Woolley, Torres (2009) ***Reducing sun-induced skin damage in a high-risk group of North Queensland men.*** **PhD Thesis, James Cook University.**

Reducing sun-induced skin damage in a high-risk group of North Queensland men

Thesis submitted by

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in December 2009

for the Degree of Doctor of Philosophy

in the School of Public Health, Tropical Medicine & Rehabilitation Sciences
James Cook University

DEDICATION

This PhD thesis into skin cancer in North Queensland is dedicated to my Uncle Ted, who passed on from melanoma skin cancer in 1999.

Before I finished this thesis, his wife and my Auntie Anne joined him.

Uncle Ted and Auntie Anne gave me love, fun and excitement when others couldn’t; for that and for many other things, they will live always in my memories.

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ACKNOWLEDGEMENT OF OTHER CONTRIBUTIONS

When I began this thesis while working as a research assistant on the Townsville Skin Cancer Survey, it was at least partly due to being a job requirement to apply for a PhD scholarship. So, the contributions of others have been very important in not only fanning my enthusiasms and sustaining them over time, but in helping me first win the PhD scholarship late in 1998, and supporting me all the way through the many milestones and hurdles until this final page.

Firstly, I must give my acknowledgement and thanks to the Cancer Council Queensland, for awarding me the George Roberts PhD Scholarship for North Queensland. The James Cook University also later supported several of my studies financially through the Parkes Bequest and Doctoral Merit Grants, while the management of the Q-Build organisation and Townsville Main Roads Department supported my studies through invaluable assistance and access to their employees. Of course, none of my studies would have been possible without the generous giving of their time by the men and women of north Queensland, and by the employees of Q-Build and Townsville Main Roads Department, in particular.

I also acknowledge my fiancée Simone, who never stopped believing that the thesis would be finished, but probably regrets she didn't threaten me more often with dire consequences if I didn't hasten up the process.

Ms Sue Devine and Dr Simone Harrison also had significant contributions to this thesis by critically revising manuscripts, while Marg Glasby looked at a lot of forearms to help me show what a difference a mandatory workplace sun protection policy makes. At least I could repay the efforts of Simone and Marg somewhat by letting them take my blood and skin tissue for one of their own studies.

Over the many years of the thesis, I’ve had PhD Associate Supervisors come and go – Doctors John Lowe, Beverly Raasch and Madeleine Nowak – and all have left their mark indelibly on the thesis and its findings. John and Bev gave me invaluable advice that put me on the right track, while Maddy has my everlasting gratitude for putting in a whole lot of time finishing the thesis off with the all-important fine-tune comb – and threatening to crack the whip every so often.

But it is my Principal Supervisor, Dr Petra Buettner, who has my most thanks. Not only has Petra been by far the main contributor to what you are now reading, and gave me the skills and knowledge to pursue research as a career, but spent so much time teaching me to better structure my work that this finally spilled over into my general thinking patterns. With all the unstinting help that Petra gave, no matter how busy she was at the time or whenever it was during the week, I had to finish this thesis as much as respect for her efforts as my own desires. Perhaps another Supervisor would have seen me finish quicker, but no other Supervisor could have made me a better researcher than Petra.

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LIST OF ABBREVIATIONS

AK/SK	Actinic (or solar) keratosis
BCC	Basal cell carcinoma
CART	Cartographic and Regression Tree
EEL	Evans Electroselenium Limited (spectrophotometer)
HBM	Health Belief Model
IQR	Inter-quartile range
JCU	James Cook University
LSS	Long-sleeve shirt
MRD	Main Roads Department
NMSC	Non-melanoma skin cancer
NQ	North Queensland
POR	Prevalence Odds Ratio
SCC	Squamous cell carcinoma
SD	Standard deviation
SED	Standard erythemal dose
SPF	Sun Protection Factor
SPSS	Statistical Package for Social Sciences
TAFE	Technical and Further Education (college)
TRA	Theory of Reasoned Action
U.K.	United Kingdom
U.S.	United States
UV/UVR	Ultra-violet radiation
WBH	Wide-brimmed hat
95%-CI	95%-Confidence interval

ABSTRACT

Background

Recorded rates of epithelial skin cancer (squamous and basal cell carcinomas) are higher in Queensland, Australia, than elsewhere. Men in North Queensland (NQ) are at particularly high risk of epithelial skin cancer: NQ men have more than twice the risk of developing skin cancer than women, and NQ men are three times more likely to develop multiple skin cancer than women. As sun exposure is regarded as the major environmental risk factor for skin cancer, NQ men must have poorer sun protective behaviours compared to women. This thesis seeks to identify the reasons for NQ men's poorer sun protective behaviours, and then trial an appropriate strategy to reduce sun-induced skin damage in a high-risk group of NQ men.

