Objective: To explore the frequency of excisions and yields of histopathologically confirmed skin cancer.

Design: A population-based skin cancer screening intervention (the SCREEN project) in the German state of Schleswig-Holstein (July 1, 2003, to June 30, 2004).

Setting: Physician offices. Participants could choose between nondermatologist physicians and dermatologists for their initial whole-body skin examination. All screening physicians received a mandatory 8-hour training course.

Participants: Inhabitants of Schleswig-Holstein 20 years or older with statutory health insurance (N=360,288).

Main Outcome Measures: Frequency of excisions and yields of malignant skin tumors (malignant melanomas [MMs], basal cell carcinomas [BCCs], and squamous cell carcinomas [SCCs]), stratified by sex and age.

Results: Overall, 15,983 excisions were performed (1 of 23 screenees). A total of 3,103 malignant skin tumors were diagnosed in 2911 persons: 585 MMs, 1,961 BCCs, 392 SCCs, and 165 other malignant skin tumors. Overall, 116 persons (3,103 of 360,288) had to be screened to find 1 malignant tumor, with 1 of 620 for MM, 1 of 184 for BCC, and 1 of 920 for SCC. Twenty excisions were performed to find 1 melanoma in men 65 years and older, but more than 50 excisions were required to find 1 melanoma in men aged between 20 and 49 years.

Conclusions: The results of SCREEN suggest a high yield of malignant skin tumors in a large-scale population-based screening project. We found that a high number of excisions was performed in the youngest screenees with an associated low yield, suggesting a need in screener training to emphasize a more conservative attitude toward excisions in young screenees.


Online First

Frequency of Excisions and Yields of Malignant Skin Tumors in a Population-Based Screening Intervention of 360,288 Whole-Body Examinations

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Worldwide, the incidence of skin cancer has risen dramatically during the past 10 to 30 years. With the aim to reduce the burden of skin cancer, different screening activities have been conducted in many European countries and overseas during recent years. In 1999, the Euromelanoma campaign began in Belgium (http://www.euromelanoma.org), with free skin cancer screening offered once a year during “Euromelanoma Day.” Almost 30 European countries participate in “Euromelanoma Week” and offer skin cancer screening by dermatologists at specialized clinics to anyone who has a suspicious-looking skin lesion. The “Euromelanoma Weeks” are accompanied by mass media campaigns that have successfully attracted many individuals at risk for skin cancer.

Mass screenings, led by dermatologists, have likely reached almost 3 million individuals in the United States and Europe, but there are an insufficient number of dermatologists to conduct population-wide screenings of high-risk individuals. Many at-risk individuals have never been screened for skin cancer. In view of the supply and demand imbalance seen elsewhere, dermatologists and general practitioners were an integral component of the melanoma screening campaigns in Queensland, Australia.

The Association of Dermatological Prevention implemented the SCREEN project (Skin Cancer Research to Provide...
Evidence for Effectiveness of Screening in Northern Germany), a systematic screening intervention throughout the entire German federal state of Schleswig-Holstein (2.8 million inhabitants) between July 1, 2003, and June 30, 2004. In this analysis, we explored the frequency of excisions and yields of histopathologically confirmed skin cancer in 360 288 persons being screened during the 12-month project.

**METHODS**

**PARTICIPANTS, PHYSICIAN TRAINING, AND SCREENING PROCEDURES**

To be eligible to receive a whole-body skin examination during SCREEN, participants had to reside in Schleswig-Holstein, be 20 years or older, and hold a statutory health insurance policy. The latter applies to approximately 85% of the population of Schleswig-Holstein. Information about and recruitment for the SCREEN project was realized via a comprehensive communication concept, including mass media campaigns (eFigure; http://www.archdermatol.com), informational leaflets sent out by health insurance companies, and direct communication between physicians and patients.

A broad range of practice-based physicians, including dermatologists and nondermatologist physicians, were invited to participate in SCREEN. To be authorized to examine participants for skin cancer, physicians were required to attend an 8-hour training course before the start of the SCREEN project. Training courses, conducted between April and September 2003, were attended by 116 dermatologists and 1673 nondermatologist physicians (general physicians, gynecologists, urologists, and others), composing 98% of all practice-based dermatologists and 64% of all eligible nondermatologist physicians with practices in the state of Schleswig-Holstein. Further details on the training are provided elsewhere.

