code accompanied by a brief standardized advice (fig2). Possible outcomes were orange for high risk ('visit a doctor soon', preferably within 4 weeks), and blue for low risk, with the advice depending on the presence of symptoms (in case of symptoms: 'keep monitoring this spot', in case of persistent symptoms > 6 weeks: check needed; in case of no symptoms: 'check regularly for changes', preferably every 3 months). For analysis, all blue results were considered 'low risk'. Half of the images were assessed by a teledermatologist within 48 hours and this advice may overrule the CNN risk classification. If the risk analysis wasn't directly available, the researcher waited for the advice before a new diagnosis and treatment was set. Actinic keratosis was considered benign for analysis of this study.

SkinVision is registered by the Belgian authorities as a CE class 1 medical product (https://mhealthbelgium.be/nl/alle-apps), which is self-certified. According to the new Medical Devices Regulation in Europe since 2021 software providing information involved in the decision-process of diagnosis or therapy choice is classified at least Class IIA. This results in the introduction of Notified Bodies as a control organ in the certification process. Currently a transitional period is taking place.

Statistical analysis was conducted using IBM SPSS Statistics (version 29.0).

RESULTS

Study population and characteristics

Between December 14, 2023 and January 25, 2024, 50 participants were included in the study. The study population consisted of 42% (N=21) men and 58% (N=29) women. The mean age was 55.3 years. Table 1 (see Appendix 2) shows the characteristics of the participants and their skin lesions.

The dataset consists of 38 (76%) benign skin lesions, 4 (8%) premalignant skin lesions (AK) and 8 (16%) malignant skin lesions (3 BCCs, 2 SCCs, 1 melanoma, 1 keratoacanthoma and 1 Bowen's disease). The skin cancer detection rate in the study population was 16% (8/50). All skin cancers were histologically confirmed.

1. *Success rate of capturing a photo for assessment*

The patient was able to capture an image for app analysis without any assistance in only 10% of cases (5/50). Inability to capture an image was due to a difficult-to-reach location (60%), coordination issues (12%) or difficulty focusing by the app (22%).

2. *Diagnostic accuracy of risk assessment by GP, app and combined advice*

2.1 Diagnostic accuracy of risk assessment by GP before app support

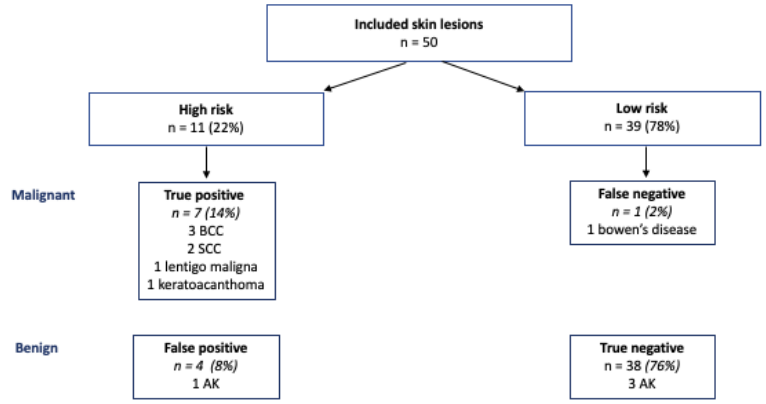


Figure 3. Diagnostic accuracy of risk assessment by GP before app support

Before app support, the GP achieved a sensitivity of 87,5% and a specificity of 90% for detection of malignancy.

