Effects of Tailored Risk Communications for Skin Cancer Prevention and Detection: The PennSCAPE Randomized Trial

Karen Glanz1, Kathryn Volpicelli2, Christopher Jepson2, Michael E. Ming2, Lynn M. Schuchter2, and Katrina Armstrong3

Abstract

Background: Prevention and early detection measures for melanoma, such as sun avoidance and skin examinations, are important, but are practiced inconsistently. In this replication of the Project SCAPE trial, we sought to determine whether tailored print materials were more effective at improving adherence than generic print materials for patients at increased risk of skin cancer.

Methods: Participants were randomized to receive personalized mailed communications about their skin cancer risk and recommended sun protection, or generic mailings. Participants were Caucasian adults, at moderate or high risk for skin cancer, recruited in outpatient primary care. The main outcomes were overall sun protection behaviors and specific protective behaviors including use of sunscreen, shirt, hat, sunglasses, shade, and sun avoidance; recent sunburns; and skin self-examination and provider skin examination.

Results: One hundred ninety-two (93.2%) subjects completed the study. Six outcome variables showed significant intervention condition effects in mixed effects models: overall sun protection behavior (P = 0.025); sunscreen use (P = 0.026); use of sunglasses (P = 0.011); sunburns in the past three months (P = 0.033); recency of last skin self-exam (P = 0.017); and frequency of skin exams by health care provider (P = 0.016).

Conclusions: Relative to generic communications, tailored risk communications resulted in improved adherence to six skin cancer protective behaviors, including a composite sun protection behavior measure, sunburns, and health care provider skin examinations.

Impact: Tailored interventions can be more effective in improving patient prevention behaviors than nontailored, generic information for patients at moderate to high risk of skin cancer. Cancer Epidemiol Biomarkers Prev; 24(2); 415–21. © 2014 AACR.

Introduction

Skin cancer is the most commonly diagnosed cancer in the United States; although skin cancer rates are increasing, most skin cancers could be prevented if people would consistently use effective sun protection, including sunscreen, hats, sunglasses, shirts, and shade (1–4). Early detection, including performing regular skin self-examinations and physician skin examinations (1, 5), has been found to result in melanoma diagnoses at earlier stages, when the disease is most treatable (6, 7).

Despite public health efforts to improve prevention and detection behaviors among adults, these habits are not routinely performed by most people (8, 9). Those at increased risk may benefit from more effective interventions that promote sun protection and early detection behaviors. Risk factors for skin cancer include personal or family history of skin cancer, UV light exposure, number of moles and freckles, fair skin, and light hair color (10, 11).

Most skin cancer prevention interventions to date have focused on the general population through mass media campaigns and school-based programs (12, 13), or have targeted individuals who work in outdoor settings as well as parents and other caregivers in recreational settings (12, 14). Interventions designed specifically for people at high risk for skin cancer may be both efficient and effective. Further, tailoring the message content of these interventions may encourage greater attention and recall in recipients than generic or nontailored materials. Tailored messages are also seen as more personally relevant, and therefore may be more likely to motivate individuals to make healthful behavior changes (15–17).

Only three studies to date have evaluated tailored interventions to promote skin cancer prevention and detection practices among at-risk populations. Geller and colleagues (18) compared a tailored telephone and print material intervention with a control condition in which physicians advised patients with melanoma to notify their siblings of their diagnosis, among siblings of recently diagnosed patients with melanoma. They observed an increase in the number of self-reported skin self-examinations by the treatment group (OR, 1.76; 95% confidence interval, 1.06–2.91). Similarly, Manne and colleagues (19) compared a tailored phone and print intervention with generic phone and print interventions among first-degree relatives of patients with melanoma. They found that those randomized to the tailored intervention reported significantly greater sun protection habits and were almost twice
as likely to have a total skin examination by a doctor. A third study, first conducted by Glanz and colleagues over 10 years ago (20), focused on at-risk adults recruited from primary care settings, and found that tailored print materials improved overall sun protection habits among these individuals.