The SCREEN project was designed as a 2-step intervention (Figure), that is, people who chose pathway A were first seen by a nondermatologist physician to receive a whole-body skin examination (step 1). In the case of 1 or more suspicious skin lesions or after having been identified as an individual at increased risk for skin cancer owing to the prevalence of risk factors, screenees were referred to a dermatologist for whole-body skin examination (step 2). As an alternative to the 2-step procedure, participants were also free to see a dermatologist directly for the whole-body skin examination (pathway B).

Individuals were instructed that they could receive only 1 screening examination. However, a few individuals received more than 1 SCREEN examination, each conducted by a different physician. For the present analyses, only first SCREEN examinations were included.

**MEASURES**

All the participating physicians completed a standardized case report form for each screened individual. In addition to personal data, such as age and sex, nondermatologist physicians documented the prevalence of risk factors (for malignant melanoma [MM]: personal history of melanoma, clinically atypical nevi, etc; or for nonmelanoma skin cancer [NMSC]: lasting UV-damaged skin, actinic keratosis, etc), the tentative clinical diagnosis, and recommendation for referral to a dermatologist if necessary. Dermatologists additionally documented a more detailed tentative clinical diagnosis, excision (yes/no; the common dermatologic practice is a full-thickness elliptical procedure with dermal and superficial sutures, conducted by the dermatologists), and the results of the histopathology report on a separate case report form. After physicians submitted the case report form, they were eligible to charge the screening service (extra-budgetary, €15/$20 per screening procedure) to their regional Association of Statutory Health Insurance Physicians. Only 1 excision per person and only 1 malignant finding per tumor entity (MM, squamous cell carcinoma [SCC], basal cell carcinoma [BCC], other malignant finding, or benign finding) per person was counted and included in the analysis.

**ETHICS**

Ethics approval was not required as SCREEN was an integral part of standard medical care during the 12-month project. SCREEN participants gave written informed consent for data storage and analysis; participation was voluntary.

**STATISTICAL ANALYSIS**

Data are presented as absolute and relative frequencies or as means (SDs). Analyses of the yields of malignant skin tumors are presented as follows: 1 tumor finding per number of screenees (Yield-S) and 1 tumor finding per number of excisions (Yield-E). A further analysis included only screenees with a screening diagnosis of skin tumors and is presented as follows: 1 tumor finding in a person with a screening diagnosis per number of screenees with a screening diagnosis of skin cancer (Yield-ES). Data are further stratified by skin cancer type (MM, BCC, and SCC), age group, and sex. For subgroup analyses, the numerators and denominators of the previous formulae were adapted accordingly.

**RESULTS**

**THE SCREEN PROJECT**

During the 12-month project, 360 288 inhabitants of Schleswig-Holstein received at least 1 whole-body skin examination, equalling a participation rate of 19.2% of
Research to Provide Evidence for Effectiveness of Screening in Northern Germany.

Of the 3103 confirmed skin cancers, BCC was diagnosed in 2911 persons (1 confirmed skin cancer per all participants). Of these, 3103 malignant skin tumors were ducted by a dermatologist. Of screenees who first saw a nondermatologist physicians, 81 547 (22.6%) were performed by dermatologists (pathway A, step 1). After referral, 46 578 of these persons were again seen by dermatologist physicians (pathway A, step 2). The rate of loss to follow-up in 452 MMs were diagnosed after a suspicion of MM. In 17 of these cases, the dermatologist stated a suspicion of BCC, in 2 cases a clini-

 overarching efficacy of screening in Northern Germany.

