Lesion Selection by Melanoma High-Risk Consumers During Skin Self-examination Using Mobile Teledermoscopy

Mobile teledermatoscopy (MTD) for the early detection of skin cancer uses smartphones with dermatoscope attachments to magnify, capture, and transfer images remotely. Using the asymmetry–color variation (AC) rule, consumers achieve dermoscopy sensitivity of 92.9% to 94.0% and specificity of 62.0% to 64.2% for melanoma.

This pilot randomized trial assessed lesions of concern selected by consumers at high risk of melanoma using MTD plus the AC rule (intervention, n = 10) or the AC rule alone (control, n = 12) during skin self-examination (SSE). Also measured were lesion location patterns, lesions overlooked by participants, provisional clinical diagnoses, likelihood of malignant tumor, and participant pressure to excise lesions.

Methods | Ethics approval, informed consent, and intervention group (n = 10) characteristics were described previously. All participants were provided with an AC rule fact sheet and standardized SSE instructions. Participants underwent clinical skin examinations (CSEs) 3 to 6 months after SSEs to assess lesions of concern found during SSE and additional lesions potentially overlooked.

Results | Participants’ characteristics were similar in the intervention and control groups: overall, 60% male; working full time, 68%; personal history of melanoma, 73%; and body areas with moles, 59%. During SSE, 107 lesions were identified (66 in the intervention group and 41 in the control group; Figure, A), with patterns of body lesion locations similar for both groups. Figure, B and C, compares lesions identified during SSE and provisional clinical diagnosis during CSE. Likelihood of malignant tumor and pressure by participants to excise lesions during CSE are listed in the Table. Forty-two additional lesions not pointed out by participants were noted during CSE (20 in the intervention group and 22 in the control group), including 1 clinically presenting as melanoma (dysplastic nevus), 2 basal cell carcinomas (1 confirmed in the intervention group and 1 resolved before surgery in the control group), and 1 squamous cell carcinoma (confirmed in the intervention group) (Table). On average, participants’ SSE in both groups missed 2 lesions (intervention median [SD], 2 [1.43]; control median [SD], 2.09 [0.93]).

Discussion | Consumer-selected lesions were unlikely to be malignant, although more than one-third were dysplastic nevi. During CSE, the dermatologist detected other higher-priority skin lesions. These lesions were in hard-to-see body areas and might have been missed during SSE.

Participants in both groups selected lesion locations that reflect the SSE primary body areas (arms, face, and front of legs) reported by Mujumdar et al. Both groups also selected lesions on the back, shoulders, and legs, reflecting findings by Carli et al. Our participants did not select lesions in sexually sensitive or harder-to-see areas.

Previously, Boone et al found a lower proportion of missed lesions in partner-assisted compared with unassisted SSEs. We instructed participants to select 3 to 5 lesions during SSE, which may have contributed to participants missing lesions and explain some discrepancies between participant and dermatologist assessment.

Future studies need to instruct participants to also submit location photographs of lesions to aid re-identification during CSE. Consumers with many moles, such as participants in...
this study, may find it difficult to discriminate lesions of concern. Such individuals benefit from regularly scheduled CSEs; however, between visits they could use MTD to follow specific lesions designated by the dermatologist. More research is needed on the interface of MTD with cognitive processes to select lesions of concern. Factual knowledge is gained from the