It is essential to disseminate and evaluate effective cancer control strategies in new audiences and over time. In particular, with the many recent advances in communication technology, it is important to learn whether tailored print, mailed materials, continue to be effective in an era when they are not as novel, and when there is competition from internet and mobile interventions. There are few, if any, examples of this type of replication and extension to inform current and future cancer prevention practice.

The present research builds on the study conducted by Glanz and colleagues (20, 21), and examines the impact of sending tailored risk information and motivational intervention materials to increased-risk adults from a large primary care practice. This new study used updated tailored communications technology, increased the number of generic mailings to match the multiple tailored mailings, and tested the intervention in a different geographical region. The aim of the PennSCAPE (Skin Cancer Awareness, Prevention, and Education) study was to evaluate the impact of tailored print materials on skin cancer prevention behaviors, skin self-examination, and provider skin examinations among an adult population at moderate to high risk for skin cancer.

Materials and Methods

Design overview

This randomized controlled trial compared the effects of mailed tailored print materials versus generic print materials on sun avoidance/protection and skin cancer detection behaviors. Primary care patients at moderate to high risk for skin cancer were recruited and randomized to one of two groups. The treatment group received three tailored mailings, including a personalized risk assessment, recommendations for sun protection and skin cancer detection, and sun safety reminders. The control group received three mailings with pamphlets containing standard skin cancer detection and prevention recommendations. Participants completed a baseline survey during the late spring or early summer, and completed a follow-up survey approximately three months later. This study, which was an extension of the original Project SCAPE trial (20), was approved by the Institutional Review Board at the University of Pennsylvania and registered on ClinicalTrials.gov as trial number NCT01356771.

Sample and recruitment

Primary care patients were recruited from the waiting room of an outpatient health practice associated with the University of Pennsylvania Health System between May and July 2011. Potential participants were approached by the study staff who introduced the study. If a patient was interested in participating, initial consent was obtained and an eligibility assessment, which included an assessment of the patient’s risk for skin cancer, was completed.

Patients were included in this study if they were ages 18 years or older, identified themselves as Caucasian, and were found to be at moderate or high risk for skin cancer as measured by the Brief skin cancer Risk Assessment Tool (BRAT), a reliable self-administered measure that assesses an individual’s level of risk for skin cancer (10). This tool measures risk for skin cancer based on questions about personal history of skin cancer, number of moles and freckles, sun sensitivity, and hair color. Risk categories were determined by total BRAT score (<27 = low risk; 27–35 = moderate risk; >35 = high risk). Patients were excluded if they had been previously diagnosed with melanoma, were currently being treated for melanoma or nonmelanoma skin cancer, or were planning to be out of town for more than three consecutive weeks during the next three months. Eligible participants were invited to take part in the study and if willing, completed the full informed consent. The baseline survey was then mailed to them to complete and return to the study office (Fig. 1).

Randomization and intervention

After completing the baseline survey, participants were enrolled in the study and randomized to the tailored intervention or generic materials group. Randomization was carried out using a random number generator and was stratified by gender (male/female) and risk level (moderate risk/high risk).

Tailored intervention. Three separate mailings were sent to participants at two-week intervals (20). The first mailing, the “Personal Skin Cancer Profile” booklet, included a personal risk assessment that was tailored to each participant based on self-reported risk factors at the eligibility assessment. The mailing included information on the key contributors to the individual’s risk level, and feedback about sun protection habits reported on the baseline survey. The second mailing included a pamphlet and bookmark. The “Guide for Skin Self-Exams” pamphlet contained feedback on respondents’ reported skin self-examination practices, skin self-examination instructions, and a body map to track changes in mole size, shape, and color. The bookmark was a tailored reminder list based on sun protection habits reported in the baseline survey. The third and final mailing contained a booklet and tip sheet. The booklet encouraged participants to visit their doctor for a total skin examination. The tip sheet provided personalized advice for purchasing and applying sunscreen that was tailored to habits reported in the baseline survey; for example, suggesting that respondents use sunscreen on some body parts that they might not consistently cover. The tailored messages were developed with theoretical foundations in the health belief model and social cognitive theory (22, 23), and were refined and produced with newer graphic technology based on materials from the previous study by Glanz and colleagues (20). The newer graphic technology had a more crisp and clean appearance than what could be easily produced a decade earlier. Samples of tailored intervention materials are shown in Supplementary Materials.

