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Results of a 10-year web-based health promotion campaign against skin cancer in Switzerland

Background: Skin cancer is the most common malignancy with rising incidence. Although early detection can be lifesaving, prevention programmes are under-utilized. In 2008, a group of board-certified dermatologists in Switzerland established a website aimed at educating about skin cancer risk factors and providing guidance on self-assessment. **Objectives:** To present the data of this programme over the last 10 years with regards to representation of the targeted groups and sustained impact on primary skin cancer prevention. **Materials & Methods:** A comprehensive web-based health promotion campaign was established for education and guidance on self-assessment. Teledermatological evaluation was offered and participants were then interviewed. **Results:** In total, 11,171 digital photos were evaluated during 2008-2018; 54.3% ($n=6,067$) from females and 45.7% ($n=5,104$) from males. In 26.7% ($n=2,983$), clinical examination was recommended. Of the participants, 1,874 replied revealing 103 malignancies (9.2% of the lesions were presented to a physician): 34 melanomas *in situ*, six squamous cell carcinomas, 53 basal cell carcinomas and 10 malignant lesions (not further specified). Of the participants, 40.5% ($n=683$) changed their attitude towards sun exposure, 48.7% ($n=820$) used more sunscreen, and 57.5% ($n=966$) improved sunscreen measures. **Conclusion:** Web-based educational programmes raise public awareness, enhance prevention, and support early diagnosis of skin cancer. Teledermatology might contribute to reducing skin cancer mortality rates

Key words: eHealth, internet-based education, skin cancer prevention, teledermatology, web-based health promotion campaign, gender medicine

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Skin cancer is the most common malignancy worldwide, particularly affecting fair-skinned populations [1-4]. Both melanoma and non-melanoma skin cancers show a steadily rising global incidence [1]. Between 2005 and 2015, melanoma incidence rates increased up to 56% in Switzerland, with the highest melanoma incidence rates in Europe [5, 6].

Particularly for melanoma, the most lethal skin cancer, early recognition is pivotal. While diagnosis of early stages is associated with excellent prognosis, treatment of advanced melanoma remains challenging. Thus, melanoma is one of the leading causes of death due to cancer among adolescents and middle-aged people [7-9]. However, despite the increasing incidence rates, there is an ongoing trend towards smaller Breslow tumour thickness during recent decades [1, 10, 11]. One reason for this improvement could be due to enhanced education of the population and an earlier diagnosis of neoplasms.

Extensive health promotion programmes regarding sun protection have been ongoing in order to improve people's knowledge about skin cancer risk factors (particularly UV exposure) and early recognition of suspicious skin lesions. Australia, for instance, with the help of extensive

nationwide health campaigns since 1987, achieved significant improvement in sun protective behaviour during 1987 and 2002 [12-14]. Furthermore, melanoma rates in Australia have been falling since 2005, while they have further increased in southern and eastern Europe [15, 16]. The effectiveness of population-based health campaigns to raise awareness of a population is undisputed [13, 14, 17, 18]. However, to maintain public awareness, continuous promotion activities are mandatory [13, 14, 17]. In Switzerland, skin cancer prevention has been promoted since 1988 by the Swiss League against Cancer [19]. Nonetheless, public knowledge and awareness is still insufficient, and there is high sunburn prevalence among the young Swiss population and implementation of sun protective behaviour is lacking [20-22].

Particularly among the young and middle-aged population, the internet is the most progressive tool to receive health-related information [23-29]. This has an increasing impact on teledermatology, which has proven to be a reliable (and economical) tool for skin cancer screening [30-33]. However, the majority of skin cancer-related web sites lack important information about risk factors and preventative measures, and several websites even contain incorrect information [34, 35]. Therefore, information on the internet of high quality but comprehensible to the general public is required for education as part of primary

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and secondary prevention strategies against skin cancer [29, 35].

Therefore, in 2008, a group of board-certified dermatologists in Switzerland established a website which educates about skin cancer risk factors and provides guidance on self-assessment, offering a cost-free teledermatological service. The first year was aimed at recruiting participation of particularly male and middle-aged individuals, who are commonly under-represented in prevention programmes [36]. In order to re-assess ongoing representation of the targeted groups and sustained impact on primary skin cancer prevention, we analysed the data from the last 10 years.