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Total (n = 47)</th>
<th>Intervention (n = 30)</th>
<th>Control (n = 17)</th>
<th>Total (n = 42)</th>
<th>Intervention (n = 20)</th>
<th>Control (n = 22)</th>
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</thead>
<tbody>
<tr>
<td>Provisional clinical diagnosis</td>
<td></td>
<td></td>
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<tr>
<td>Melanoma</td>
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<td>NA</td>
<td>NA</td>
<td>1 (2.4)</td>
<td>1 (5.0)</td>
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<tr>
<td>Basal cell carcinoma</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>2 (4.8)</td>
<td>1 (5.0)</td>
<td>1 (4.5)</td>
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<tr>
<td>Squamous cell carcinoma</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>1 (2.4)</td>
<td>1 (5.0)</td>
<td>NA</td>
</tr>
<tr>
<td>Dysplastic nevus</td>
<td>12 (25.5)</td>
<td>9 (30.0)</td>
<td>3 (17.6)</td>
<td>34 (81.0)</td>
<td>15 (75.0)</td>
<td>19 (86.4)</td>
</tr>
<tr>
<td>Benign nevus</td>
<td>15 (31.9)</td>
<td>10 (33.3)</td>
<td>5 (29.4)</td>
<td>2 (4.8)</td>
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<td>1 (4.5)</td>
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<tr>
<td>Solar keratosis</td>
<td>2 (4.3)</td>
<td>NA</td>
<td>2 (11.8)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Seborrheic keratosis</td>
<td>5 (10.6)</td>
<td>2 (6.7)</td>
<td>3 (17.6)</td>
<td>1 (2.4)</td>
<td>1 (5.0)</td>
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</tr>
<tr>
<td>Other*</td>
<td>13 (27.7)</td>
<td>9 (30.0)</td>
<td>4 (23.5)</td>
<td>2 (4.8)</td>
<td>NA</td>
<td>1 (4.5)</td>
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<tr>
<td>Likelihood of malignancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very unlikely</td>
<td>17 (36.2)</td>
<td>9 (30.0)</td>
<td>8 (47.1)</td>
<td>4 (9.5)</td>
<td>4 (20.0)</td>
<td>NA</td>
</tr>
<tr>
<td>Unlikely</td>
<td>24 (51.1)</td>
<td>17 (56.7)</td>
<td>7 (41.2)</td>
<td>30 (71.4)</td>
<td>11 (55.0)</td>
<td>19 (86.4)</td>
</tr>
<tr>
<td>Neutral</td>
<td>6 (12.8)</td>
<td>4 (13.3)</td>
<td>2 (11.8)</td>
<td>5 (11.9)</td>
<td>3 (15.0)</td>
<td>2 (9.1)</td>
</tr>
<tr>
<td>Likely</td>
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<td>NA</td>
<td>NA</td>
<td>2 (4.8)</td>
<td>1 (5.0)</td>
<td>1 (4.5)</td>
</tr>
<tr>
<td>Very likely</td>
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<td>NA</td>
<td>NA</td>
<td>1 (2.4)</td>
<td>1 (5.0)</td>
<td>NA</td>
</tr>
<tr>
<td>Patient pressure to excise</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No pressure</td>
<td>45 (95.7)</td>
<td>29 (96.7)</td>
<td>16 (94.1)</td>
<td>24 (57.1)</td>
<td>8 (40.0)</td>
<td>16 (72.7)</td>
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<tr>
<td>Little pressure</td>
<td>1 (2.1)</td>
<td>1 (3.3)</td>
<td>0</td>
<td>16 (38.1)</td>
<td>10 (50.0)</td>
<td>6 (27.3)</td>
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<td>Average pressure</td>
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<td>1 (5.9)</td>
<td>NA</td>
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<td>NA</td>
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<td>Above average pressure</td>
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<td>NA</td>
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<td>NA</td>
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<tr>
<td>Strong pressure</td>
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<td>NA</td>
<td>1 (2.4)</td>
<td>1 (5.0)</td>
<td>NA</td>
</tr>
</tbody>
</table>

Abbreviation: NA, not applicable.

* Other includes solar lentigo (n = 1), dermatofibroma (n = 1), scar (n = 1), skin graft (n = 1), and benign atypical nevus undergoing regression (n = 1).
AC rule, but knowledge alone may not allow discrimination between benign and malignant skin lesions.\(^6\)

**Conclusions** | Future studies of MTD could benefit from targeting partner-assisted SSEs, increasing the number of SSEs to generate more lesions submitted for telediagnosis, assessing the effect of dermatologists’ feedback between SSE rounds, and submitting lesion location photographs. The process of lesion selection decision making using MTD or other lesion selection aids merits further investigation.

