Predictors of sun protection in northern Australian men with a history of nonmelanoma skin cancer

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Abstract

Background. It is important to understand what predicts regular use of sun protection in men susceptible to skin cancer.

Methods. A questionnaire survey of men with previous nonmelanoma skin cancer (n = 300) was conducted.

Results. Participants who typically used sunscreen tended to be younger, have fewer excised skin lesions, work indoors, and have spent most of their life in the tropics. Predictors of wearing a long-sleeved shirt with a wide-brimmed hat were not enjoying sun exposure, not having barriers to using sun protection, having more skin lesions previously excised, working for a company with a mandatory policy of sun protection, attitudes that the benefits of a suntan do not outweigh the risks and that skin cancers cannot be easily treated, and age over 50.

Conclusions. Men who adequately protect themselves from the sun and who have better attitudes to sun exposure were more often those with a high level of negative experience with skin cancer. Therefore, the sun protection attitudes and behaviors of some men may only improve after significant sun damage. This study recommends that the use of appropriate sun protective clothing should be made mandatory for all who work outdoors in high-sun-exposure occupations.

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Introduction

Basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) are the two major histological types of nonmelanoma skin cancers (NMSC). Studies have identified ultraviolet radiation (UVR) damage to adult skin as an important environmental risk factor for both SCC and BCC [1–4]. Together, SCC and BCC are the most frequently reported malignancies in Caucasian populations [5]. Two studies in Queensland, Australia, found this region to have one of the highest reported age-standardized incidence rates of NMSC worldwide [6,7].

Both northern Australian studies found skin cancer rates were significantly higher in males, which is consistent with other studies [8–11]. The north Queensland study found 42% of men who had a NMSC excised between 1997 and 1998 had more than one NMSC excised, compared to only 34% in women [7]. As there are no known genetic differences between men and women regarding susceptibility to NMSC, these higher rates in north Queensland men are most likely a result of lifestyle differences in sun exposure. Indeed, previous studies have found that men spend more time in the sun [12 13] and use less sun protection [13].

Reducing the time men spend in the sun is likely to be difficult. A study found that men with a recently excised NMSC initially avoided the sun, but then returned to their previous outdoor habits after 1 year [14]. Outdoor habits and lifestyle evolve over many years, and attempts to change these habits are likely to be very difficult. Further, avoiding the sun is problematic for men who work outdoors, and for those living in an environment with high ambient UVR. A more practical way to reduce men’s risk of NMSC may be to encourage or enforce new patterns of sun protection.

The present study investigated the predictors of “regular” use of sunscreen, long-sleeved shirts, and wide-
brimmed hats of men with a history of NMSC living in a high-risk UVR environment. Understanding what predicts regular use of sun protection might increase the potential to develop more effective sun protection messages or interventions for men.

**Methods**

**Participants**

The present cross-sectional study was conducted in Townsville, north Queensland (latitude 19°S; population 127,000). Ethical approval for the questionnaire was obtained from the Human Ethics Subcommittee, James Cook University, approval number H871. Males for this study were obtained from the Townsville Skin Cancer Survey database, which contains data of all excised, histologically confirmed skin cancers from 1997 to 1999 [7]. Men selected for the present study had one NMSC (BCC or SCC) excised in 1997 and no record of melanoma. Participants were randomly selected from the Townsville Skin Cancer Survey. The sampling procedure for the present study attempted to reflect the age structure of the male population of Townsville that had experienced an excised NMSC in 1997. However, analysis of the age structure of the participants in the present study found an overresponse toward younger men, in particular, those aged from 40 to 60 years.

Data for the present study was collected by self-administered questionnaire between October and December 1999. The questionnaire together with an introductory letter and self-addressed return envelopes were sent by mail directly to the randomly selected group of men (n = 680). If a person did not reply within 3 weeks, a second questionnaire was mailed. Due to ethical concerns with privacy, men could not be contacted by telephone if they did not respond to the initial two mail-outs. The overall response rate was 44%. However, after all effort was made to track them down, 196 men did not receive the questionnaire because of an incorrect address due to the high degree of mobility that occurs in the Townsville region. Therefore, a more accurate response rate for the present study is 62%.

