Are workers or their workplaces the key to occupational sun protection?

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Introduction

Outdoor workers are at increased risk of excessive exposure to solar ultraviolet radiation (UVR), and there is a significant association between skin cancer and outdoor occupation.[1] Scheduling work to outside of peak UVR hours can be problematic, so sun protection (shade, clothing and sunscreen) is often the best option. Although UVR is identified as a potential workplace hazard,[2] sun protection among New Zealand (NZ) outdoor workers tends to be marginalised as an occupational safety issue, with available evidence[3] and anecdotal reports suggesting that control strategies are not widely implemented, leaving key occupational groups inadequately protected.

Occupational and workplace policies, practices, norms and environments potentially influence individual sun protection knowledge, attitudes and behaviours and sun exposure experience through the provision of protective equipment (e.g. movable shade structures, clothing) and products (e.g. sunscreen), and regulation, monitoring and enforcement. Policy development can improve sun protection in large organisations,[4] and perceived workplace support is associated with increased sunscreen use,[3] although its use among outdoor workers is often inadequate.[5] Therefore, in order to better understand the key influences on occupational sun-protection, it is important to examine the role of both workplace and individual worker factors associated with sun protection. Accordingly, the primary aims of the present study were to determine whether sun protection was predicted by potentially modifiable: (i) workplace sun protection features (e.g. having a sun protection policy, provision of protective equipment and conducting sun-safety and skin cancer training); (ii) perceived workplace social support for sun protection (e.g. pressure to get the job done, health concerns of employer and workmates, and self-efficacy of sunscreen use); (iii) personal attitudes, beliefs and knowledge.

Methods

Design and Setting

This paper reports on the sun protection practices arm of a dual arm cross-sectional study that also examined workers occupational UVR exposures. A convenience sample of three outdoor occupational groups: horticulture (includes viticulture), roading (includes paving), and building (includes roofing) in Central Otago, a region of New Zealand's South Island, participated in the survey. Ethical approval was obtained from the Human Ethics Committee, University of Otago (number 06/138). Participating workers completed a questionnaire and recorded sun protection practices for five consecutive days, January to February 2007.

Abstract

Issue addressed: High levels of sun exposure and skin cancer are experienced by outdoor workers. To develop effective preventive strategies it is important to understand which factors predict sun protection use.

Methods*:* Outdoor workers (n=74) in Central Otago, New Zealand, completed a questionnaire and recorded sun protection practices for five consecutive working days, January-March 2007.

Results: Sun protection was predicted by beliefs of personal susceptibility to skin cancer, suntan attitudes, and perceived workplace support, but not knowledge.

Conclusions: Both individual and workplace factors influence outdoor workers' sun protection.

Key words: Skin cancer, suntan, protection, occupation.

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So what?

Interventions for outdoor workers should aim for a settings-based approach to promote behavioural change.

Participants

Statistical power calculations were based on UVR exposure rather than sun protection outcomes. Since no convenient sampling frame for outdoor workers is available in NZ, all workplaces from the selected outdoor occupations listed in the Yellow Pages of the Central Otago telephone directory were contacted by mail, using university letterhead, provided with a brief summary of the project aims and invited to participate. The inclusion criteria stipulated that participating workers must usually work outdoors between 10 am and 4 pm (daylight saving time), five days per week. Of 40 workplaces invited to participate, 13 were eliminated as staff numbers were too low (<3 potential participants); 10 did not respond to the invitation and couldn't be contacted by telephone; two declined; and one was dropped during fieldwork due to staff annual leave; leaving a total of 14 workplaces and 74 workers. Workplaces not contacted were spread across occupational groups and the time of recruitment (December 2006) was likely to be responsible, as some workplaces were affected by the holiday period.