Generic intervention. Those assigned to the generic materials group received three standard informational mailings over a six-week period. The materials were “off-the-shelf” skin cancer education materials that were clearly written and attractively produced by major national prevention organizations, and covered topics that generally paralleled those in the tailored materials. The first mailing contained general information about melanoma, risk factors for melanoma, and how to detect melanoma in a pamphlet published by the American Cancer Society (24). The second mailing focused on how to conduct skin self-examinations and included a pamphlet and a bookmark illustrating what to look at in a skin cancer self-exam (25, 26). The final
mailing was a pamphlet published by the American Academy of Dermatology that included information on sun exposure and ways to protect oneself from the sun (27). The generic intervention was set up to include a similar level of detail as the tailored intervention materials to provide equal time and attention.

**Measures**

The baseline survey collected information on demographic characteristics, sun safety knowledge, beliefs and attitudes about skin cancer, sun exposure and protection habits, social norms regarding sun protection, and detection behaviors (including skin self-examinations and thorough skin examinations by a medical professional). The follow-up survey asked similar questions with additional questions about reactions to the mailed materials.

The baseline and follow-up survey items were from the *Sun Habits Survey*, a previously developed questionnaire from the Project SCAPE study conducted by Glanz and colleagues, which was shown to have good reliability and reproducibility for main outcome measures (20). Thirteen items assessed beliefs and attitudes toward skin cancer and sun protection using a 5-point Likert scale (e.g., "people are more attractive with a tan"). These items yielded two summary scales—barriers to sun protection (5 items) and pessimism about skin cancer (3 items); scale scores were calculated as the mean of responses to its component items. Sun exposure was assessed by asking respondents to indicate the average number of hours per day they had spent in the sun between 10 am and 4 pm the previous summer, separately for weekdays and weekend days. Two other items asked respondents to indicate how many times in the previous summer and in the past three months they had a sunburn (none, once, twice, or more than twice). Sun protection behaviors were evaluated for six protective behaviors (sunscreen, shirt with sleeves, sunglasses, hats, seeking shade, and limiting hours outdoors between 10 am and 4 pm) on a 4-point Likert scale (1 = never or rarely, 4 = always); these items yielded a summary scale calculated as the mean of the responses to all six items. Skin self-examinations were measured by asking respondents if they had ever closely examined themselves for signs of skin cancer, including melanoma, and if so, how recently; responses to these two items were combined to create a variable with four levels (1 = never, 2 = over 3 months ago, 3 = 1–3 months ago, 4 = in the last month). Skin examinations by a medical professional were measured by

![Figure 1. CONSORT diagram for the PennSCAPE Trial.](#)
asking respondents if they ever had a health care provider examine their skin closely for signs of skin cancer, followed by a question about frequency of these skin examinations; responses to the two items were combined to create a variable with five levels (0 = never, 1 = every few years, 2 = once a year, 3 = every few months, 4 = each month or more). Perceived risk of skin cancer was assessed using two items asking respondents to indicate their chance of getting skin cancer ever and in the next 10 years; both items were accompanied by 6-point response scales (1 = very unlikely, 2 = somewhat unlikely, 3 = uncertain, 4 = somewhat likely, 5 = very likely, 6 = already had it). A summary scale of perceived skin cancer risk was calculated as the mean of responses to the two items. Finally, social norms around sun protection behaviors were assessed using four items asking how many of the participant’s friends and family members use sunscreen or avoid sun exposure, each on a 4-point response scale (1 = none, 2 = a little, 3 = some, 4 = a lot); a summary scale of norms was calculated as the mean of responses to the four items (see Supplementary Table S1).

At the follow-up survey, participants were asked whether they remembered receiving educational materials about skin cancer prevention from the University of Pennsylvania. For those who responded “yes,” a set of questions about the materials followed. They were asked how many different mailings they received, how much of the materials they had read, and if they still had the materials. They were also asked to rate several aspects of the materials on 5-point scales: “easy to understand,” “informative,” “interesting,” “personal relevant,” “attractive/nice to look at” (for all of these, 1 = poor, 5 = excellent), “confusing” (1 = very, 5 = not at all), and “useful or helpful” (1 = not at all, 5 = very useful). For participants who responded to at least five of these seven evaluation items, an overall scale of favorable evaluation was created as the mean of all responses (Cronbach alpha = 0.87).