2.2 Diagnostic accuracy of risk assessment by the app

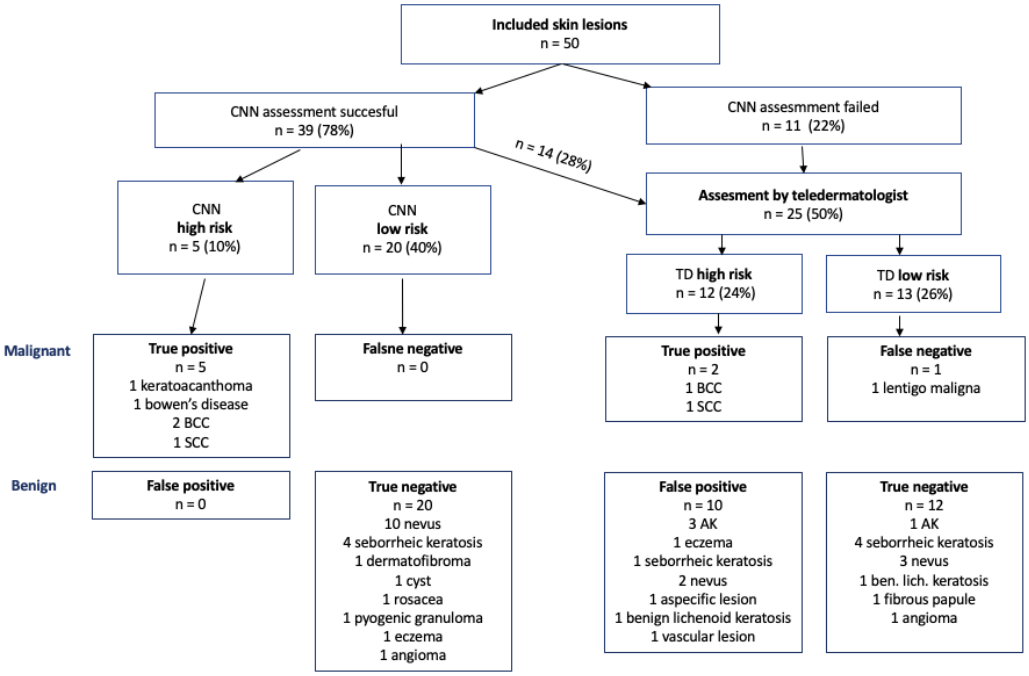


Figure 4. Diagnostic accuracy of risk assessment by the app

In half of the cases (25/50), the result was immediately available after assessment (within 30 seconds). In these lesions, the CNN reached a sensitivity and specificity of 100%.

In the other half, a teledermatologist from SkinVision was consulted before a risk score was available. The teledermatologist assessment resulted in in a sensitivity and specificity of 16% and 92% respectively.

Overall, the SkinVision app service (evaluation with teledermatology advice) achieved a sensitivity of 87,5% (7/8) and specificity of 76% (33/42) after two days.

2.3 Diagnostic accuracy of risk assessment by GP after app advice

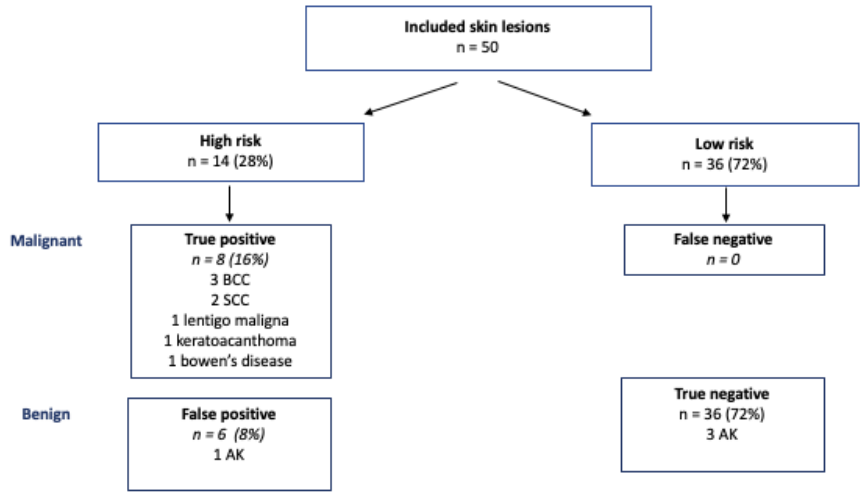


Figure 5: Diagnostic accuracy of risk assessment by GP after app support

The sensitivity of the GP after using SkinVision was 100% and the specificity 85,7%. After app support, the GP sensitivity increased while specificity decreased. In no case the researcher was certain about the initial diagnosis and was therefore sensitive to the app's assessment. One skin lesion (Bowen's disease) was correctly reclassified from low risk to high risk. The eczema was reclassified from true negative to false positive due to a high risk assessment by the app. In one case (benign lichenoid keratosis) the GP still changed the diagnosis from low-risk to high-risk lesion, despite the app's low-risk assessment, out of fear of missing a skin cancer. The investigator adjusted the diagnosis in only 1 case out of 25 (2%) where a direct risk assessment was available.