A total of 452 MMs were diagnosed after a suspicion of MM. In 17 of these cases, the dermatologist stated a suspicion of BCC, in 2 cases a clini-

Table 1. Description of the Participants in the Population-Based SCREEN Project

<table>
<thead>
<tr>
<th>Variable</th>
<th>Women (n = 265 306)</th>
<th>Men (n = 94 982)</th>
<th>Total (N = 360 288)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population-based participation rate</td>
<td>27.0</td>
<td>10.4</td>
<td>19.2</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>48.2 (16.2)</td>
<td>53.9 (15.7)</td>
<td>49.7 (16.2)</td>
</tr>
<tr>
<td>Age group, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-34</td>
<td>59 513 (22.4)</td>
<td>12 043 (12.7)</td>
<td>71 556 (19.9)</td>
</tr>
<tr>
<td>35-49</td>
<td>86 375 (32.6)</td>
<td>25 133 (26.5)</td>
<td>111 508 (30.9)</td>
</tr>
<tr>
<td>50-64</td>
<td>70 117 (26.4)</td>
<td>29 756 (31.3)</td>
<td>99 873 (27.7)</td>
</tr>
<tr>
<td>≥ 65</td>
<td>49 301 (18.6)</td>
<td>28 050 (29.5)</td>
<td>77 351 (21.5)</td>
</tr>
<tr>
<td>Exclusions</td>
<td>10 296 (3.9)</td>
<td>5 687 (6.0)</td>
<td>15 983 (4.4)</td>
</tr>
<tr>
<td>Stratified by age group, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-34</td>
<td>2337 (3.9)</td>
<td>926 (7.7)</td>
<td>3263 (4.6)</td>
</tr>
<tr>
<td>35-49</td>
<td>3473 (4.0)</td>
<td>1304 (5.2)</td>
<td>4777 (4.3)</td>
</tr>
<tr>
<td>50-64</td>
<td>2586 (3.9)</td>
<td>1554 (5.2)</td>
<td>4140 (4.2)</td>
</tr>
<tr>
<td>≥ 65</td>
<td>1900 (3.9)</td>
<td>1903 (6.8)</td>
<td>3803 (4.9)</td>
</tr>
<tr>
<td>Persons with histopathologically confirmed malignant diagnosesb</td>
<td>1613 (15.7)</td>
<td>1298 (22.8)</td>
<td>2911 (18.2)</td>
</tr>
<tr>
<td>MM/LMMc</td>
<td>372 (23.1)</td>
<td>213 (16.4)</td>
<td>585 (20.1)</td>
</tr>
<tr>
<td>BCCc</td>
<td>1055 (65.4)</td>
<td>906 (69.8)</td>
<td>1961 (67.4)</td>
</tr>
<tr>
<td>SCC/Bowen’s carcinoma/morbus Bowenc</td>
<td>187 (11.6)</td>
<td>205 (15.8)</td>
<td>392 (13.5)</td>
</tr>
<tr>
<td>Other types of malignant skin tumorsc</td>
<td>95 (5.9)</td>
<td>70 (5.4)</td>
<td>165 (5.7)</td>
</tr>
<tr>
<td>Persons with histopathologically confirmed benign findingsb</td>
<td>7838 (76.1)</td>
<td>4032 (70.9)</td>
<td>11 870 (74.3)</td>
</tr>
</tbody>
</table>

Abbreviations: BCC, basal cell carcinoma; LMM, lentigo maligna melanoma; MM, malignant melanoma; SCC, squamous cell carcinoma; SCREEN, Skin Cancer Research to Provide Evidence for Effectiveness of Screening in Northern Germany.

d Percentages refer to the total number of participants with confirmed malignant diagnosis; as a person could have been diagnosed as having more than 1 type of skin cancer, these percentages do not sum to 100%.

c Percentages refer to the total number of participants with excision.

FREQUENCY OF EXCISIONS

Overall, 1 excision was performed per 23 persons examined (360 288 screenees, 15 983 excisions) (Table 1). In this sample, men had more excisions than did women: 1 of 13 for men aged 20 to 34 years and 1 of 19 for men aged 35 to 64 years, in contrast to 1 of 25 and 1 of 27, respectively, in women in the same age groups (data not shown in detail).