All follow-up surveys were self-administered or completed by telephone by trained interviewers. Telephone interviews were conducted if respondents did not return the mailed survey after two reminders. After completion of the baseline and follow-up survey, participants were given gift card incentives ($20 for each survey).

Statistical analysis

Descriptive statistics were computed for all variables in the analysis. Differences in baseline characteristics between treatment and control groups, and between study completers and non-completers, were assessed using t tests (for continuous variables) and χ² tests (for categorical variables).

Difference scores (follow-up minus baseline) were created for the following main outcomes: overall sun protection behavior score; scores on the six individual protective behaviors; number of sunburns (last summer at baseline, in the past three months at follow-up); hours of sun in average weekday and average weekend day; recency of last skin self-exam; and frequency of skin exam by health care provider. Difference scores were also computed for four attitude outcomes: perceived skin cancer risk; perceived benefits of sun protection; perceived barriers to sun protection; and pessimism about skin cancer.

Mixed effects models of these difference scores were then performed, using treatment and age as predictors, and for those outcomes displaying significant effects of treatment, the role of potential mediator variables was examined using the method of Baron and Kenny (28). Finally, differences between the control and treatment groups on reactions to the intervention materials were assessed using t tests and χ² tests.

Results

Participation and sample characteristics

In total, 630 patients were approached at the outpatient health practice. Of this group, 307 declined to participate and 102 were ineligible after completing the eligibility assessment. The main reason for ineligibility was low risk for skin cancer, as determined by the BRAT score. Of the 221 patients who were found eligible, 93% (N = 206) completed the baseline survey, were enrolled and randomized, and were contacted to complete a follow-up survey. The study completion rate was 93.2% (N = 192; Fig. 1).

Participants were Caucasian (100%), almost three quarters female (73.4%), and 55.2 years old on average (Table 1). Most (70.5%) were college educated and were employed either full- or part-time (57.8%). About 60.9% (N = 117) were categorized as high risk, whereas 39.1% (N = 75) were considered at moderate risk for skin cancer. In addition, 15.6% of participants had a personal history of nonmelanoma skin cancer, and 43.2% reported a family history of skin cancer. A little over half (53.1%) reported at least one sunburn the previous summer. Sun protection habits scores averaged 2.59, between “sometimes” and “usually” on a 4-point Likert scale. Significant differences were found between the treatment and control groups only by wearing sunscreen and sunglasses; the control group was slightly more likely than the treatment group to use sunscreen and to wear sunglasses when outside during midday hours.

More than 90% of those who were randomized completed the study follow-up. Dropouts (N = 14) were significantly more likely to be male, younger (43.4 ± 17.4 compared with 55.2 ± 15.2), unemployed or students, and randomized to the treatment group. Those who did not complete the study also were at greater risk for skin cancer and less likely to use sunscreen at baseline. There were no other statistically significant differences between completers and non-completers.

Main outcomes

Of the main outcome variables examined, six displayed significant effects of treatment in mixed effects models controlling for age. The behaviors that showed a significant impact of treatment were as follows: overall sun protection behavior score [(F (1, 129) = 5.15, P = 0.025)]; use of sunglasses [(F(1, 130) = 6.68, P = 0.011)]; and use of sunscreen [(F(1,127) = 5.06, P = 0.026)]. Treatment impact was also significant for the number of sunburns [(F(1, 130) = 4.63, P = 0.033); recency of last skin self-exam [(F(1, 130) = 5.83, P = 0.017]; and frequency of skin exams by health care provider [(F(1, 128) = 5.95, P = 0.016; Table 2]. Because the dependent variables in these models were change scores, a significant effect of treatment means that the change in the outcome variable from baseline to follow-up differed either in direction or magnitude across the treatment groups. For example, for the overall protective behavior score, the mean increased more among intervention participants from (2.53 to 2.74) than among control participants (from 2.64 to 2.76). For sunburns in the past three months, the mean decreased among intervention participants (from 1.54 to 1.47) and increased among control participants (from 1.46 to 1.56). For recency of last skin self-exam and frequency of skin exam by a health care provider, the means increased more among intervention participants than among control participants (Table 2).
Mediators analysis