Participants and methods

The website (www.myskincheck.ch) has been annually promoted in the mass media and via on-site promotions in pharmacies since 2015, as well as via digital media. The website contains comprehensive information about skin cancer, its risk factors, sun protective behaviour, and instructs about self-examination of the skin according to the ABCD-rule (Asymmetry, irregular Border, multiple Colours, and rapid Dynamic). Teledermatological evaluation of suspicious skin lesions is provided every year, over a period of a month (in May). Visitors of the webpage can upload their lesions in question and receive standardized management recommendations from a dermatologist:

- (1) Your lesion is harmless. If there is no change within the next six months, it can be considered benign.
- (2) The resolution of your photo is insufficient for teledermatological evaluation.
- (3) Your lesion is suspicious.

All participants with the latter response were advised to consult a dermatologist or a general practitioner. Participants who gave their permission for a follow-up interview were then contacted via email. They received an individual link to the online survey and were asked about their diagnosis and the influence of the health promotion campaign on their sun protective behaviour. Follow-up survey questions are presented in *table 1*.

Statistics

Statistical analysis was performed using Microsoft Excel 2010 and GRAPHPAD PRISM software version 5.00 (GraphPad Software, San Diego, CA, USA). Mean improvement scores (MIS), standard deviation (SD) and confidence intervals (CI) of 95% were computed.

Results

Since the start of the prevention project, the webpage was frequented 287,760 times and 11,171 skin lesions were uploaded. The highest number of participants was recorded in 2011 ($n = 2,266$) followed by 2018 ($n = 1,654$) (*table 2*). Overall, 6,067 inquiries were from females (54.3%) and 5,104 from males (45.7%).

Of the 11,171 evaluated lesions, 26.7% ($n = 2,983$) were classified as suspicious by our dermatologists and 59.5% ($n = 6,681$) as harmless. In 13.5% ($n = 1,507$), the quality of the photo was insufficient for evaluation.

Table 1. Follow-up survey questions

1. Did you follow our advice to see a dermatologist? Dermatologist Other doctor No consultation
2. Where was / is the suspicious skin lesion? Face Chest Back Arms Legs Other
3. Has the lesion been removed? Yes No
4. Was it benign or malignant? Benign Malignant Unknown
5. What was the diagnosis? Melanoma Basal cell carcinoma Squamous cell carcinoma Lentigo benigna Seborrheic keratosis Nevus Unknown Other
6. Has your attitude towards solar radiation changed after visiting this webpage? Yes No
7. Have you used more sunscreen since the initial response? Yes No
8. Have you used improved UV protection strategies in terms of shade, lunch breaks, and clothing since the initial response? Yes No
9. Demographic data (Sex, Age)

Of the 11,171 participants, 6,825 (61.1%) agreed to being subsequently contacted, and email addresses were valid at the time of the survey for 6,171 participants: 97 in 2008, 673 in 2009, 646 in 2010, 1,171 in 2011, 356 in 2013, 386 in 2014, 632 in 2015, 347 in 2016, 645 in 2017 and 1,218 in 2018 (in 2012, no email addresses were collected).

Responses

Of the contacted participants, 30.4% (1,874/6,171) answered the follow-up queries, and 91.7% (1,719/1,874) of those answered the entire survey. Of the participants who responded, 49.5% (927/1,874) were females and 44.2% (828/1,874) males; 6.4% (119/1,874) did not declare their gender. The average age at the time of participation was 41.9 years (SD: 14.9), and females were slightly younger (mean age: 39.4; SD: 13.9) than males (mean age: 44.7; SD: 15.5) (*figure 1*).

Table 2. Number of participants who uploaded photos of skin lesions for assessment.