Table 2 summarizes the results for melanoma. Overall, 1 in every 620 screenees was diagnosed as having MM (Yield-S). In this sample, yields were higher in men than in women and in older screenees than in younger screenees. The only exception was the yield of MM in the 35- to 49-year-old age group, where 732 women needed to be screened to detect 1 MM compared with 1048 men. The ratio of histopathologically confirmed MM to the number of excisions (Yield-E) was 1:28 in women and men, but more than 50 excisions were performed for MM in men aged 20 to 49 years. Of the 15 983 excisions performed during the SCREEN project, 7408 (46%) were done because of a documented suspicion of MM. A total of 452 MMs were diagnosed after a suspicion of MM, giving a yield of 1 of 17 (Yield-ES). The remaining 133 MMs (of which 55.6% occurred in women) were diag-

In all, 15 983 individuals had lesions excised (4.4% of all eligible persons (women: 27%, men: 10%). Among the SCREEN participants, 3 of 4 screenees were women. Within the respective sex strata, older women and younger men were underrepresented. Of all 360 288 screenees, 2722 (0.76%) reported a previous NMSC, in contrast to 1.4% (1133 of 81 547) and 3.3% (2731 of 81 547), respectively, in women in the same age groups (data no
In 133 cases, 91 persons were at risk for MM, 12 for NMSC, and 19 for MM and NMSC.

SQUAMOUS CELL CARCINOMA

One in 920 screenees was diagnosed as having SCC (Yield-S) (Table 3). Similar to MM, the yields in this sample were higher for men and in the older age groups. The ratio of histopathologically confirmed SCC to the number of excisions (Yield-E) was 1 per 56 in women and 1 per 28 in men. A total of 739 excisions were conducted due to a documented suspicion of SCC, resulting in 207 SCC findings. The ratio of SCC per excision was 1 per 4 in women and in men (Yield-ES). An additional 185 SCCs (of which 53% occurred in women) were histopathologically confirmed in people who did not have a documented screening diagnosis of SCC. In 92 of these instances, the dermatologists stated a screening diagnosis of BCC, in 12 cases a clinical suspicion of MM, and in 40 cases a clinical suspicion of other types of malignant skin tumors. Of all 185 cases, 113 persons were at risk for NMSC, 10 for MM, and 37 for MM and NMSC.

Table 2. Malignant Melanoma (MM) Findings

<table>
<thead>
<tr>
<th>Sex and Age, y</th>
<th>Confirmed MM, Total No.</th>
<th>Excisions Because of Suspicion of MM, No.</th>
<th>MM of Those With Suspicion of MM, No.</th>
<th>Yield-S, 1 MM per X Screeneesa</th>
<th>Yield-E, 1 MM per X Excisionsb</th>
<th>Yield-ES, 1 MM per X Excisions After Suspectc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-34</td>
<td>58</td>
<td>1412</td>
<td>42</td>
<td>1/1027</td>
<td>1/41</td>
<td>1/34</td>
</tr>
<tr>
<td>35-49</td>
<td>118</td>
<td>2066</td>
<td>87</td>
<td>1/732</td>
<td>1/30</td>
<td>1/24</td>
</tr>
<tr>
<td>50-64</td>
<td>109</td>
<td>1165</td>
<td>95</td>
<td>1/644</td>
<td>1/24</td>
<td>1/13</td>
</tr>
<tr>
<td>65+</td>
<td>87</td>
<td>429</td>
<td>74</td>
<td>1/867</td>
<td>1/22</td>
<td>1/6</td>
</tr>
<tr>
<td>Subtotal</td>
<td>372</td>
<td>5092</td>
<td>298</td>
<td>1/714</td>
<td>1/28</td>
<td>1/18</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-34</td>
<td>18</td>
<td>545</td>
<td>12</td>
<td>1/670</td>
<td>1/52</td>
<td>1/46</td>
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<tr>
<td>35-49</td>
<td>24</td>
<td>725</td>
<td>17</td>
<td>1/1048</td>
<td>1/55</td>
<td>1/43</td>
</tr>
<tr>
<td>50-64</td>
<td>72</td>
<td>601</td>
<td>53</td>
<td>1/414</td>
<td>1/22</td>
<td>1/12</td>
</tr>
<tr>
<td>65+</td>
<td>99</td>
<td>445</td>
<td>72</td>
<td>1/284</td>
<td>1/20</td>
<td>1/7</td>
</tr>
<tr>
<td>Subtotal</td>
<td>213</td>
<td>2316</td>
<td>154</td>
<td>1/453</td>
<td>1/28</td>
<td>1/16</td>
</tr>
<tr>
<td>Total</td>
<td>585</td>
<td>7408</td>
<td>452</td>
<td>1/820</td>
<td>1/28</td>
<td>1/17</td>
</tr>
</tbody>
</table>

