

The effect of sunscreen use on sunburn occurrence in New Zealand

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Abstract. The purpose of this analysis is to determine whether the use of sunscreen is associated with sun exposure and sunburn occurrence in a large sample of New Zealanders.

Background

Overexposure to ultraviolet radiation (UVR) is the main modifiable risk factor for developing melanoma and other skin cancers [International Agency for Research on Cancer, 1992; Leiter and Garbe, 2008]. Specifically, intermittent sun exposure and sunburn history play a major role in increasing melanoma risk [Gandini *et al.*, 2005; Cancer Society of New Zealand, 2010] while chronic sun exposure increases the risk of the two main types of non-melanoma skin cancer (NMSC), basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) [Bauer *et al.*, 2011; Schmitt *et al.*, 2011].

Sunscreen use has been promoted as a way to reduce UVR, which should theoretically reduce the risk of developing skin cancer. Existing evidence supports the hypothesis that sunscreen helps to protect against SCC and potentially to a lesser extent (or perhaps not at all), BCC [Green *et al.*, 1999; Pols *et al.*, 2006; Ulrich *et al.*, 2009]. The literature is conflicting, however, with regards to melanoma. Some studies have found that sunscreen use is associated with an increased risk of melanoma [Wolf *et al.*, n.d.], while other studies have found a negative association [Green *et al.*, 2011], or no statistically significant effect [Huncharek and Kupelnick, 2002]. One of the possible reasons for the increased risk of melanoma among sunscreen users is that sunscreen does not sufficiently protect from UVA radiation, which is thought to play a role in developing melanoma and BCC [Garland *et al.*, 1993; Gasparro, 2000]. Another theory is that sunscreen users may increase their sun exposure as a result of feeling ‘protected’, and some evidence indicates that they may be more likely to stay outdoors longer and/or to burn compared to non-sunscreen users [Autier *et al.*, 2007; Køster *et al.*, 2010].

The research questions are the following:

1. Is there an association between sunscreen use and sun exposure?
2. What is the effect of sunscreen use on sunburn occurrence?

Method

The Sun Exposure Survey (SES) is a population-based observational study that has been conducted triennially from 1994 to 2013. It is a nationally

representative sample that employs quotas for geographic region, gender, and age group. Data from 29 weather stations around the country were provided by MetService and NIWA to calculate a “fine weather score” for sampling purposes. The weather score was calculated hourly based on data relating to the UV Index, temperature, and cloud cover. Households were sampled when their geographic area met a certain threshold score. The sampling method for phoning households varied throughout the waves of data collection; in 2013 it was Random Digit Dialling (RDD). One adult (aged 18 to 54) was randomly selected from each household; an additional person aged 13 to 17 could be selected for the youth sample. Respondents were interviewed on the Monday, Tuesday, or Wednesday following the fine weather weekend in question to minimise recall bias. They were asked about their outdoor activities, weather perception, sun exposure, sun protection behaviours, phenotypic factors (e.g. skin colour), campaign recall, and knowledge/attitudes relating to tanning, risk perception, and melanoma. Selection weights were used for households where there was more than one occupant to adjust for the probability of a person being selected for participation in the survey. Population benchmarks from the census were used to adjust the sample to reflect the country’s makeup by gender, age group, and ethnicity.

Seven waves of data relating to sun exposure, sunburn, and sun protection behaviours were analysed on a cross-sectional basis. Chi Square tests and ordered logistic regression were used to assess the association between sunscreen use and sun exposure. A logistic regression model was used to investigate the effect of sunscreen use on sunburn, which adjusted for other factors that may be associated with sunburn, such as other sun protection behaviours, sun exposure, and phenotypic/demographic risk factors. Odds ratios were calculated with $\alpha=.05$.

Results

The combined data set for seven waves of data comprised 7,121 adults aged 18 to 54 years, of whom 5,684 were outdoors for at least 15 minutes during the previous summer weekend and therefore included in the analyses. Table 1 includes the preliminary results of unweighted percentages of those who used sunscreen for each exposure time period in Table 1. There is a statistically significant, linear relationship by which sunscreen use increases as exposure increases ($X^2=163.8$, $p=.000$. OR=1.8, $p=.00$).

Table 1. Sunscreen use by sun exposure*

Sun exposure (time spent outside)	% who used sunscreen**
15 min to 1 hour	46.8
1 hour 15 min to 2 hours	53.0
2 hours 15 min to 3 hours	58.5
3 hours 15 min to 4 hours	64.8
More than 4 hours	60.4

*among those who were outdoors for at least 15 minutes over the previous summer weekend, n=5,684

**unweighted data

Table 2 shows the weighted rates of sunscreen use and sunburn by year. While sunscreen use increased from 1994 to 2013, sunburn rates remained relatively stable. Table 3 shows that respondents who used sunscreen had similar rates of sunburn compared to those who did not use sunscreen in all survey years except for 1997 and 2006. In 1997, those who used sunscreen had about half (19.1%) the sunburn rate as those who did not use sunscreen (40.0%, OR=0.3, p=.00). The inverse was true in 2006, where those who used sunscreen (29.8%) had about double the sunburn rate as those who did not (15.9%, OR=1.93, p=.05).

Table 2. Rates of sunscreen use and sunburn by year*

Year	Sunscreen use (%)	Sunburnt (%)
1994	38.9	11.0
1997	31.1	33.5
2000	37.0	24.1
2003	44.9	20.7
2006	51.0	23.0
2010	51.3	19.5
2013	54.9	22.3

*among those who were outdoors for at least 15 minutes over the previous summer weekend, n=5,684

Table 3. Sunburn rate by sunscreen use*

Year	Used sunscreen	Didn't use sunscreen	Odds Ratio (ref=didn't use sunscreen)	p value
1994	12.2	10.2	1.40	.45
1997	19.1	40.0	0.30	.00
2000	25.7	23.1	1.01	.87
2003	23.0	18.9	0.97	.94
2006	29.8	15.9	1.93	.05
2010	21.3	17.0	1.00	.99
2013	20.6	24.3	0.65	.15

*among those who were outdoors for at least 15 minutes over the previous summer weekend, n=5,684

Discussion

The findings are clear that as New Zealanders stay outdoors longer, they are more likely to use sunscreen. The direction of this relationship, however, is unknown. It is unclear if increased exposure occurs as a result of a sense of feeling protected by sunscreen or if increased exposure serves as a cue to action for sunscreen application. There does not appear to be a relationship between sunscreen use and sunburn; that is, sunscreen use does not appear to help protect from sunburn, nor does it pose as a risk factor for sunburn. These findings reaffirm current sun safety messaging of the importance to use multiple methods of sun protection and not to over-rely on sunscreen as the sole method. The 20 years of sun exposure data available in New Zealand create many opportunities to build comprehensive models that analyse which factors increase and decrease the risk of sunburn, which may help to further develop appropriate sun safety messages.

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