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Uploaded skin lesions (n)	494	1342	1042	2266	783	598	598	921	532	929	1654

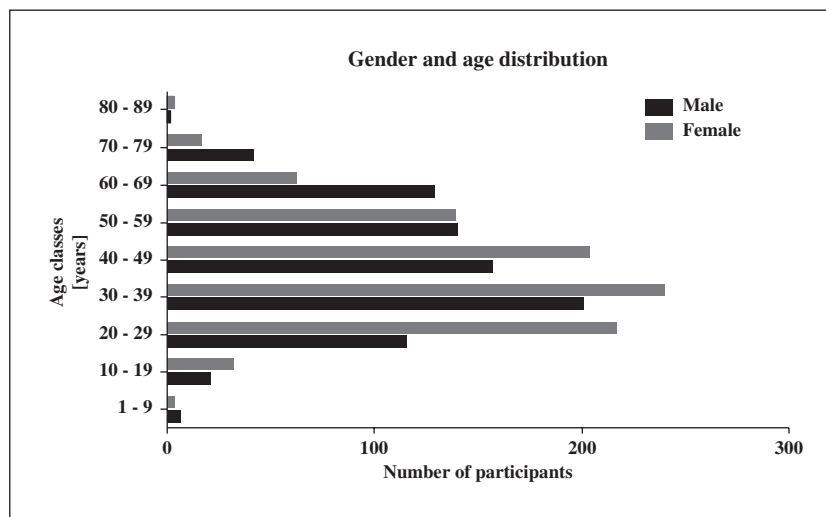


Figure 1. Gender and age distribution of the survey participants.

Compliance with management recommendations

Of all the participants, 59.6% (1,117/1,874) presented their lesion to a medical practitioner: 48.5% to a dermatologist (n = 909) and 11.1% to another physician (n = 208).

In 2008, 83.1% of the participants who received the recommendation for medical referral (64/77; 29 females, 48 males) followed this advice: 86.2% (25/29) of females and 81.3% (39/48) of males. Of these participants, 95.3% (61/64) consulted a dermatologist and 4.7% (3/64) consulted another physician.

In 2018, 71.6% (48/67; 36 females, 28 males) of the participants followed the advice for medical referral: 75.0% (27/36) of females and 71.4% (20/28) of males (gender was unknown in three participants). Of these, 83.3% (40/48) consulted a dermatologist and 1.7% (8/48) consulted another physician.

Thirteen (16.9%) participants in 2008 and 18 (26.9%) in 2018 did not follow the recommendation, and one participant in 2018 did not answer the question (figure 2).

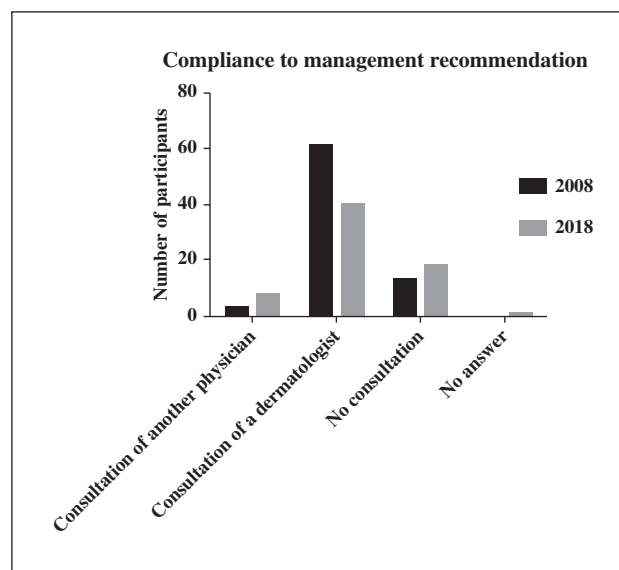


Figure 2. Compliance with management recommendations.

Excision

In response to the answers from participants, 430 underwent an excision of the skin lesion, corresponding to 38.5% (430/1117) of lesions presented to a physician. In 58.3% of these lesions (651/1117), excision was not considered by the physician; 3.2% of the participants (36/1117) did not answer.

Diagnosis

Of the 1,117 lesions that were presented to a physician, 103 (9.2%) were evaluated as malignant: 34 lesions were diagnosed as melanomas, 53 as basal cell carcinomas, and six as squamous cell carcinomas. Ten participants could not provide the diagnosis of their malignant lesion.

