

Skin Cancer Smartphone Applications for German-speaking Patients: Review and Content Analysis Using the Mobile App Rating Scale

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In response to the increasing incidence of skin cancer (1), dermatology-specific applications (software), such as skin cancer smartphone apps, have been developed, addressing various topics such as the detection of skin cancer via computer-based algorithms. Physicians still serve as the primary information and diagnostic source for patients diagnosed with any cancer entity (2). However, due to limited time for physicians to provide comprehensive consultations (3), many patients tend to use further information sources to compensate for their informational deficits (4). Thus, skin cancer-related smartphone apps might represent useful supportive information tools. The aim of this study was to systematically identify and evaluate skin cancer smartphone apps that are available in German to provide an overview of their features, quality and practicability.

METHODS

The Apple App Store via iTunes and Google Play Store for smartphone apps were searched up to 12 September 2018 to identify all relevant skin cancer-related apps. The search terms covered skin cancer in general, melanoma and non-melanoma skin cancer (NMSC), and German synonyms for “mole”. Apps had to meet the following inclusion criteria: (i) cover skin cancer; (ii) address previously unaffected (primary prevention) or affected individuals (secondary prevention); (iii) address lay people; and (iv) be available in German. Apps were excluded if they were addressed towards health professionals, created for entertainment (e.g. games) or provided information for medical conferences. Titles of the smartphone apps were independently screened for duplicates and the pre-defined eligibility criteria (TS, AW).

All preselected apps that were available free of charge were downloaded. Information related to the individual features and aims of the apps were extracted by the same reviewers independently. The Mobile App Rating Scale (MARS) was used for evaluation of the apps (5). MARS is an expert-based rating scale consisting of multiple dimensions that assess engagement, functionality, aesthe-

tics, content and subjective quality on a 5-tier scale. The subjective quality dimension was omitted, as performed in other studies (6).

Descriptive statistics, including the expression of each dimension of the scale as mean values and standard deviations (SD), were performed with MS Excel (version 2010, Microsoft Corp., Redmond, WA, USA) and SPSS (IBM SPSS Statistics version 25, IBM Corp., Armonk, NY, USA). Inter-rater agreement of the 3 reviewers was determined using the intra-class correlation coefficient (ICC) and inter-item correlation. The relationship between the number of features and the MARS score dimension were examined using Spearman's correlation. A significance level of 0.05 was considered statistically significant.

RESULTS

The search identified 677 smartphone apps. Using a multi-step process, the apps were screened for duplicates and for accordance with the study eligibility criteria. A final total of 17 smartphone apps met the eligibility criteria. Descriptive information about the content of the apps is shown in Tables SI, SII and Fig. S1¹.

Sixteen apps were downloaded. Three apps were not available free of charge; however, 2 of these (“UV Radiation now” and “My Skin Pal”) were available as free versions, which were used for evaluation. The mean \pm SD MARS score ranged from 4.36 ± 0.42 (“My SkinPal”) to 2.82 ± 0.52 (“eDerma”), with a mean score of 3.78 ± 0.55 (Table SIII¹). The aesthetics dimension obtained the highest mean score (4.10 ± 0.66) and the information dimension the lowest (3.68 ± 0.61). The mean scores for the dimensions “functionality” and “engagement” were 3.89 ± 0.55 and 3.40 ± 0.64 , respectively. The most variability was observed for the 2 dimensions aesthetics (IQR 1.19) and engagement (IQR 1.18) (Fig. 1, Table SIV¹). An acceptable overall inter-rater agreement (ICC: 0.774, 95% confidence interval (95% CI) 0.676–0.838) was determined (7). The inter-item correlations r varied from 0.505 to 0.682, indicating moderate individual agreement between the 3 reviewers when assessing the individual items (Table SV¹). General and functional characteristics of the evaluated apps were statistically significantly associated with the total MARS score. The apps' number of features was significantly negatively correlated with the engagement dimension, i.e. higher engagement scores were more likely to be achieved by apps that offered few features. Within the MARS dimensions, all dimensions statistically significantly correlated with each other (Table SIII¹).