**Questionnaire**

Participant demographics were determined using questions on age, skin type, employment status, socioeconomic, and history of skin cancer. Skin type, an index of sun sensitivity that represents both the propensity to sunburn and the capacity to develop a tan, was assessed according to Fitzpatrick’s classification (scale I to IV from most sun sensitive to least sun sensitive Caucasian skin) [15]. Employment status was based on answers given for “If you are currently employed, what is your job?” This allowed categorizing the men’s current occupation into high (e.g., fisherman, farmer) or low (e.g., tradesman) sun exposure. Socioeconomic status was determined by questions on their total yearly household income, and highest level of education (categories: “have not finished primary school”, “finished primary school, some high school”, “junior certificate (grade 10)”, “senior certificate (grade 12)”, “apprenticeship, TAFE, diploma or certificate training”, and “university degree”).

History of previously experienced skin cancer was reported as the number of skin cancers or other skin lesions that had been excised. The length of time the participants had lived in the tropics (categories: only some, most, and all of my life) was also recorded. Recent sun behaviors were assessed by questions on the use of sun protection (hats, clothing, sunscreen, and shade), regular daily activities, workplace sun protection, recreational sun exposure, seasonal sun exposure, and specific questions on fishing as one of the favorite past times in north Queensland. Questions referring to recent sun protection were stated like: “The last time you were out, did you wear a shirt…” followed by questions asking, for example, what type of shirt (long sleeve, short sleeve, T-shirt, singlet, etc.) and whether this behavior was typical. Only typical behaviors were considered in the analyses. Further details of the methodology used have been previously published [16].

The main part of the questionnaire was developed utilizing the Theory of Reasoned Action (TRA) and the Health Belief Model (HBM) [17 18]. Based on the TRA, questions referring to attitudes toward sun exposure and using sun protection were included. Attitudes were investigated with respect to enjoying the sun, barriers to using sun protection, obtaining and having a suntan, developing further NMSC, and aspects of outdoor lifestyle. Questions relating to the HBM included perceived susceptibility to future skin cancers and perceived severity and treatability of skin cancer, as well as questions relating to perceived benefits and barriers of acting sun-safe. Questions assessing attitudes and beliefs used a Likert structure, allowing the men to answer from strongly agree to strongly disagree.

**Statistical analysis**

Data were coded numerically and entered into the computerized statistical package for social sciences, SPSS Release 6.1.3 for Windows. Whether or not the men typically used sunscreen was dichotomized into the dependent variable “typically used/did not use sunscreen when in the sun for at least 20 min”. Whether or not the men typically wore both a wide-brimmed hat and a long-sleeved shirt was dichotomized into the dependent variable “typically wore/did not wear a long-sleeved shirt and wide-brimmed hat when in the sun for at least 20 min”.

...
complete list of the variables as they were considered for statistical analysis is given in Tables 1 and 2. Bivariate relationships between demographics, attitudes, beliefs, and behaviors and the dependent variables were assessed by Chi-square tests, t tests, and nonparametric Wilcoxon tests, as appropriate. Mean values and standard deviation (SD), or median values and interquartile ranges (IQR) described numerical variables.

The present study is exploratory rather than definitive, having a primary aim of identifying possible factors that predict the use of sun protection in north Australian men with a history of NMSC. Therefore, the alpha levels have not been adjusted for level of significance in multiple testing, in accordance with Bonferroni.