Additionally, 76.9% (n = 859) of all skin lesions referred to a physician were evaluated by the consulted physician as benign. The benign diagnoses included 433 melanocytic nevi, 112 benign lentigines, 80 seborrheic keratoses, five fibromas and 25 other benign lesions. In 197 cases, the participants could not provide the definitive diagnosis and seven participants with a benign lesion did not answer the question about their diagnosis. Of the participants, 111 (9.9%) did not know whether their skin lesion was benign or malignant: of these, 104 were unaware of their diagnosis, five had another diagnosis unrelated to skin cancer, and two participants did not declare a diagnosis. Forty-four (3.9%)

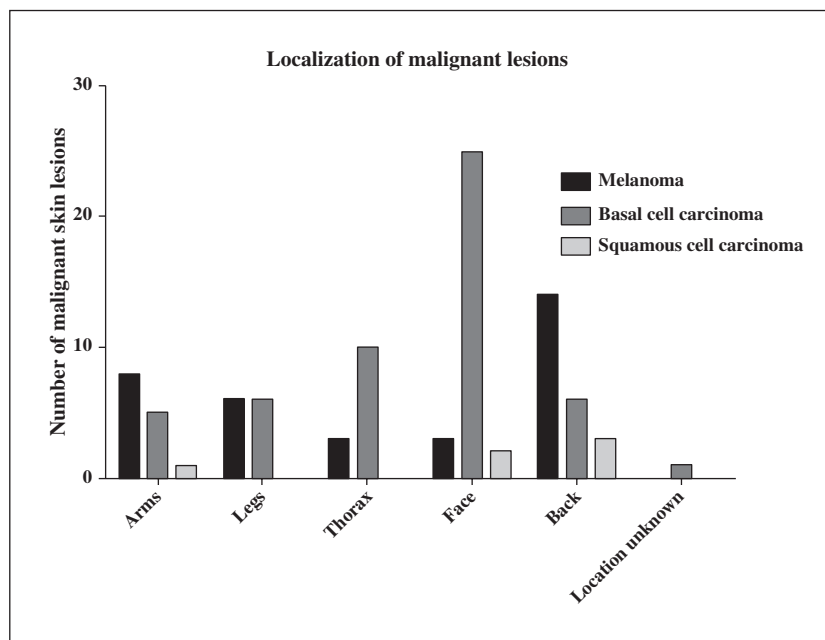


Figure 3. Localization of malignant lesions.

participants did not answer the question about malignancy and diagnosis.

Malignant lesions

Malignancies were found in 59.2% of males (61/103) and 40.8% of females (42/103).

At the time of diagnosis of malignancies, the mean age was 54.2 years (SD: 13.9); 51.1 years (SD: 13.6) in females and 56.3 years (SD: 13.8) in males.

The highest number of malignancies was observed in 2011 ($n = 22$), and in the same year, the largest number of participants was recorded, with 2,266 uploaded lesions.

Except for two melanomas, which were clearly lentigo malignas, all other melanomas were excised. Basal cell carcinomas were removed in 49 of 53 cases. Four of the six squamous cell carcinomas were excised. The non-excised malignancies were most likely treated either by superficial radiation therapy or other treatment modalities (no further data available).

Classification of malignant lesions by participants

Participants were asked about their knowledge of the malignancy of their skin lesion. Of the 53 participants with basal cell carcinoma, 36 had the impression that their basal cell carcinoma was benign, 13 knew that their basal cell carcinoma was malignant, and four were unaware of the nature of their basal cell carcinoma. Of the six participants with squamous cell carcinoma, one evaluated the lesion as benign, three as malignant, and two were unaware. Participants with melanomas evaluated their lesions as malignant in 30 of 34 cases and benign in four cases.

Anatomical distribution of malignant skin lesions

Malignant lesions were derived from the face in 32.0% (33/103), from the back in 23.3% (24/103), from the arms in 18.4% (19/103), from the thoracic region in 12.6% (13/103)

and from the legs in 11.7% (12/103). In two participants, the location of the malignant lesion was unknown.

Basal cell carcinomas were found on the face in 47.2% (25/53), on the thoracic region in 18.9% (10/53), on the back in 11.3% (6/53), on the legs in 11.3% (6/53), on the arms in 9.4% (5/53), and the location was unknown in one case.

Melanomas were located on the back in 41.2% (14/34), on the arms in 23.5% (8/34), on the legs in 17.6% (6/34), on the face in 8.8% (3/34), and on the thoracic region in 8.8% (3/34).

Squamous cell carcinomas were derived from the back in 50% (3/6), from the face in 33.3% (2/6) and from the arms in 16% (1/6) (figure 3).