Monika Janda, PhD
Lois J. Loescher, PhD
Parastoo Banan, MD
Caitlin Horsham, BHealthSc
H. Peter Soyer, MD

**Author Affiliations:** School of Public Health, Institute of Health and Biomedical Innovation, Queensland University of Technology, Brisbane, Australia (Janda, Horsham); College of Nursing, The University of Arizona, Mel and Enid Zuckerman College of Public Health, and Skin Cancer Institute, Tucson (Loescher); Dermatology Research Center, The University of Queensland, School of Medicine, Translational Research Institute, Princess Alexandria Hospital, Brisbane, Australia (Banan, Soyer).

Corresponding Author: Monika Janda, PhD, Queensland University of Technology, Victoria Park Rd, Kelvin Grove, QLD 4061, Brisbane, Australia (m.janda@qut.edu.au).

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**Author Contributions:** Drs Janda and Soyer had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Janda, Loescher, Soyer.

Acquisition of data: Janda, Banan, Soyer, Horsham.

Analysis and interpretation of data: Janda, Loescher, Horsham, Soyer.

Drafting of the manuscript: Janda, Loescher, Horsham.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Janda.

Obtained funding: Janda, Soyer.

Administrative, technical, or material support: Janda, Banan, Horsham.

Study supervision: Janda, Soyer.

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Perniosis is a local inflammatory disorder caused by prolonged exposure to nonfreezing cold.\(^1\) The pathogenesis of this disorder is not fully understood but is likely of microvascular origin.\(^2\)

We describe a novel method to evaluate cutaneous blood flow in a typical patient with perniosis, a woman in her 20s who was referred to the dermatology clinic with a 10-day history of painful purple discoloration on her toes that began shortly after running in cold weather. She had no lesions on her fingers and no systemic symptoms except for fatigue. Her family history was negative for autoimmune disease. The results of a workup that included complete blood cell count, antinuclear antibody cryoglobulins, and cold agglutinins were negative except for a slightly decreased white blood cell count and 8% atypical lymphocytes, which later normalized. She was placed on a regimen of nifedipine (10 mg twice daily). Her skin symptoms resolved during 3 months but recurred when exposed to cold and when stopping nifedipine.

**Methods** | This study was approved by The Pennsylvania State University institutional review board. Both written consent and verbal consent were obtained from the participants. Measurements were obtained weekly for 4 weeks during the course of treatment. The protocol was repeated in a healthy age- and sex-matched individual.

The patient donned a water-perfused suit that covered the entire body\(^3\) and was instrumented with thermocouples on the dorsomedial, lateral, and mid-right foot for measurement of skin temperature. A laser Doppler flowmetry probe in a local heater was placed on the left foot in an area unaffected by ulcerations. Blood pressure was measured continuously throughout the protocol.

First, 33°C water was perfused through the suit for thermoneutral measurements, and then 48°C water was perfused to increase the mean skin temperature and stimulate cutaneous vasodilation. A laser-speckle contrast image (LSCI) (moorFLPi; Moor Instruments) was obtained of the right foot to visualize cutaneous blood flow throughout the protocol. The patient was returned to thermoneutral, and the local heater on the left foot was increased to 42°C to induce local endothelial nitric oxide synthase-dependent vasodilation.\(^4\) Laser Doppler flux under the local heater was measured throughout local heating. Cutaneous vascular conductance (CVC) was calculated as an index of skin blood flow using the following equation: CVC = Flux/MAP, where MAP indicates the mean arterial pressure.

**Results** | Figure 1 shows an LSCI and the mean skin temperature of the right foot of a healthy control subject (left pan-