Multiple logistic regression analysis was used to identify independent predictors of typically using sunscreen when in the sun, and typically wearing a wide-brimmed hat with a long-sleeved shirt when in the sun, and to estimate their impacts. All variables in Tables 1 and 2 were considered in multivariate logistic regression analysis, but only independent significant predictors were accepted into the final model. Results of the multiple logistic regression analysis are presented as prevalence odds ratios (POR), together with 95% confidence intervals (95% CI). Throughout the study, a statistical test was considered significant when the P value was below 0.05.

**Results**

**Description**

A total of 300 men (response rate 62%) who previously experienced NMSC participated in the study. The mean age of the men was 51 years (SD ± 4), with 60% (n = 171) having at least a Senior Certificate or Grade 12 education (32%, n = 96). 72% of men (n = 214) had spent most or all of their life living in the tropics, and 19% (n = 56) report currently working in a high-sun-exposure occupation. Overall, when men went out in the sun for at least 20

<table>
<thead>
<tr>
<th>Predictors of using sunscreen</th>
<th>Typically use sunscreen when in the sun?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No (n = 118)</td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
</tr>
<tr>
<td>Age (mean; SD&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>52 ± 4</td>
</tr>
<tr>
<td>Have skin type I or II (lighter skin)</td>
<td>59%</td>
</tr>
<tr>
<td>Have a Grade 12 level education</td>
<td>51%</td>
</tr>
<tr>
<td>Currently work in a high-sun-exposure occupation</td>
<td>30%</td>
</tr>
<tr>
<td>Have spent at least most of my life in the tropics</td>
<td>19%</td>
</tr>
<tr>
<td>Number of skin lesions excised previously (median; IQR&lt;sup&gt;b&lt;/sup&gt;)</td>
<td>3; 2–10</td>
</tr>
<tr>
<td><strong>Beliefs</strong></td>
<td></td>
</tr>
<tr>
<td>I use sufficient protection when out in the sun</td>
<td>41%</td>
</tr>
<tr>
<td>My risk of further skin cancer is high</td>
<td>75%</td>
</tr>
<tr>
<td>I want to protect myself from further skin cancer</td>
<td>66%</td>
</tr>
<tr>
<td>Using sun protection will help prevent further skin cancer</td>
<td>37%</td>
</tr>
<tr>
<td>My skin type helped cause my skin cancer</td>
<td>57%</td>
</tr>
<tr>
<td>A suntan is risky to my health</td>
<td>85%</td>
</tr>
<tr>
<td>Skin cancers are not easily treatable</td>
<td>75%</td>
</tr>
<tr>
<td>Skin cancer is a serious risk to my health</td>
<td>77%</td>
</tr>
<tr>
<td><strong>Attitudes</strong></td>
<td></td>
</tr>
<tr>
<td>I do not like exposing myself to the sun</td>
<td>52%</td>
</tr>
<tr>
<td>I do not look better with a suntan</td>
<td>63%</td>
</tr>
<tr>
<td>I do not feel better with a suntan</td>
<td>78%</td>
</tr>
<tr>
<td>The benefits of a suntan do not outweigh the risks</td>
<td>68%</td>
</tr>
<tr>
<td>I do not have barriers to using sun protection</td>
<td>22%</td>
</tr>
<tr>
<td><strong>Behaviors</strong></td>
<td></td>
</tr>
<tr>
<td>I typically use a wide-brimmed hat for protection in the sun</td>
<td>59%</td>
</tr>
<tr>
<td>I typically use a long-sleeved shirt for protection in the sun</td>
<td>32%</td>
</tr>
<tr>
<td>I use much less sun protection in the cooler months</td>
<td>33%</td>
</tr>
<tr>
<td>My workplace requires the use of sun protection</td>
<td>69%</td>
</tr>
<tr>
<td>I have experienced sunburn since my last excised NMSC</td>
<td>55%</td>
</tr>
<tr>
<td>I do regular activities in the sun between 10 and 2</td>
<td>78%</td>
</tr>
<tr>
<td>I try to avoid going out in the sun around midday</td>
<td>47%</td>
</tr>
<tr>
<td>I spend time doing recreational activities on my days off</td>
<td>9%</td>
</tr>
</tbody>
</table>

<sup>a</sup> SD = standard deviation.