Abbreviations: Yield-E, yield-excisions; Yield-ES, yield-excisions-suspected; Yield-S, yield-screenees.

a Yield-S is based on the total number of MM diagnosed during the SCREEN project and the total number of screenees included in the project (total and in a given stratum).

b Yield-E is based on the total number of MM diagnosed during the SCREEN project and the total number of excisions performed during the project (total and in a given stratum).

c Yield-ES is based on the number of MM diagnosed of only screenees whose lesions had been excised because of a suspicion of MM and the number of excisions performed because of a suspicion of MM.

Table 3. Squamous Cell Carcinoma (SCC) Findings

<table>
<thead>
<tr>
<th>Sex and Age, y</th>
<th>Confirmed SCC, Total No.</th>
<th>Excisions Because of Suspicion of SCC, No.</th>
<th>SCC of Those With Suspicion of SCC, No.</th>
<th>Yield-S, 1 SCC per X Screeneesa</th>
<th>Yield-E, 1 SCC per X Excisionsb</th>
<th>Yield-ES, 1 SCC per X Excisions After Suspectc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-34</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>35-49</td>
<td>6</td>
<td>14</td>
<td>1</td>
<td>1/1436</td>
<td>1/579</td>
<td>1/14</td>
</tr>
<tr>
<td>50-64</td>
<td>36</td>
<td>75</td>
<td>19</td>
<td>1/1948</td>
<td>1/72</td>
<td>1/4</td>
</tr>
<tr>
<td>65+</td>
<td>145</td>
<td>257</td>
<td>69</td>
<td>1/341</td>
<td>1/14</td>
<td>1/4</td>
</tr>
<tr>
<td>Subtotal</td>
<td>187</td>
<td>349</td>
<td>89</td>
<td>1/1419</td>
<td>1/56</td>
<td>1/4</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-34</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1/12043</td>
<td>1/926</td>
<td>1/2</td>
</tr>
<tr>
<td>35-49</td>
<td>3</td>
<td>8</td>
<td>0</td>
<td>1/8378</td>
<td>1/435</td>
<td>NA</td>
</tr>
<tr>
<td>50-64</td>
<td>33</td>
<td>91</td>
<td>19</td>
<td>1/902</td>
<td>1/48</td>
<td>1/5</td>
</tr>
<tr>
<td>65+</td>
<td>168</td>
<td>289</td>
<td>98</td>
<td>1/167</td>
<td>1/12</td>
<td>1/3</td>
</tr>
<tr>
<td>Subtotal</td>
<td>205</td>
<td>390</td>
<td>118</td>
<td>1/464</td>
<td>1/28</td>
<td>1/4</td>
</tr>
<tr>
<td>Total</td>
<td>392</td>
<td>739</td>
<td>207</td>
<td>1/920</td>
<td>1/41</td>
<td>1/4</td>
</tr>
</tbody>
</table>

Abbreviations: NA, not applicable; Yield-E, yield-excisions; Yield-ES, yield-excisions-suspected; Yield-S, yield-screenees.

a Yield-S is based on the total number of SCCs diagnosed during the SCREEN project and the total number of screenees included in the project (total and in a given stratum).

b Yield-E is based on the total number of SCCs diagnosed during the SCREEN project and the total number of excisions performed during the project (total and in a given stratum).

c Yield-ES is based on the number of SCCs diagnosed of only screenees whose lesions had been excised because of a suspicion of SCC and the number of excisions performed because of a suspicion of SCC.

For further clarification, 1 case was a clinical suspicion of SCC, and in 1 case a clinical suspicion of skin cancer without further specification. Of all 133 cases, 91 persons were at risk for MM, 12 for NMSC, and 19 for MM and NMSC.
Overall, 1 in every 184 screenees was diagnosed as having BCC (Table 4). When these data were stratified by age group within sex, yields were routinely higher for men and for the older age groups. Nine excisions were needed to detect 1 BCC. After a documented suspicion of BCC, 2815 excisions were performed, in which 1707 histopathologically confirmed BCCs were detected (Yield-ES = 1 of 2).