Five variables were considered as possible mediators of the effects of treatment described above: (i) perceived skin cancer risk; (ii) perceived benefits of sun protection; (iii) perceived barriers to sun protection; (iv) skin cancer pessimism; and (v) social norms. According to the method of Baron and Kenny (28), the first criterion for mediation is that the potential mediator be significantly associated with the predictor (i.e., treatment). Accordingly, mixed effects models of change scores on each of the possible mediators listed above were performed, using treatment and age as the predictors. Treatment was significantly associated with change in social norms (P = 0.034); however, the effect of treatment did not approach significance in the models of the other possible mediators (P = 0.12 to 0.92). Therefore, change in social norms was selected for further examination. The mixed effects models of the six significant outcome variables reported above were repeated, with change in social norms included as an additional predictor. The effect of treatment was reduced in all cases, although it remained significant or nearly so for four of the outcomes (sunburns in past three months, P = 0.065; recency of last skin self-exam, P = 0.051; frequency of skin exams by health care provider, P = 0.046; use of sunglasses, P = 0.066). For the other two outcomes, the effect of treatment became nonsignificant. Thus, change in perceived social norms appeared to mediate the effect of treatment to a limited degree.

Reaction to intervention materials

Of the 192 participants in the analysis, 181 (94.3%) recalled receiving the intervention materials (97.6% of intervention participants vs. 91.7% of control participants; χ² (1 df) = 2.583, P = 0.114). Of these 181, 69.1% of intervention group participants, versus 48.0% of control group participants, reported having read all the materials [χ² (1 df) = 8.179, P = 0.004]. In addition, intervention group participants rated the materials as significantly more attractive than did control group participants [4.27 vs. 3.95, t (179 df) = 2.426, P = 0.016]. Responses to other items about the intervention materials did not differ significantly between the two groups, and the mean score on the overall reaction scale was not significantly higher for the intervention group than for the control group (4.33 vs. 4.24, P = 0.37).

Discussion

The PennSCAPE Trial found that tailored risk communications for adults at moderate or high risk for skin cancer were effective for improving prevention and early detection behaviors for six outcomes, compared with generic print communications: overall sun protection behavior, use of sunscreen and sunglasses, sunburns, and recent skin self-examination and frequency of skin exams by health care provider. No significant effects of the intervention were found for behaviors of wearing shirts or hats, or for limiting sun exposure or shade-seeking. Change in perceived norms of sun protection mediated the effects of treatment to a limited degree.
Table 2. Changes in behaviors and attitudes from baseline to follow-up, by treatment group