3. Influence of app results on treatment or referral

In 22% (N=11) of the cases the treatment plan changed after using SkinVision.

The melanoma was initially referred, but the policy was incorrectly changed to follow up after the low risk notification from the app. The Bowen's disease was misclassified as AK, for which a follow-up appointment was scheduled. After the high risk notification from the app, the policy was correctly adjusted to a referral.

Overall, in 27% (3/11) of the cases the treatment plan was correctly changed after using SkinVision, in 36% the adjustment was incorrect, and in 36% (4/11) the treatment plan varied three times.

The level of agreement between the treatment plan of the GP and the dermatologist was similar before using the app compared to afterwards. (K value 0.458 vs. 0.425)

Level of agreement

Comparison of policy 1 vs. policy 3

- Policy 1 = 3 N = 31 (62%)
- Policy 1 ≠ 3 N = 19 (38%)
- SPSS crosstabs Kappa value: 0.458 - P-value: <0.001

Comparison of policy 2 vs. policy 3

- Policy 2 = 3 N = 30 (60%)
- Policy 2 ≠ 3 N = 20 (40%)
- SPSS crosstabs Kappa value: 0.425 - P-value: <0.001

4. Influence of app results on exact diagnosis

In 8% (N=4) the diagnosis was adjusted after using SkinVision, this adjustment didn't lead to a correct diagnosis in any case. In 3 of 4 cases, the diagnosis was adjusted to a benign lesion that was not immediately recognized.

The level of agreement between the diagnosis of the GP and the dermatologist was comparable before using the app compared to afterwards. (K value 0.489 vs. 0.468).

Level of agreement

- Comparison diagnosis 1 (before using SV) vs. diagnosis 3
    - Diagnosis 1 = 3 N = 30 (60%)
    - Diagnosis 1 ≠ 3 N = 20 (40%)
    - SPSS: crosstabs Kappa value: 0.489 P-value: <0.001
- Comparison diagnosis 2 (after using SV) vs. diagnosis 3
    - Diagnosis 2 = 3 N = 29 (58%)
    - Diagnosis 2 ≠ 3 N = 21 (42%)
    - SPSS: crosstabs Kappa value: 0.468 P-value: <0.001

5. Influence of app results on certainty regarding risk classification

In 64% (n=32), the use of SkinVision did not affect certainty regarding the diagnosis.

In 3 benign cases (6%), the false positive assessment by the app conflicted with the true negative assessment of the GP, causing increased uncertainty; however, the GP trusted her own judgment and didn't change diagnosis.

In 11 benign and 4 malignant cases, the agreement between the app and her own judgment increased the GP's confidence in her assessment.

DISCUSSION

Principal findings

In this pilot study, the CE-marked smartphone app (SkinVision) did not support the researcher in decision-making regarding spots suspected for skin cancer. The use of the app did not lead to an optimization of the diagnostics and/or the treatment of the general practitioner in training.

Before app support, the GP achieved a sensitivity of 87,5% and a specificity of 90% for detection of malignancy. The GP misclassified one Bowen's disease as low risk. The app incorrectly classified one malignant lesion (the only melanoma in this study) as low risk, which carries important implications. This shows that the app is not flawless and may lead to significant diagnostic errors. In this study the SkinVision app achieved an overall sensitivity and specificity of 87,5% and 76% (incl. evaluation with teledermatology advice). This is similar to the results described by Freeman et al. (8) where SkinVision achieved a sensitivity of 80% and the specificity of 78%. After app support, the GP sensitivity increased while specificity decreased.

The use of the app also provided no added value to determine the correct treatment plan. The treatment changed in 22% (11/50) of the cases with the use of SkinVision, but this didn't result in an optimization. For instance, the treatment of lentigo maligna was incorrectly adjusted from referral to follow-up due to a low-risk notification from the app.