Behavioural adjustment

Of the participants who responded to our survey, 40.5% (683/1687) adjusted their attitude towards solar radiation after visiting this webpage; 40.3% of females (362/898) and 40.8% of males (318/780). Sunscreen usage was increased in 48.7% of participants (820/1685); 47.3% of females (425/898) and 50.5% of males (394/780). UV protection strategies, in terms of searching for shade, use of lunch breaks to shelter from sun exposure, and/or wearing long clothes, were improved in 57.5% of the survey participants (966/1,681).

Attitudes towards sun exposure were changed after visiting the webpage in 69.8% (67/96) of participants with indicated malignant skin lesions and in 43.6% (345/792) of the participants with indicated benign skin lesions. Sunscreen usage increased after visiting the webpage in 69.8% (67/96) of participants with a malignant diagnosis and in 52.5% (416/792) with a benign diagnosis. UV protection measures, in terms of seeking shade and using lunch breaks and clothing to shelter from UV exposure, were enhanced in 76.0% (73/96) participants with a malignant diagnosis

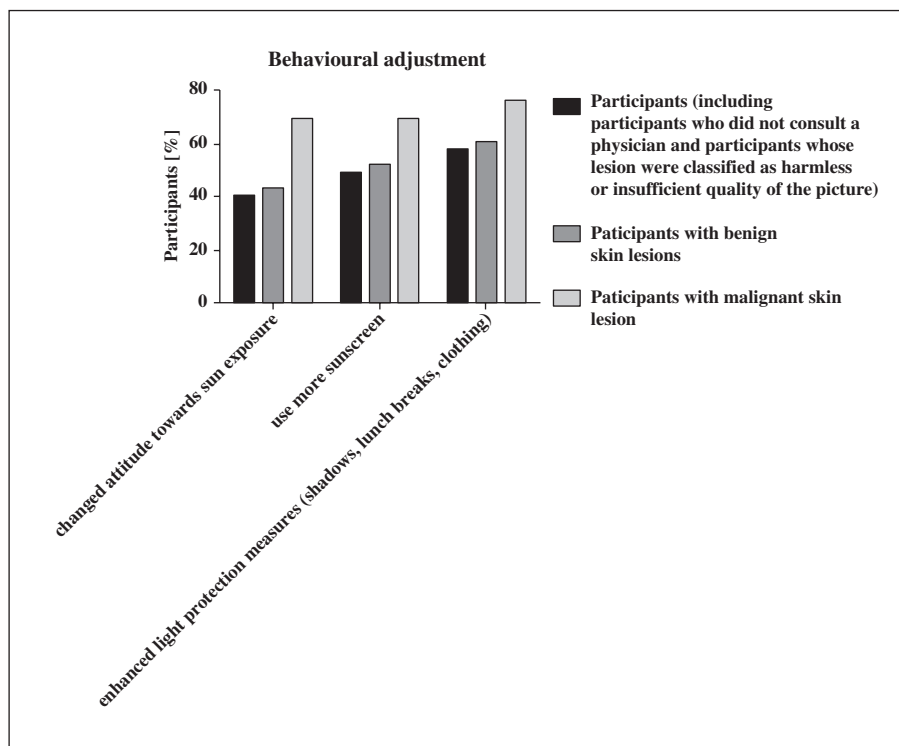


Figure 4. Behavioural adjustment (changed attitude towards sun exposure, usage of sunscreen and enhanced light protection measures) of all participants, participants with benign skin lesions and participants with malignant skin lesions after visiting the webpage.

and in 60.8% (480/790) participants with a benign lesion (figure 4).

Time and cost

A network of 9 to 14 participating dermatologists per year ensured the timely evaluation of each inquiry. On average, patients waited 1.38 days for a response from the dermatologist about the status of their skin lesion. The annual cost for dermatologists varied from 15.000 CHF to 20.000 CHF depending the number of participants (corresponding to 15-20 CHF for each photograph, depending on the year). Supplementary annual costs consisted of a maintenance cost of 5.000 CHF for the website and marketing costs of 10.000 CHF for promotion and online campaigns.