An additional 254 persons (57.5% women) without a documented screening diagnosis of BCC were diagnosed as having BCC. In these cases, dermatologists' presumptive diagnoses were SCC (n=50), MM (n=41), and other types of malignant skin tumors (n=8). Of all 254 cases, 125 persons were at risk for NMSC, 53 for MM, and a further 51 for MM and NMSC.

OTHER TYPES OF MALIGNANT SKIN TUMOR FINDINGS AND BENIGN FINDINGS

In addition to the 585 MM, 392 SCC, and 1961 BCC findings, 165 other types of malignant skin tumors (special forms of malignant skin tumors, eg, fibroxanthoma, T-cell lymphoma, and others) were documented, giving a Yield-S of 1 per 2184 screenees and a Yield-E of 1 per 96.9 excisions. Among those 11 870 persons with benign findings (Yield-S = 1 per 30.4 screenees; Yield-E = 1 per 1.35 excisions), 12 927 different findings were documented. The most common findings were atypical nevi (5265 persons), followed by junctional compound, dermal nevi (5102 persons). Actinic keratosis was diagnosed in 719 persons, and 1841 persons had other skin lesions.

COMMENT

To date, the SCREEN project is the largest population-based skin cancer screening intervention implemented worldwide, with more than 85% of the population of Schleswig-Holstein 20 years or older being eligible for a free whole-body skin examination during the 12-month project period. In this article, we report frequency of excisions, yields of histopathologically confirmed malignant skin tumors, and ratios of malignant neoplasms to the number of excisions for 360 288 screenees. During SCREEN, 15 983 excisions were performed. The overall ratio of 1 excision per 23 screenees was largely dependent on age and sex; that is, large differences were observed when data were stratified by sex and age.

First, in this sample, yields were higher for men, a finding that confirms earlier reports from the United States and Australia. Herein, although only 26% of screenees were men, 36% of all MMs, 46% of all BCCs, and 52% of all SCCs were diagnosed in men. Similar to findings from the large American Academy of Dermatology programs, we found the highest yields in men 50 years and older; that is, although this group composed 16% of the SCREEN sample, they had 29% of all melanomas. It seems that men are less likely to participate in cancer screenings, but when they do, they often generate higher yields. Most likely, the SCREEN project recruited a higher proportion of previously unscreened, high-risk men. In view of the high yields achieved, these results suggest that recruitment strategies for interventions aimed at early detection of skin cancer should aim to screen a greater proportion of men, particularly in the middle-age to older group, a recommendation in agreement with previous research in this area.

Second, observed age differences were similarly striking. A substantially larger number of young people needed to be screened to diagnose a skin cancer, which can be explained by the lower incidence of malignant neoplasms, in particular NMSC, in young persons. However, it was surprising and unexpected that almost 5%
of screenees in the youngest age group had an excision, in particular young men (7.7% compared with 3.9% in young women). In other words, 1 in 13 young men compared with 1 in 25 young women had an excision. Furthermore, more than 50 excisions were performed in men aged 20 to 49 years to confirm 1 melanoma. Overall, we observed that the ratio of histopathologically confirmed malignant neoplasms to excisions was similar between men and women, that is, 1 in 28 women and men who had an excision were diagnosed as having MM, and 1 in 10 women and 1 in 7 men were diagnosed as having BCC. Notable differences were found only for SCC (1 in 56 women and 1 in 28 men). Nevertheless, more than 30 excisions per 1 skin cancer detected in young participants is of concern. Hence, an area of improvement for a screening intervention is to reduce the number of unnecessary excisions of nonmalignant lesions, with particular focus on quality assurance of excisions in young persons.