Variables of interest and measures

Sun protection score

The primary outcome of interest was a sun protection score, averaged over five days. To avoid recall bias, workers were provided with a chart each day on which to record their sun protection practices, 11 am-4 pm NZST, by circling pictures (e.g. of a broad-brimmed hat, cap, sunglasses, singlet) and filling in on a human figure outline the areas where they had applied sunscreen. The 'rule of nines',[6] a standard technique for assessing burn area in the pre-hospital setting, was used to calculate a protection score for the body areas covered by clothing, with half points assigned to sunscreen covered areas – given less certain protection. A score of 100 indicates complete protection.

Predictors of interest

Participants completed a self-administered, 30-item questionnaire assessing demographic characteristics; knowledge about skin cancer and sun protection guidelines; perceived skin cancer risk; attitude towards suntans; perceived workplace support and workplace policy, training and equipment provision. Questionnaires were completed and returned to the fieldworker at each work site on day one of the study. Questionnaire items were measures selected or adapted from published sources,[7,8] or used in earlier studies.[3,9]

Summary indexes were created from multiple items, using an additive approach. Knowledge was assessed by 20 items, including knowledge about UVR, sun protective clothing, sunscreen and checks for skin cancer – answers were scored as either one (correct) or zero (incorrect). Similarly, a workplace protection score was obtained by adding up 'yes' (one) and 'no' (zero) responses to 14 items about workplace sun protection policy, provision of protective products and equipment, re-scheduling and sun-safety training. Attitudes

Table 1: Demographic data by occupational group.

Variable	Builders n (%)	Horticulture workers n (%)	Road workers n (%)	Overall
Sex				
Male	38 (97)	4 (25)	19 (100)	61 (82)
Female	1(3)	12 (75)	0	13 (18)
Age group (years)				
15-30	15 (38)	9 (56)	8 (42)	32 (43)
31-45	14 (36)	3 (18)	7 (37)	24(32)
46-60	10 (24)	4 (25)	4 (21)	18(24)
Skin type[a]				
I	4 (10)	2 (13)	1 (5)	7 (9)
II	30 (77)	9 (56)	14 (74)	53 (72)
III	5 (13)	3 (19)	4 (21)	12 (16)
IV	0	1 (6)	0	1 (1)
Ethnic group[b]				
NZ European	38 (97)	16 (100)	19 (100)	73 (99)
Maori	1 (2)	0	0	1 (1)
Chinese	1 (2)	0	0	1 (1)
Secondary school education				
Yes	32 (82)	14 (88)	12 (63)	58 (78)
No	7 (18)	2 (12)	7 (37)	16 (22)

(a) Skin types (skin response after 30 minutes of unprotected exposure at start of summer): I – just burn and not afterwards; II – burn first, then tan afterwards; III – not burn at all, just tan; IV – nothing would happen.

(b) More than one ethnic group may be selected.

Note. Because of missing data, percentages may not total 100.

to suntans were assessed by measuring six beliefs (e.g. "A suntan makes me feel more attractive") on a true/false scale, with the number of undesirable answers (in terms of skin cancer prevention) added to create a summary score – high scores indicating that suntans were viewed favourably. The perceived workplace support index was created by adding 'correct' (i.e. desirable) responses to six questions (e.g. about whether sun protection was prioritised, employee health was valued, workmates were health conscious and if getting a job completed was more important than sunburn concerns). Perceived risk of developing skin cancer was indicated on a nine-point Likert-type scale from one (low) to nine (high). Details of all measures are available from the authors.

Statistical analysis

Associations between occupational group and predictors of interest were investigated using one-way ANOVA with Scheffe's adjustment for multiple comparisons. A general linear model was used to assess the independent contributions to sun protection of workplace protection factors and perceived workplace support, adjusting for occupational group. Since the study was exploratory, having the primary aim of identifying factors that may predict sun protection, statistical significance was set at 0.05, with tendencies (*p* values between 0.05 and 0.10) noted. Data were collected from individuals aggregated in workplaces, so analyses accounted for the effects of cluster sampling, using the cluster option in Stata version 9.[10]

Results

Sample characteristics

Complete data were available for 99% of participants, with the remaining 1% assumed to be missing at random and therefore, disregarded. Participants' demographic characteristics are presented in Table 1. Mean age was 35 years (range 15-66), most were male (82%) and builders (53%), followed by road workers (26%), and horticulture workers (22%). The intra-class correlation coefficient within organisations was 0.12 for sun protection score.