Discussion

In order to control increasing incidence rates of skin cancer, prevention strategies and early detection of skin cancer is mandatory [1, 17, 18]. Since the majority of melanomas are discovered by the patients themselves or their partners, periodic public education regarding skin cancer risk factors, criteria and self-examination of the skin is requisite [37, 38]. Previous studies have already underscored the importance of skin examination at the time of melanoma diagnosis in reducing Breslow's index [38-40]. Superior results in terms of patient survival are achieved with complementary primary and secondary prevention [41].

With increasing usage of the internet in professional and social life - including health-related issues - appropriate web-based education for prevention becomes more and more important [26, 42-44].

Since teledermatology (along with, but also without, dermoscopy) has proven to be a sensitive and specific tool with high predictive value, its wide-ranged usage suggests that it is useful in population-based skin cancer screening - not only from an economical point of view [30, 45, 46]. The use of specialised experts in analysing uploaded lesions provided high quality evaluation. Although dermoscopic evaluation by experienced dermatologists is superior, this would not normally be directly available to the majority of the population. Therefore, we focused on teledermatology without dermoscopy. Expectedly, the website generated strong interest, with 287,760 users of the website since the start of the prevention project, 10 years ago, with 11,171 uploads of skin lesions for dermatologic evaluation. Participants were not bound to a physical consultation in terms of time or place. If such a programme could be offered throughout the year, the diagnostic delay of weeks or months up to the appointment with the physician could be prevented, and participants could receive a specialist opinion within a few days and even use this application abroad, for instance during holidays or business travel. Furthermore, diagnostic efficiency could be improved as diagnosis is made by specialists who are centralised. On average, our patients waited 1.38 days for a response from the 9 to 14 participating dermatologists regarding the status of their mole. In 2018, the system evolved to better manage requests, and those older than three days were automatically redistributed to another dermatologist. With a bigger network of dermatologists, the upscaling of this operation seems very promising. During pandemics, web-based health programmes and particularly teledermatology play an even greater role as they ensure medical care without the risk of infection, especially

for high-risk patients. We may assume that this effect will remain, at least partly, even after pandemics, and increasing web usage will continue to play an important role in many different aspects of life, as well as in health issues.

One of the goals of this project was to reach the male population as their participation in traditional prevention programmes is less frequent compared to females [27, 44, 47]. Furthermore, the incidence of melanoma is higher in males who present with more advanced stages when diagnosed [48]. By promoting the programme, the teledermatology service reached more males than females in the first year with 53% male participants [36]. In the following years, this distribution was not retained, with 45.7% (5,104/11,171) male and 54.3% (6,067/11,171) female participants, although the number of participants overall increased (table 2). However, a fairly balanced gender ratio could be gained with greater male participation compared to classic prevention programmes which usually register 20-42% male participants [49]. Participants' compliance was comparatively high, up to 83.1%, and females were more compliant (up to 86.2%) than males (up to 81.3%), although this was not significant. However, after visiting the website, behavioural adjustment was slightly better in males who answered the survey compared to females; 50.5% of males and 47.3% of females increased their sunscreen usage. UV protection strategies, such as usage of shade, lunch breaks, or clothes, were improved in 59.1% of males and 55.9% of females. In 2008, we hypothesized that men are less likely to seek a physical consultation and less interested and therefore less informed about the topic, but could be more responsive to internet-based health information. The results of 2008 reflect the social changes and attitude towards web-based information both for males and females. The development over the years, however, reflects the adjustment of web usage throughout the whole population, relatively independent of gender or age.

With the help of this webpage, at least 103 malignant lesions including 34 melanomas, 53 basal cell carcinomas, six squamous cell carcinomas, and 10 other malignancies were diagnosed. These data refer to at least 0.13% of Switzerland's annual melanoma incidence with 2,700 melanoma cases per year (3.4/2,700) [50]. An even higher rate of malignancies based on our programme may be assumed, as only 8.6% (962/11,171) of all participants, who uploaded a photo, subsequently took part in the survey and indicated their diagnosis and/or the nature of their lesion. In addition, it is conceivable that not all participants with malignant diagnoses answered our email survey reliably. In particular, participants with a malignant diagnosis may not have participated due to health issues or a desire to remain private.

However - in contrast to the evaluation in 2008 - participation in the teledermatological study and the subsequent survey was lower in males throughout the following years (45.7% [5,104/11,171] and 44.2% [828/1,874]) and more malignancies were found in males (59.2% [61/103]).