<sup>b</sup> IQR = interquartile range.
min, 176 (60%) reported they typically used sunscreen, and 83 (28%) reported they typically wore a long-sleeved shirt and wide-brimmed hat.

The most common reasons why men did not use sun protection were “did not get around to putting it on” (n = 57; 24%), “inconvenient” (n = 51; 22%), and because they are “hot and uncomfortable to wear in the tropics” (n = 41; 17%).

**Bivariate analysis—sunscreen use**

Men who typically used sunscreen were more likely to be younger and have a higher level of education, compared to men who did not use sunscreen. These men were more likely to work indoors, spend time doing recreational activities on days off, and be more longer-term residents of north Queensland. There was statistically no difference between regular users and nonusers of sunscreen with respect to experiencing recent sunburn (Table 1).

**Bivariate analysis—use of a long-sleeved shirt with a wide-brimmed hat**

Men who typically wore a long-sleeved shirt and wide-brimmed hat reported greater numbers of previously excised skin cancers or suspicious skin lesions, and had lighter skin (types I and II). They also tended to be more longer-term residents of north Queensland, spending most or all of their life in the tropics. These men were more likely to use sunscreen as well as a long-sleeved shirt and wide-brimmed hat, be required to use sun protection at their workplace, and use a similar or only slightly less level of sun protection year round (Table 2).

Men who wore a long-sleeved shirt and wide-brimmed hat were also more likely to have the beliefs that skin cancers are not easily treatable and are a serious risk to their health. These men also had the attitudes that they do not enjoy going out in the sun, and that they do not look or feel better with a suntan. Men who wore a long-sleeved shirt
and wide-brimmed hat were more likely to state that they had not experienced recent sunburn.

**Multivariate analysis**

Multivariate logistic regression identified that sunscreen use in men with a history of NMSC was predicted by not having barriers to using sun protection, having spent at least most of their life in the tropics and doing recreational activities on days off. Men who avoided going out in the sun around the midday hours also showed regular use of sunscreen, as did men who wore a hat the last time they were out in the sun for at least 20 min (Tables 3 and 4).

Multivariate logistic regression identified that use of a long-sleeved shirt with a wide-brimmed hat in men with a history of NMSC was predicted by working for a company with a mandatory sun protection policy, not enjoying sun exposure, and believing that the benefits of a suntan do not outweigh the risks. Use of protective clothing in men was also predicted by having fewer barriers to using sun protection and more previously excised skin cancers. Men with the attitude that skin cancers cannot be easily treated also showed increased use of protective clothing, as did men aged 50 years and over.

### Table 3
Results of multiple logistic regression analysis identifying predictors of “typically using sunscreen when in the sun” in north Australian men (*n* = 281) with a history of nonmelanoma skin cancer

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Total sample (n = 281)</th>
<th>Use sunscreen (%)</th>
<th>POR [95% CI]b</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have barriers to using sun protection</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Yes</td>
<td>156</td>
<td>25%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>125</td>
<td>36%</td>
<td>5.7 [2.9–10.2]</td>
<td></td>
</tr>
<tr>
<td>I have spent at least most of my life in the tropics</td>
<td></td>
<td></td>
<td></td>
<td>0.0090</td>
</tr>
<tr>
<td>No</td>
<td>81</td>
<td>21%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>200</td>
<td>40%</td>
<td>2.4 [1.2–4.4]</td>
<td></td>
</tr>
<tr>
<td>I do recreational activities in the sun on my days off</td>
<td></td>
<td></td>
<td></td>
<td>0.0002</td>
</tr>
<tr>
<td>No</td>
<td>228</td>
<td>15%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>53</td>
<td>46%</td>
<td>4.7 [2.3–13.5]</td>
<td></td>
</tr>
<tr>
<td>I avoid going out in the sun during the midday hours</td>
<td></td>
<td></td>
<td></td>
<td>0.0003</td>
</tr>
<tr>
<td>No</td>
<td>113</td>
<td>20%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>168</td>
<td>41%</td>
<td>2.9 [1.4–5.2]</td>
<td></td>
</tr>
<tr>
<td>I wore a hat the last time I was out in the sun</td>
<td></td>
<td></td>
<td></td>
<td>0.0203</td>
</tr>
<tr>
<td>No</td>
<td>32</td>
<td>4%</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>249</td>
<td>57%</td>
<td>2.6 [1.3–12.4]</td>
<td></td>
</tr>
</tbody>
</table>