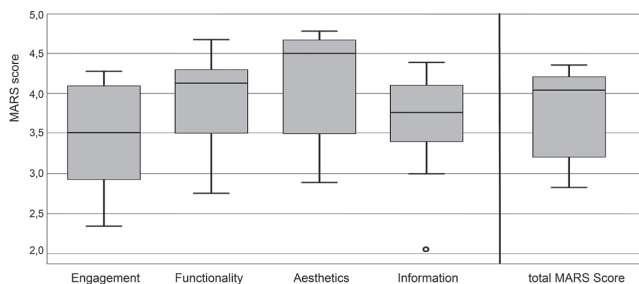


Fig. 1. Box plot showing the Mobile App Rating Scale (MARS) dimension scores. The box plot shows the median, first, and third quartiles and minimum and maximum scores, outliers are depicted as circles. The dimensions are evaluated on a 5-point scale ranging from 1 to 5 (1 = inadequate, 2 = poor, 3 = acceptable, 4 = good, and 5 = excellent).

¹<https://doi.org/10.2340/00015555-3240>

DISCUSSION

Seventeen skin cancer smartphone apps currently available in German were identified and their contents evaluated using a standardized rating scale (MARS). The majority of identified apps covered the topics education and prevention of skin cancer (i.e. education on the harms of sun exposure, application of sunscreen), followed by apps for self-monitoring, tracking of skin lesions and mole analysis tools. Four apps were additionally connectable to a chargeable dermoscopy device.

Interestingly, none of the apps specifically addressed NMSC, although this is the most common type of all cancers (8). The reason for this might be that non-pigmented skin cancer lesions are not easy to document and evaluate photographically (9) and that NMSC is considered to be less dangerous than melanoma (8). Hence, there might be no substantial demand for sole NMSC apps. In addition, NMSC tends to affect older individuals who are not the primary target group for smartphones.

Smartphone cameras can provide high-resolution images, making them suitable for skin cancer prevention. Early detection of malignant skin lesions is crucial for a better prognosis, as melanoma tumour staging and prognosis are highly associated (10). In particular, high-risk populations for developing skin cancer, such as immunocompromised patients, organ-transplant recipients and patients with previously diagnosed skin malignancies, may benefit. Education, prevention and self-monitoring, which were the most frequently reported app functions, can help to increase awareness of skin self-examination or of potential risks, such as extensive tanning behaviour.

Altogether, half of the tested apps achieved a high mean MARS score, demonstrating overall high quality. Our analysis showed that apps offering more functions achieved lower engagement scores. A possible explanation could be that these apps might not need to rely as much on user engagement as, for example, apps that intend to change the behaviour of their users (e.g. tanning timers). Questionable quality of provided information and potential security issues are important downsides. Analysis showed that the information score was the lowest of all assessed dimensions (3.68 ± 0.61); therefore, the provided information should be used with caution. In addition, we were unable to identify information regarding the algorithms, colour filters, methodology or the accuracy of the 5 identified risk-assessment apps. Inappropriate algorithms may lead to false-positive or false-negative estimates, with the associated risks of the user either panicking about a harmless condition or not consulting a specialist about a worrisome lesion. In general, the role of apps using artificial intelligence for the analysis of skin lesions is not yet fully established (11).

To date, health-related apps do not have to be authorized or approved in Germany and information regarding the validation of apps remains scarce. Regarding the apps yielded by the current search, little research regarding their validation was available and, if so, it was provided mainly by the app developers (12, 13) or the authors re-

ceived fees from them during the study (9). This makes their reliability questionable. Overall, only 3 apps (“UV-Check”, “MySkinPal”, “Sunface”) have been evaluated by the independent information portal “HealthOn”. Furthermore, nearly all apps have been developed by companies, suggesting potential conflict of interest; for instance, the ultraviolet (UV)-monitoring app “My UV Patch” from La Roche Posay (L’Oréal) recommends using their own sunscreen. Thus, critical and independent scientific review by experts is highly desirable for such apps before they are widely available.

In conclusion, smartphone apps offer inexpensive and attractive means for the education and prevention of skin cancer for lay persons. However, scientific evidence supporting these apps is lacking. Therefore, they should be utilized with caution, and reliability criteria should be implemented in the future.

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