Sun protection knowledge, attitudes, practices, perceived risk, workplace protection and perceived workplace support

The mean scores and 95% confidence intervals for items and scales are presented in Table 2. Post hoc tests indicated that horticulture workers' sun protection was significantly higher than that of road workers (difference 9.2; 95% CI_{diff}: 5.1, 13.3; $p = <0.01$), and builders (difference 6.2; 95% CI_{diff}: 2.9, 9.5; $p = <0.01$). There was no significant difference between builders and road workers ($p=0.23$). Road workers had higher workplace protection scores than builders (difference 4.9; 95% CI_{diff}: 3.6, 6.1; $p<0.01$) and horticulture workers (difference 3.2; 95% CI_{diff}: 0.3, 6.1; $p=0.03$). There were no significant differences in workplace protection scores between horticulture workers and builders ($p=0.25$). No differences in perceived workplace support were identified between occupational groups, after adjustment for multiple comparisons.

Multivariate Models

Regression analyses investigating the association of personal and workplace factors with sun protection (Table 3) indicate that personal factors explained the most variance ($R^2=0.22$). Controlling for occupation, workplace protection factors were not associated with sun protection ($p=0.12$), while perceived workplace support was positively associated with sun protection ($p<0.01$). At the personal level, having a positive attitude towards suntans tended to reduce sun protection ($p=0.08$), whereas high perceptions of risk tended to increase sun protection ($p=0.09$). Knowledge was not a predictor ($p=0.68$).

Table 2: Means and 95% CIs for sun protection variables by occupational group (total n=74).

Variable	Builders	Horticulture workers	Road workers	Overall	*P* value*
Sun protection score	72.1	78.3	69.0	72.6	0.01
(range 0-100)	(69.3,74.9)	(74.3, 82.3)	(63.6,74.4)	(70.4, 74.8)	
Knowledge	14.6	15.3	14.7	14.8	0.69
(range 0-20)	(13.8, 15.4)	(14.0, 16.5)	(13.4, 16.1)	(14.2, 15.4)	
Attitude towards suntans	2.3	2.3	2.5	2.3	0.90
(range 0-6, 6=pro-tan)	(1.9, 2.8)	(1.5, 3.1)	(1.9, 3.1)	(2.0, 2.7)	
Perceived skin cancer risk	5.2	4.9	5.4	5.2	0.67
(range 1-9, 9=high)	(4.6, 5.8)	(3.9, 5.9)	(4.7, 6.2)	(4.8, 5.6)	
Workplace protection	2.0	3.6	6.8	3.5	<0.01
(range 0-14, 14=high)	(1.5, 2.5)	(2.3, 4.9)	(5.8, 7.8)	(2.9, 4.2)	
Perceived workplace support	3.3	3.9	3.8	3.6	0.04
(range 0-6, 6=supportive)	(2.9, 3.6)	(3.5, 4.3)	(3.4, 4.3)	(3.4, 3.8)	

** P value is for the overall test of differences between groups based on a one-way ANOVA*

Discussion

Consistent with previous research we found that, at an individual level, a positive attitude towards suntans was associated with reduced sun protection use.[11-13] Knowledge about skin cancer and prevention guidelines was not associated with sun protection,[14,15] but those who perceived themselves as at medium risk of developing skin cancer were less likely to protect themselves than those who considered themselves at high risk. When skin type, as a potential mediator, was included in the statistical models, the results remained unchanged.

Our study also examined the influence on workers' sun protection of workplace policy, equipment provision, scheduling and training. We found that these interventions were not associated with improved protection. However, perceived workplace support had a strong association with sun protection practices. Perceived workplace support was associated with increased sunscreen use in another NZ study of outdoor workers[3] and among US pool lifeguards.[16] These findings suggest that skin cancer prevention programs should be developed in conjunction with other workplace health and safety interventions.