a Only the data of men with no missing values for all predictors accepted into the model were analyzed.

b POR [95% CI] = prevalence odds ratio and 95% confidence interval.

### Discussion

This cross-sectional study is the first to identify the predictors of wearing sunscreen and sun protective clothing in men with previous NMSC. The present study found 60% of men with previous NMSC reported that they regularly used sunscreen when in the sun for 20 min or more, while 28% reported wearing a long-sleeved shirt and wide-brimmed hat. These levels of sun protection are similar to...
those reported in an Israeli study involving patients with a previous BCC [19], where 64% regularly used sunscreen and 49% regularly wore hats or long-sleeved shirts. However, use of sun protection is appreciably higher in this sample compared to previous studies involving participants from the general American, Canadian, or Australian populations [20–23]. Persons who already experienced their susceptibility to skin cancer are likely to be more thoughtful toward sun protection, as found in Rosenman’s study from 1995, where previous history of skin cancer increased the likelihood of sun protection in farmers and their spouses [24].

In the present study, men with previous NMSC who used sunscreen tended to be younger, be indoor workers who do recreational activities on days off, and have lived most of their life in the tropics. Men who wore a long-sleeved shirt with a wide-brimmed hat had spent most or all their life in the tropics, were more likely to use sunscreen regularly, and have more excised skin cancers or skin lesions. Men who were older and had fairer skin were more likely to wear a long-sleeved shirt with a wide-brimmed hat, but not sunscreen. Similar patterns of age and skin type with sun protection use have been found previously in Australia and elsewhere [25–28].

The present study suggests that men living in north Queensland have found through personal experience that adequate sun protection is best afforded by using a long-sleeved shirt, a wide-brimmed hat and sunscreen together, in particular, if they have a lighter skin type. Previous studies have found wearing long-sleeved shirts and wide-brimmed hats reduce the incidence of both sunburn and naevi, while using sunscreen alone actually increases risk [25,29]. Therefore, it appears that north Australian men have found through experience that the use of a long-sleeved shirt and wide-brimmed hat is integral to a personal sun protection strategy, rather than just relying on sunscreen.

Previous studies have discussed several human failings that reduce the effectiveness of sunscreen, in particular, in the tropics [30–33]. The evaluation of the SunSmart campaign conducted in Victoria, Australia, in 1997–1998 concluded that wearing protective clothes offered better protection from sunburn than other measures [25]. Using sun protective clothing in combination with sunscreen is likely to be even more important in high UVR environments such as north Queensland.

The present study also suggests that the more negative experience men have with skin cancer (i.e., having more lesions previously excised) and the longer they have lived in the tropics, the more they use wide-brimmed hats, long-sleeved shirts, and sunscreen. This suggest that only after much negative experience with skin cancer do men change their attitudes to sun exposure and sun protection, and follow the recommended sun protection messages by using a long-sleeved shirt, wide-brimmed hat, and sunscreen.