Research limitations

The limited dataset of this pilot study (N=50) represents a major limitation. The results cannot be easily generalised to a broader population, as the study was conducted by only one researcher (a general practitioner-in-training), which strongly affects the external validity. Moreover, the SkinVision app was developed for self-diagnosis in the ambulatory setting and not as a specific support tool for primary care physicians. In practice, however, general practitioners will likely encounter the app, as it is freely provided in Belgium for members of the Christian Mutuality (CM) (13) and Helan. (14)

An additional limitation is the lack of diversity. In this study, 64% of participants had a fair skin type (Fitzpatrick skin type II). Further research into the effectiveness of SkinVision in different skin types is needed.

The study design, in which the physician uses the app after the dermatological consultation of the patient, could involve potential bias as well. A design in which the researcher applies the app prior to the consultation with the dermatologist would be better to prevent potential influence from the patient.

App limitations

Despite the fact that the app was developed for self-diagnosis, our research shows that in 90% of the cases the patient needed assistance with photographing the skin lesion. Due to limited coordination, difficulty with focusing or specific locations, most patients were unable to take the photo themselves. In 22% (N=11/50) of the cases, both the researcher and the patient didn't succeed to perform a scan

using the app and a regular photo was taken instead. In a study by Gregoor et al. published in 2023, they reached a similar conclusion. In their study less than half of the patients were able to successfully use the app on their own (44%, N = 22), the majority required help from the researcher or a friend/family member (48%, N = 24) and in four cases (8%, N = 4), neither the patient nor the researcher were able to successfully assess the skin lesion using the app. (15)

Smartphone apps for early detection of skin cancer face several challenges, including the limitations of images captured by smartphone cameras. While AI systems trained on dermoscopy images have demonstrated diagnostic accuracy similar to that of specialist physicians (16), similar improvements have not been established for macroscopic images. As with all AI imaging tools, the training set is crucial for AI performance; underrepresentation of darker skin types or rare conditions such as amelanotic melanoma can lead to suboptimal results. (17)

Moreover, in more than half of the cases, no direct risk assessment is available. This leads to a lot of doubt and uncertainty, both for the patient and the doctor. If the risk assessment is not directly available in half of the cases, a system to follow-up this assessment needs to be developed. There is certainly a need for specific support tools for primary care physicians, but it would be valuable to develop a specific app that provides immediate advice and offers a differential diagnosis that can support the GP in making an informed decision.

Finally, there was a discrepancy in the assessment of actinic keratosis. For example, three skin lesions (AK) were correctly identified by the researcher and documented as “reassuring” despite their premalignant nature. An AK is associated with low morbidity and no mortality and can be effectively treated in primary care. This “reassuring” assessment contradicts SkinVision's assessment, which considers an AK to be a high-risk lesion.

Study implications

Long waiting times for dermatology appointments are a challenge in many regions. AI could improve access to specialist-level expertise. (18) A more accurate assessment of suspicious skin lesions by general practitioners with AI support could lead to fewer referrals and unnecessary biopsies, improving the patient experience and reducing the need for and costs of dermatology specialist services. (19) In theory, the incorporation of AI in primary care, when equipped with sufficient sensitivity, holds the potential to enhance the effective triage of high-risk lesions. This would ensure that individuals with skin cancer promptly receive appropriate medical attention. (18)

A sensitivity of 87,5% means that approximately one out of eight cases of skin cancer is missed. Chu et al. concluded that smartphone apps using AI-based analysis did not show sufficient accuracy and were associated with a high likelihood of missing melanomas (20). In general, a sensitivity of at least 90% is considered desirable for cancer screening, as it is important to miss as few cancers as possible.

A specificity of 76% means that one in 4 benign lesions is falsely identified as high risk, which can lead to high volumes of benign skin lesions being categorized as high risk and unnecessary dermatology visits. (21) A potential negative consequence of population-wide implementation of these types of apps is therefore the risk of overdiagnosis and thus suboptimal use of scarce healthcare resources. (11, 21)

A study published in 2020 by Tschandl et al. established that good quality AI-based support improves diagnostic accuracy over that of either AI or physicians alone and that especially the least experienced clinicians gain the most from AI-based support. (9) They show an inverse relationship between the net gain from AI-based support and rater experience. Practitioners in the least experienced group changed their initial diagnosis more often than experts, who benefited only marginally. (9)