Most NZ sun protection surveys have been based on the recall of behaviour during the previous summer weekend,[17] thereby providing no weekday occupational data. Where occupational data have been obtained, the use of sun protection products (e.g. hat, sunglasses) has been dichotomised ('yes'/'no') without either indication of the time of day when used or the duration of use.[3] The use of detailed sun protection chart diaries in our study was a more rigorous method for documenting protection and, although such methods involve some risk of modifying behaviours, diaries have been used successfully in studies of gardeners[18] and outdoor workers,[7] and validated for use among US postal workers.[19]

There were some limitations to our study. First, the sample of outdoor workers was small, so may lack sufficient statistical power to clearly demonstrate multivariate effects. Second, given the relatively low workplace response rate, it is possible that non-participating workplaces may have less sun protective or health conscious workers, so our results may overestimate protective behaviours. Third, although items from other questionnaires and published studies were used, the validity and reliability of these measures were not tested.

Some tentative implications for health promotion may be drawn from this study. Since those who perceived they were at risk of cancer were better protected, a focus on the negative impact of UVR on skin and appearance may usefully complement training to increase awareness of risk. To facilitate a deeper understanding of personal risk and avoid optimistic bias, occupational health nurses could provide training directly relevant to target individuals, for example, via skin checks. There is some evidence that the inclusion of skin checks in skin cancer prevention programs may significantly increase sun protection among outdoor workers.[7,20]

The finding that perceived workplace support was associated with sun protection supports a settings-based approach to promote a comprehensive strategy for outdoor workers and highlights the need for management commitment to sun-safety protocols. Although the workplace variables in this study were unable to account for variance in sun protection over and above personal attitudes and beliefs, personal attributes can be difficult to change, and change often only happens after significant skin damage has already occurred.[21] Therefore, workplace factors are potentially important, and trade unions could play a role in helping to create sun-safe workplaces.[21] In particular, sunscreen and sun protective gear appropriate to the work tasks should be provided.

Table 3: Summary of regression analysis for predictors of sun protection.

	Model 1 workplace protection			Model 2 perceived workplace support			Model 3 personal factors		
Variable	***B***	***SE B***	***p-value***	***B***	***SE B***	***p-value***	***B***	***SE B***	***p-value***
Overall occupation			<0.01			<0.01			<0.01
Occupation									
Horticulture versus building	5.2	1.8	0.01	5.4	1.5	<0.01	5.0	1.4	0.005
Road work versus building	-6.1	3.2	0.08	3.9	1.9	0.07	-2.6	2.0	0.22
Horticulture versus road work	11.2	2.5	<0.01	9.2	1.3	<0.01	7.6	1.7	<0.01
Workplace protection	0.6	0.4	0.12						
Perceived workplace support				2.0	0.6	<0.01			
Positive attitude towards tan							-1.4	0.7	0.08
Perceived risk							11.8	6.5	0.09
Knowledge							0.1	0.3	0.68
R^2		0.13			0.17			0.22	

B and SE B refer to regression parameter estimates and their standard errors.

It is recommended that, in addition to testing the findings of this study among a larger sample, future research should investigate barriers to employers taking responsibility for the sun-safety of their employees. To further explore the predictors of sun exposure behavior identified in this study, the effect of worker and workplace factors on personal occupational UVR exposure, measured by personal UVR dosimeters will be examined in the second arm of this research. Taken together, the results from these two study arms should help inform and guide skin cancer risk reduction efforts for outdoor workers.

Implications

Sun protection is the most viable strategy for reducing skin cancer risk among outdoor workers, for whom sun exposure is unavoidable. However, in order to be effective, the focus and content of interventions to encourage sun protection must be appropriate and relevant for target occupational groups. By focusing on individual responsibility alone, fewer skin cancers are likely to be prevented than may be prevented by taking a broader approach to risk reduction[22] that is consistent with the Ottawa Charter model of health promotion practice.[23]

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