This finding fits with both the TRA [17] and the HBM, [18] which suggest an individual’s experience with disease improves their attitudes regarding personal susceptibility, and the seriousness and treatability of the disease, which in turn, predict regular use of the preventive action. This study also supports the theory that sun protection behavior is more related to personal experience concerning skin cancer, rather than knowledge of the risks of sun exposure [34]. While almost all participants in the present study knew of the risks associated with both suntans and sunburns, almost half of those who did not use protective clothing stated they thought skin cancer was easily treatable, and less than one third stated that it was traumatic for them to discover they were susceptible to skin cancer. Because NMSC are relatively easily treated by excision and the fatality rate is low (approximately 1% of all deaths are currently caused by NMSC [35]), not all men may believe NMSC is a serious threat to their health. How seriously north Australian men view NMSC as a health threat needs further investigation.

The use of sun protective clothing in northern Australian men also appears to be influenced somewhat by climatic barriers. The present study found a common barrier to men using sun protective clothing was that it is “hot and uncomfortable”, while sunscreen was found to “make your hands greasy” and “run into your eyes”. Much of northern Australia lies within the tropical latitudes, where the general pattern is hot and humid conditions for many months of the year. Therefore, those who work outdoors in the tropics should wear clothing more suitable for hot conditions and physical activity to aid the body’s cooling processes, and use more appropriate alcohol-based sunscreens that are less greasy and runny. Work clothing should minimize the heat factor by having thermal characteristics more suitable to hot and humid conditions: having lightweight, high vapor and air permeability, and low thermal insulation properties [36].

Exposure to the use of long-sleeved shirts, wide-brimmed hats, and alcohol-based sunscreens in a supportive work environment may also improve men’s attitudes to using sun protection and their self-efficacy in wearing long-sleeved shirts, hats, and sunscreen. Actively using sun protection may also increase the time men think about the risks of skin cancer in general, which has been found to reduce unrealistic optimism [37].

The present study suggests workplace policies that require male employees to use a brimmed hat, long-sleeved shirt, and sunscreen do actually affect the men’s use of wide-brimmed hats and long-sleeved shirts, although not sunscreen. Approaches such as enforcing sun-safe policies on work sites should be further investigated to promote a more comprehensive sun protection strategy for outdoor workers, such that they are adequately protected throughout their working life.

The present study suggests that it is no longer sufficient to merely provide sunscreen in the workplace, or give outdoor workers a choice to use sun protective clothing or not. Both employers and employees must be made aware of the importance of regular and comprehensive sun protection. A recent Western Australian study concluded that trade
unions could have an important role in the creation of sun-safe workplaces [38].

In conclusion, north Australian men’s use of sun protection was generally associated with much negative experience of skin cancer. Men’s better attitudes to sun exposure and sun protection were also associated with much negative experience of skin cancer. This suggests sun protection should be mandatory for people who work outdoors in the sun, as the sun protection attitudes and behaviors of some men may only improve after significant sun damage.

This study recommends that the use of appropriate sun protective clothing and sunscreen should be made mandatory for all those who work outdoors in high-sun-exposure occupations.

However, the present study has several limitations, in particular, its relatively low response rate. Men have been well documented as being difficult to study [39], particularly when it involves research into skin cancer [40,41]. It is likely that respondents were more health concerned than nonrespondents, but health-concerned people with previous NMSC might tend to avoid the sun and might protect themselves better from the sun. This response bias might give an underrepresentation of sun exposure and an overrepresentation of sun protective behavior in north Australian men with previous skin cancer.

However, the overresponse of participants between the ages of 40 and 60 years would also likely affect the self-reporting of sun exposure and the predictors of sun protection. Respondents from younger age groups are likely to have more sun exposure than older age groups and more positive attitudes to sun exposure. This response bias toward younger men may result in an overrepresentation of sun exposure and an underrepresentation of sun protective behaviors, mixing with the effects of a potentially more health-conscious sample.

In addition, the quality of the information exclusively relies on the recall of the participants. In particular, no attempt has been made to cross-check the reported number of previously excised skin cancers or skin lesions. However, all participants had at least one confirmed skin cancer just recently excised, which lends some support for the assumption that these men had a high awareness of issues relating to their skin and to skin cancer.

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