Furthermore, it is also important to investigate what users do with the advice from the app. Gregoor et al. are one of the few who have investigated this matter. His study established that 54% of the patients with a benign skin lesion and a low risk rating would be reassured and cancel their GP visit. (15)

A recent systematic review about the diagnostic accuracy of algorithm-based smartphone apps for assessing skin cancer risk has criticized the fact that many diagnostic accuracy studies have weak evidence due to poor study design and thus do not support the implementation of the current apps (8). Despite this fact, health institutions in the Netherlands, Belgium, and the UK have promoted the app In Belgium it is freely provided for members of the Christian Mutuality (CM) (13) and Helan. (14)

Since 2020, the landscape of algorithm-based apps for skin cancer detection has been rapidly evolving. (18) A review of the Apple App Store, Google Play Store, and Google Search in 2022 identified 25 skin cancer self-detection apps exhibiting inconsistent outputs and low diagnostic accuracy (23). It is also difficult to make an accurate comparison between different apps, since the rate of service or algorithm change is faster than the process of peer-review publication. (24)

However, the CE medical device classification 1 (25) that was applied for SkinVision® may be inadequate. Since May 2021, the new Medical Devices Regulation (MDR) in Europe reclassifies software for diagnostic or therapeutic decision-making as Class IIa or Class IIb if it may influence surgical decisions. (26)

Future Research

It is expected that apps for self-diagnosis of skin cancer, may have significant growth in the coming years. It is crucial that (general) practitioners are actively involved in this development. The GP plays a key role in the early detection of skin cancer and in guiding patients to secondary care. The integration of technology into general practice may offer added value, but it also raises questions about the reliability and practical implementation of these apps. While participants acknowledged the usefulness of performing a skin check at home, a lack of integration with the healthcare system was mentioned as an issue. (27) Additionally, participants would have liked the option to directly visit a dermatologist after receiving a high-risk rating from an mHealth app, without first having to visit the GP. Collaboration between app developers, GPs and dermatologists is advocated to improve mHealth integration with skin cancer care. (27)

A recent study suggests that a diagnostic aid for GPs in the resolution of dermatologic consultations could be a significant time-saver. (28) AI has the potential to assist primary care clinicians to triage suspicious skin lesions, but research is now needed on real-world primary care populations to establish the accuracy and safety. (29) Furthermore, we recommend future research to explore the views of GPs and dermatologists towards mHealth apps for skin cancer screening. (27)

CONCLUSION

The SkinVision app has not yet shown sufficient evidence to support general practitioners (GP) in decision-making regarding lesions suspected for skin cancer. mHealth apps have potential to empower patients to self-assess skin lesions at home or support GP's but the current diagnostic accuracy is too low. Therefore, further independent validation studies are needed in a real world setting to examine the diagnostic accuracy and most effective approach for patients and GP's before these apps or other AI devices can be safely implemented in skin cancer detection.

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APPENDIX

1. *Standardised questionnaire*

BEOORDELINGSFORMULIER ONCO TRIAGE

studienummer:

datum:

Geslacht	☐ man ☐ vrouw ☐ andere
Leeftijd	.....
Huidtype	☐ Type I verbrandt altijd, nooit bruin ☐ Type II verbrandt meestal, lichtbruin ☐ Type III verbrandt soms, gemiddeld bruin ☐ Type IV verbrandt zelden, bruiner dan gemiddeld ☐ Type V verbrandt nooit, altijd donker bruin ☐ Type VI altijd donker bruin, geen verandering
Locatie van het huidletsel	☐ Hoofd ☐ Nek ☐ Schouder ☐ Arm ☐ Hand ☐ Rug ☐ Borst ☐ Buik ☐ Genitaal ☐ Been ☐ Voet ☐ Andere .....
Symptomen	☐ Geen klachten ☐ Verandering van vorm, kleur of grootte ☐ Jeuk ☐ Bloedverlies ☐ Infectieus / niet genezende wonde ☐ Andere: .....
	Sinds wanneer? .....
Gebruik van immunosuppressiva	☐ Ja ☐ Nee
Persoonlijke voorgeschiedenis van huidkanker	☐ Nee ☐ Ja ☐ melanoom ☐ basocellulair carcinoom ☐ spinocellulair carcinoom ☐ ik weet het niet