The anatomical distribution of melanomas and basal cell carcinoma is in accordance with the literature. Most melanomas were located on the back (41.2%) and extremities (41.2%), while basal cell carcinomas were preferentially localized on sun-exposed areas (47.2% on the face). In contrast, squamous cell carcinomas demonstrated atypical distribution and were mostly detected on the back (50%) followed by the face (33.3%) and the arms (16%).

However, the small proportion of squamous cell carcinomas ($n=6$) detected in this study most likely biased this distribution and this should therefore be taken into account [51-53].

Interestingly, knowledge about the nature of skin lesions was inconsistent among participants with malignant lesions. While 88.2% of participants with melanoma were informed about the malignancy of their skin lesion, 67.9% of participants with basal cell carcinoma classified their skin lesion as benign and 7.5% were unsure whether the lesion was benign or malignant. Likewise, 16.7% of the participants with diagnosed squamous cell carcinoma evaluated their skin lesion as benign, and 33.3% could not specify whether it was benign or malignant. Misleading communication from physicians, in an attempt to not unsettle their patients, might be an explanation, as well as a lack of consultation time for education. However, a lack of knowledge might result in an underestimation of skin cancer risk and reduce compliance regarding risk-limiting behaviour and self-examination. This study supports this hypothesis as the influence of the webpage on sun protective behaviour of participants with malignant skin lesions (69.8%; 67/96) was significantly higher compared to that of individuals with benign skin lesions (43.6%; 345/792). Changes in sun protection behaviour also seem to have improved after a malignant diagnosis; 69.8% (67/96) of the participants with a malignant diagnosis used more sunscreen after visiting the webpage and 76.0% (73/96) considered more sun protection measures, such as the use of shade, lunch breaks and clothing. On the other hand, among participants with benign skin lesions, only 52.5% (416/792) used more sunscreen and 60.8% (480/790) enhanced their sun-protective measures.

Although the greatest educative effect of the webpage was detected following a malignant diagnosis, the other participants also benefitted from this website; 40.5% (683/1,687) of all participants who responded to our survey changed their attitude towards sun protection, 48.7% (820/1,685) used more sunscreen, and 57.5% (966/1,681) improved their UV protection techniques. Three participants indicated that they did not change their behaviour, as they already used intense sun protective measures before visiting the website. The measured effect on habitual changes by this web-based prevention campaign is relatively high compared to other educational programmes with comparable design. Furthermore, contrary to most web-based campaigns, we detected a large long-term effect [54-57]. However, data are not directly comparable and different habits may be variably prone to change. Notably, despite a lower compliance to management recommendations and participation in prevention projects, males showed improved implementation of sun protective behaviour after visiting the webpage compared to females. An underlying reason could be that females had already implemented improved UV protection strategies, in contrast to males, before visiting the educational web site. This possibility, however, underscores the necessity for gender-adapted education.

A limitation of the study is the retrospective nature of the email survey which was performed on a voluntary basis. Consequently, 16.8% (1,874/11,171) of all participants responded and uploaded a photo of their skin lesion for dermatologic evaluation. In particular, participants with malignant skin lesions may have avoided participation due

to concerns about data protection, or did not participate in the survey because of their disease. Furthermore, high-risk behaviours, such as tanning (indoor/outdoor), holidays in sun-intense regions or doing a lot of out-door activities, were not addressed in this questionnaire and might have biased our results. However, as we collected a large data set over 10 years with a total of 1,874 survey participants, this bias may have been limited. Due to the retrospective design of this study, we were unable to analyse data relative to tumour stage or precise diagnosis.

In conclusion, the presented survey confirms that online prevention programmes can sensitize the population to risk factors and lead to behavioural changes, reducing at-risk behaviour. For early diagnosis of skin cancer, teledermatology is an effective technique that may reach a large proportion of a population with a high level of compliance, which is usually not easily achieved due to working life or other time constraints. For the future, increased usage of web-assisted diagnostic methods could be an efficient way to further enhance skin cancer prevention and screening with the help of gender-adapted responsiveness. Further data on the effect of psychological aspects, such as compliance and patient confidence based on computer-assisted diagnostic techniques, are required, as well as targeted gender-adapted education. ■

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