<table>
<thead>
<tr>
<th>Construct</th>
<th>Range</th>
<th>Baseline Mean (SD)</th>
<th>Follow-up Mean (SD)</th>
<th>P*</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention and detection behaviors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun protection habits</td>
<td>(1–4)</td>
<td>Control 2.64 (0.62)</td>
<td>2.76 (0.58)</td>
<td>5.15</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 2.53 (0.59)</td>
<td>2.78 (0.53)</td>
<td>5.06</td>
<td>0.03</td>
</tr>
<tr>
<td>Wear sunscreen</td>
<td>(1–4)</td>
<td>Control 2.90 (1.02)</td>
<td>3.15 (0.86)</td>
<td>5.06</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 2.60 (1.04)</td>
<td>2.95 (0.92)</td>
<td>5.06</td>
<td>0.03</td>
</tr>
<tr>
<td>Wear sunglasses</td>
<td>(1–4)</td>
<td>Control 3.23 (0.94)</td>
<td>3.34 (0.85)</td>
<td>6.68</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 2.94 (1.02)</td>
<td>3.19 (0.89)</td>
<td>6.68</td>
<td>0.01</td>
</tr>
<tr>
<td>Wear shirt</td>
<td>(1–4)</td>
<td>Control 2.39 (1.04)</td>
<td>2.41 (1.05)</td>
<td>0.72</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 2.55 (0.88)</td>
<td>2.52 (0.96)</td>
<td>0.72</td>
<td>0.40</td>
</tr>
<tr>
<td>Seek shade</td>
<td>(1–4)</td>
<td>Control 2.56 (0.83)</td>
<td>2.52 (0.84)</td>
<td>1.35</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 2.43 (0.76)</td>
<td>2.62 (0.78)</td>
<td>1.35</td>
<td>0.25</td>
</tr>
<tr>
<td>Wear a hat</td>
<td>(1–4)</td>
<td>Control 2.11 (1.08)</td>
<td>2.29 (0.99)</td>
<td>0.40</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 2.20 (0.99)</td>
<td>2.41 (0.90)</td>
<td>0.40</td>
<td>0.53</td>
</tr>
<tr>
<td>Limit hours in the sun</td>
<td>(1–4)</td>
<td>Control 2.67 (0.92)</td>
<td>2.64 (0.89)</td>
<td>1.02</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 2.86 (0.91)</td>
<td>2.02 (1.19)</td>
<td>1.02</td>
<td>0.32</td>
</tr>
<tr>
<td>Recency of last skin self-examination</td>
<td>(1–4)</td>
<td>Control 2.62 (1.32)</td>
<td>2.98 (1.19)</td>
<td>5.83</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 2.39 (1.26)</td>
<td>3.06 (1.15)</td>
<td>5.83</td>
<td>0.02</td>
</tr>
<tr>
<td>Frequency of total skin exam by a medical professional</td>
<td>(1–5)</td>
<td>Control 1.31 (1.12)</td>
<td>1.36 (1.10)</td>
<td>5.95</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 1.22 (1.07)</td>
<td>1.41 (1.02)</td>
<td>5.95</td>
<td>0.02</td>
</tr>
<tr>
<td>Sun exposure: weekday</td>
<td>(1–6)</td>
<td>Control 1.64 (1.58)</td>
<td>1.57 (1.41)</td>
<td>1.22</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 1.28 (1.26)</td>
<td>1.43 (1.43)</td>
<td>1.22</td>
<td>0.27</td>
</tr>
<tr>
<td>Sun exposure: weekend</td>
<td>(1–6)</td>
<td>Control 2.67 (1.81)</td>
<td>2.50 (1.71)</td>
<td>0.17</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 2.75 (1.72)</td>
<td>2.51 (1.64)</td>
<td>0.17</td>
<td>0.68</td>
</tr>
<tr>
<td>Sunburn frequency (last 3 months)</td>
<td>(1–4)</td>
<td>Control 1.46 (0.87)</td>
<td>1.56 (0.92)</td>
<td>4.63</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 1.54 (0.77)</td>
<td>1.47 (0.70)</td>
<td>4.63</td>
<td>0.03</td>
</tr>
<tr>
<td>Perceptions and beliefs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived skin cancer risk</td>
<td>(1–6)</td>
<td>Control 3.42 (1.07)</td>
<td>3.37 (1.03)</td>
<td>2.45</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 3.39 (1.06)</td>
<td>3.53 (1.03)</td>
<td>2.45</td>
<td>0.12</td>
</tr>
<tr>
<td>Perceived benefits of sun protection</td>
<td>(1–5)</td>
<td>Control 3.64 (0.45)</td>
<td>3.78 (0.38)</td>
<td>0.30</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 3.61 (0.44)</td>
<td>3.74 (0.38)</td>
<td>0.30</td>
<td>0.58</td>
</tr>
<tr>
<td>Perceived barriers to sun protection</td>
<td>(1–5)</td>
<td>Control 2.46 (0.79)</td>
<td>2.38 (0.80)</td>
<td>1.40</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 2.62 (0.72)</td>
<td>2.46 (0.85)</td>
<td>1.40</td>
<td>0.24</td>
</tr>
<tr>
<td>Skin cancer prevention pessimism</td>
<td>(1–5)</td>
<td>Control 1.92 (0.75)</td>
<td>1.76 (0.70)</td>
<td>0.01</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention 1.91 (0.74)</td>
<td>1.70 (0.69)</td>
<td>0.01</td>
<td>0.92</td>
</tr>
</tbody>
</table>

NOTE: Bold indicates significance.