Third, the overall yield of histopathologically confirmed malignant neoplasms was 1 in 116 screenees. Earlier studies have not reported overall yields for all malignant neoplasms, that is, MM, BCC, and SCC, but we are able to compare the yield of MM with multiple programs in the United States and Europe. In SCREEN, 620 persons needed to be screened to diagnose 1 MM. This yield of 1.6 melanomas per 1000 persons is in line with other reported yields for histopathologically confirmed MM in Australia (2 of 1000), whereas it was lower than that in Padova (6 of 1000; “educational program”), Belgium (9 of 1000; “Melanoma Monday”), and Sweden (9 of 1000), programs with far fewer participants but particularly attracting high-risk individuals and led exclusively by dermatologists. The only database of comparable size to that of the SCREEN project exists from the dermatologist-led American Academy of Dermatology program showing a yield of 1.5 per 1000, that is, almost identical to the present findings. In Australia, a comparable yield of 2 per 1000 was achieved in a program led primarily by primary care physicians who screened 16 383 persons, of which 48.4% were male. In a prospective study from Australia comparing the performance of general practitioners (8790 screening examinations; 45.8% male screenees) and primary care skin cancer clinics (19 965 screenings; 49.8% male screenees), 189 persons needed to be screened to diagnose 1 MM (eg, 6 per 1000), 15 needed to be screened to diagnose 1 SCC (67 per 1000), and 8 needed to be screened to diagnose 1 BCC (120 per 1000), findings different than those found in SCREEN. Note that SCREEN yields were comparable with yields achieved in the Australian and American Academy of Dermatology programs, whereas the melanoma incidence in Australia is 3 times higher compared with that in Germany (GLOBOCAN 2008 data; Australia, 36.7 per 100 000; Germany, 12.1 per 100 000) and in Schleswig-Holstein. In contrast, SCREEN yields were lower compared with yields achieved in the Euromelanoma campaign targeting high-risk individuals, albeit the melanoma incidence in Germany is comparable with that in Italy (8.9 per 100 000), Belgium (10.4 per 100 000), and Sweden (16.0 per 100 000).

Within the SCREEN project, melanoma was more commonly diagnosed than was SCC despite SCC being more common in the general population. This anomaly may be due to the prescreening publicity that targeted moles and MM more so than NMSC.

Of some concern, 7408 individuals had an excision due to a presumptive diagnosis of melanoma; of these, 452 had histopathologically confirmed melanoma. This 1 per 17 ratio exceeds the 1 per 10 ratio found in the American Academy of Dermatology national programs. When these 7408 persons were differentiated according to their screening pathway (nondermatologist physicians plus dermatologists vs dermatologists only), the Yield-ES values were almost the same for the 2 groups (pathway A: 1 per 17, pathway B: 1 per 16).

Fourth, we noted many skin cancers in persons without a documented suspicion of skin cancer; for example, 133 MMs were found in screenees without a documented screening diagnosis of MM (254 BCC and 185 SCC findings). However, we do not know whether the dermatologists did not recognize the lesion to be an MM, BCC, or SCC or whether the dermatologist did not document the exact screening diagnosis. Therefore, further continuous training courses should emphasize the need for accurate documentation as results of the data analysis are valid and reliable only if the documentation itself is valid and reliable.

This project has strengths and limitations. Overall, with a screening intervention for MM, BCC, and SCC that reached 360 288 people (or 19% of the entire region), we could report population-based data for skin cancer screening with more precise estimates of yields and excisions performed by age and sex compared with previous efforts. New information on the rate of excisions and yields by age and sex will be instructive to the emerging efforts to selectively screen high-risk individuals via mass screening programs.

Equally important, this is the largest study of dermatologists and nondermatologist physicians that includes information from screening programs with confirmed diagnoses of MM, BCC, and SCC. SCREEN seems to be an appropriate response to a high demand for screening with a relatively short supply of dermatologists. Herein, all dermatologists and nondermatologist physicians received an intensive and standardized 8-hour training model (including epidemiology, etiology, clinical picture of skin cancers, skin cancer risk factors, criteria for screening appraisal, the screening procedure [anamnesis, standardized whole-body examination, and documentation], and physician-patient communication). The nondermatologist physicians had the ability to refer patients based on the presence of either risk factors or a suspicious lesion.