Eerstegraads familielid met huidkanker (moeder, vader, zus, broer, kind…)	☐ Nee
	☐ Ja
	  ☐ melanoom
	  ☐ basocellulair carcinoom
	  ☐ spinocellulair carcinoom
	  ☐ ik weet het niet

PERSOONLIJKE BEOORDELING - **VOOR** GEBRUIK SKINVISION

Huidletsel	☐ pluis ☐ niet-pluis

Vermoedelijke diagnose	☐ benigne
	  ☐ naevus
	  ☐ verruca seborrhoica
	  ☐ lentigo solaris
	  ☐ dermatofibroom
	  ☐ vasculair letsel
	☐ pre-maligne
	  ☐ actinische keratose
	☐ maligne
	  ☐ basaalcelcarcinoom
	  ☐ spinocellulair carcinoom
	  ☐ atypische naevus of melanoom
	☐ andere:
	  .....

Zekerheid omtrent diagnose (5 likert schaal)	☐ heel zeker (80 - 100%) ☐ zeker (60 - 80%) ☐ neutraal (40 - 60%) ☐ onzeker (20 - 40%) ☐ heel onzeker (0 - 20%)
Beleid	☐ geruststellen - geen behandeling nodig ☐ vervolgafspraak - follow-up ☐ cryotherapie ☐ biopsie, excisie… of doorverwijzen

BEOORDELING SKINVISION APP

De foto is genomen door	☐ Patiënt ☐ Arts
Risico inschatting app	☐ Blauw ☐ Blauw + symptomen ☐ Oranje

Advies AI	☐ Check regularly ☐ Keep monitoring ☐ Visit a doctor
Opmerking vb. technische moeilijkheden	…… …… ……

PERSOONLIJKE BEOORDELING - **NA** GEBRUIK SKINVISION

Vermoedelijke diagnose	☐ benigne ☐ naevus ☐ verruca seborrhoica ☐ lentigo solaris ☐ dermatofibroom ☐ vasculair letsel ☐ pre-maligne ☐ actinische keratose ☐ maligne ☐ basaalcelcarcinoom ☐ spinocellulair carcinoom ☐ atypische naevus of melanoom ☐ andere: ……
Zekerheid omtrent diagnose (5 likert schaal)	☐ Heel zeker (80 - 100%) ☐ Zeker (60 - 80%) ☐ Neutraal (40 - 60%) ☐ Onzeker (20 - 40%) ☐ Heel onzeker (0 - 20%)
Beleid	☐ geruststellen - geen behandeling nodig ☐ vervolgafspraak - follow-up ☐ cryotherapie ☐ doorverwijzen voor curretage, biopsie, excisie, fotodynamische therapie, imiquimod….
Reflectie - Wat is de invloed van de risicoscore op mijn persoonlijke beoordeling? - Beïnvloedt de risicoscore mijn zekerheid omtrent de diagnose? - …	…… …… …… …… …… …… …… …… ……

2. *Study population and characteristics*

		N	%
Geslacht	Man	21	42%
	Vrouw	29	58%
Leeftijd	Min.	18	
	Max.	88	
Huidtype	I	8	16%
	II	32	64%
	III	9	18%
	IV	1	2%
Locatie	Gelaat	18	36%
	Nek	5	10%
	Rug	5	10%
	Schouder	4	8%
	Arm	4	8%
	Andere	4	8%
Symptomen	Geen	19	38,5% (19/50)
	Verandering vorm/kleur/grootte	19	61% (19/31)
	Niet genezend/infectieus	12	39% (12/31)
	Jeuk	8	26% (8/31)
	Bloedend	1	3% (1/31)
Persoonlijke voorgeschiedenis huidkanker	Geen	39	78%
	Melanoom	4	8%
	BCC	6	12%
	Type onbekend	1	2%
Familiale voorgeschiedenis huidkanker	Geen	43	86%
	Melanoom	1	2%
	SCC	1	2%
	Type onbekend	5	10%
Opleidingsniveau	Lager	4	8%
	Middelbaar	16	32%
	Hoger	17	34%
	Universiteit	13	26%
Gebruik van immunosuppressiva	Nee	46	92%
	Ja	4	8%

Table 1. study population and characteristics