*Effect of treatment group in mixed effects models of difference scores (follow-up minus baseline) on each outcome variable, controlling for age.

These findings are similar to those of two earlier Project SCAPE trials (20, 21). In the Project SCAPE trial with adults (20) and in the Project SCAPE Family Study (21), tailored materials improved adults’ overall sun protection behaviors and recency of skin self-examination. There also were intervention-related increases in sunscreen use in the Family Study (21), increased use of sunglasses in the adult trial (20), and a finding of social norms mediation in the Family Study (21). Similar to the previous trials (20, 21), the effect sizes were small to medium. Replication of these effects, especially the composite sun protection behavior score and skin self-examination, attests to the robustness of the tailored risk communication intervention in a different audience (geographically and racially), several years later. As in the previous trials, nearly all respondents reported that they received the print materials and most indicated that they had read them.

The study participants in the current trial were, on average, 10 years older than those in the previous trials, and more likely to be college graduates. In addition, this trial was conducted during a time when the internet had become a much more common source of health and medical information. Even so, the printed mailed materials both reached and influenced people at increased risk for skin cancer. This indicates that print materials can still be effective in the present age of digital media.

There are three notable strengths of the current study. First, the use of a randomized control trial design for testing the intervention is strong and rigorous. Also, the use of multiple generic mailed materials for the control group (rather than a single mailing, as in the previous trials), which created attention-matched control group. This increases confidence in attributing treatment effects to the tailored risk communications rather than to the number of mailings. A third strength was the high retention rate of randomized subjects at over 90%. The study has limitations as well, including a relatively short follow-up period and lack of attention to the use of artificial sources of UVR, or indoor tanning. Also, the present trial used only survey measures to assess behaviors, rather than the Sun Habits Diary used in the two earlier trials (20, 21). Nevertheless, recent research has found that survey measures are reasonably valid indicators of sun protection and exposure practices (29–31).

The PennSCAPE Trial adds to a growing body of evidence supporting the promise of tailored communications to promote positive health behavior (17) and more specifically, skin cancer prevention practices. Print tailored materials are an inexpensive and effective way to engage high-risk individuals in preventive behaviors for a significant and growing public health problem; thus, achieving small effects across a broad reach of audiences can be considered to have public health significance. Further, this tailored intervention can be delivered through various platforms (e.g., print, web, mobile media) in today’s electronic media environment. With the addition of this trial to the body of evidence, future efforts should focus on disseminating and implementing these strategies in primary health care practice and public health settings.
Disclosure of Potential Conflicts of Interest
No potential conflicts of interest were disclosed.

Authors’ Contributions
Conception and design: K. Glanz, M.E. Ming, L.M. Schuchter, K. Armstrong
Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): K. Glanz, K. Volpicelli, K. Armstrong
Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): K. Glanz, K. Volpicelli, C. Jepson, L.M. Schuchter
Writing, review, and/or revision of the manuscript: K. Glanz, K. Volpicelli, C. Jepson, M.E. Ming, L.M. Schuchter, K. Armstrong

References

Published OnlineFirst November 28, 2014; DOI: 10.1158/1055-9965.EPI-14-0926

www.aacrjournals.org Cancer Epidemiol Biomarkers Prev; 24(2) February 2015 421

Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): K. Glanz, K. Volpicelli
Study supervision: K. Glanz, K. Volpicelli

Grant Support
This work was supported by NIH grant #5ULC2 CA148310 (to K. Armstrong, principal investigator; K. Glanz, sub-principal investigator).

The costs of publication of this article were defrayed in part by the payment of page charges. This article must therefore be hereby marked advertisement in accordance with 18 U.S.C. Section 1734 solely to indicate this fact.

Received August 7, 2014; revised November 21, 2014; accepted November 23, 2014; published OnlineFirst November 28, 2014.

Tailored Risk Communications PennSCAPE