Furthermore, as a newly implemented screening project may detect “harvested” cases, results may reflect the prevalence rather than the incidence of skin cancer. Programs, such as SCREEN, that rely on targeted advertising to promote screening have difficulties excluding some proportion of asymptomatic cases. Also, because case report forms were submitted does not ensure that whole-body skin examinations were performed. More elaborate quality assurance should be implemented in future
efforts. Finally, we do not know how many skin cancers were missed in the group of screenees lost to follow-up and in the screen-negative persons who visited a non-dermatologist physician first (pathway A screenees). Only recently, record linkages between existing cohorts and the database of the epidemiologic Cancer Registry Schleswig-Holstein have been made possible. An upcoming record linkage will give further insights into the effects of SCREEN on false-negative findings, tumor staging, survival, and mortality.

**CONCLUSIONS**

To our knowledge, SCREEN is the largest skin cancer screening project implemented worldwide. Although this sample size is substantially larger than those of other studies, we achieved comparable yields, especially for melanoma findings, suggesting that large-scale screening interventions detect a high rate of malignant skin lesions. Herein, we report a high number of excisions for few confirmed skin cancers in young screenees. Future screening activities may, therefore, benefit from improved training of the physicians regarding selection of lesions requiring excision. Specifically, we suggest (1) adapting the training curriculum toward a more conservative attitude toward excisions in young screenees and (2) implementing a formal and tailored feedback system in which quality indicators, such as Yield-S and Yield-E, stratified by age and sex are reported to the nondermatologist physicians and dermatologists. We conclude that these results not only inform current policy makers and the wider research community but can also be used as a comparison for the upcoming evaluation of the national Skin Cancer Early Detection Program that was implemented in Germany in July 2008.

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**REFERENCES**

10. Baade PD, Youl PH, English DR, Mark Elwood J, Aitken JF. Clinical pathways to


Murder by Fungus: The Plot to Assassinate Fidel Castro With Madura Foot

Various skin infections (eg, smallpox, anthrax, typhus, tularemia) have been used or have the potential for use as bio-warfare agents for the purposes of causing widespread disease.1 By contrast, to my knowledge, the use of infectious skin diseases as instruments of targeted political violence are unreported in the medical literature. However, declassified records from the US Central Intelligence Agency (CIA) have revealed what may be the only known assassination attempt using a skin mycosis.2 In 1963, at the height of the Cold War, the CIA planned to exploit Cuban leader Fidel Castro’s affinity for scuba diving by adulterating a wetsuit to cause eumycotic mycetoma (ie, Madura foot), a chronic granulomatous infection of cutaneous and subcutaneous tissues caused by Eumycota fungi.

The wetsuit, along with complementary scuba breathing canisters imbued with Mycobacterium tuberculosis bacilli, was to be personally delivered to Castro as gift from US attorney James Donovan, who was negotiating the release of US prisoners after the failed 1961 Bay of Pigs invasion. The plot was abandoned only after the CIA discovered that Donovan had already given Castro a wetsuit as an act of goodwill on his own accord.2

The CIA’s decision to infect Castro with eumycotic mycetoma vis-à-vis a wetsuit is intriguing if also implausible. Transmission of the fungus from the wetsuit was at best improbable, given that eumycotic mycetoma typically requires direct inoculation to initiate infection. Nevertheless, were the vector a success, the plot had a reasonable chance of remaining covert, given the significant burden of cutaneous mycoses in Cuba at the time.3

The course of Castro’s illness would not be unlike that of eumycotic mycetoma infection today: slow progression from a solitary, painless subcutaneous nodule to the formation of superficial abscesses and sinus tracts with characteristic granular discharge. While systemic involvement and mortality would have been unlikely, localized tissue destruction, with invasion of bones, nerves, and tendons, was possible. Contemporary medical management options would have been limited to toxic parenteral antifungal agents of questionable efficacy (eg, diaminodiphenylamine dihydrochloride and amphotericin B), and surgical intervention would almost certainly have been needed for full eradication. The disabling effects on Castro’s public and private life might have been substantial, opening the door for further destabilization of his regime.

Interestingly, this was not the CIA’s first attempt to inflict cutaneous harm on Castro. Other documents from the same period detailed a prior failed scheme to dust Castro’s shoes with thallium salt, a potent chemical depilatory, with the hope of causing his famed beard to fall out.2 In retrospect, the role of dermatologic disease in matters of national security during this critical period of US history may have been greater than previously thought.

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