Aims

1. Identify what predicts sun-induced skin damage and use of sun protection in high-risk NQ men;
2. Explore and develop understandings of NQ men's knowledge, beliefs, attitudes and behaviours toward skin damage, skin cancer and using sun protection, and compare these to women's; and then
3. Use these understandings to determine and implement the most appropriate intervention to improve sun protective behaviours in a high-risk target group.

Methods

The three major aims of this thesis are each aligned with the accepted strategy for improving problem health behaviours. This requires the three aims to be done sequentially, with the information gained in the exploratory stage (first and second aims) used to determine the most appropriate target group and intervention used in the intervention stage (third aim).

For the exploratory stage, this body of work used two quantitative studies to determine the group of NQ men at most risk of developing further skin cancer, and to identify the underlying reasons associated with their high risk of skin cancer. The first study was a self-administered cross-sectional survey mailed out to NQ men with a previous histologically-confirmed BCC or SCC (names and addresses obtained from a previous study's database). The second study was a researcher-administered cross-sectional survey with 24-hour telephone follow-up for incidence of sunburn, of NQ men (79%) and women enjoying recreational boating. Both quantitative studies involved participants identified by the literature as being high risk for developing skin cancer.

These underlying reasons are then explored in-depth via a qualitative study of 64 adult residents of Townsville (42 men, 22 women), involving 13 focus groups and 12 in-depth interviews. Older male adults were recruited for the qualitative study using a separate form mailed out with the survey to NQ men with a previous skin cancer, while younger adults and women were recruited via various media. The study used thematic analysis of the participant's own words and thoughts, with emerging themes checked with further groups, and all negative cases – people with thoughts or experiences different to the majority – explored in-depth.

This component of the thesis provides a greater understanding of the sun-related knowledge, beliefs, attitudes and personal barriers behind the gender differences in the sun exposure and sun protective practices of NQ men and women. This information also led to the author identifying the most appropriate intervention strategy to reduce further skin cancer in the high risk group of NQ men.

In the later intervention stage, it was not possible at the time, to do a prospective, controlled intervention, the strongest study design. Instead, this work uses two cross-sectional studies (including a skin examination) to evaluate a proposed mandatory workplace sun protection policy for its effectiveness in reducing the sun-induced skin damage (suntan level, recent sunburn, actinic keratoses and epithelial skin cancer) of NQ outdoor working men by comparing two sites: a site where employees work under a mandatory sun protection policy, and a second site where employees work under a voluntary sun protection policy. The site with the mandatory workplace sun protection policy requires their employees to wear a long-sleeved shirt and wide-brimmed hat when working in the sun, while the comparison site requires employees to wear a corporate uniform, but this uniform can be short-sleeved and employees can further choose whether or not to wear a hat or sunscreen.

Main results – exploratory stage

The first cross-sectional study of NQ men with previous skin cancer found 55% had experienced sunburn since their last skin cancer excised (sunburn being defined as "at least skin redness after 24 hours"). Using multivariate analysis, important predictors of sunburn were identified as being:

- working outdoors for more than two hours on a typical workday ($p=<0.01$);
- the beliefs that "skin cancer is not caused by recent sun damage" ($p=0.02$); "sun protection won't help prevent skin cancer" ($p=0.04$); and "I look better with a suntan" ($p=0.01$);
- not wearing a long-sleeved shirt (LSS) and wide-brimmed hat (WBH) together ($p=0.04$).

When NQ men with previous skin cancer went out in sun for at least 20 minutes, 36% reported wearing a long-sleeved shirt, 64% a wide-brimmed hat, and 60% applying sunscreen. The important predictors of wearing a long-sleeved shirt and wide-brimmed hat together included:

- not having barriers to using sun protection ($p=0.01$);

- the belief “skin cancer is not easily treatable” ($p=0.01$);
- the attitudes that “the benefits of suntan don’t outweigh risk” ($p=0.04$); and “I don’t enjoy being out in the sun” ($p=<0.01$);
- having more than six skin lesions previously excised ($p=0.04$).

In addition, the first survey found outdoor working men (defined as spending more than one hour in the sun on a typical workday) with sun-sensitive skin reported more previous skin lesions ($p = 0.04$) than other men. Also, while outdoor working men are out in the sun more on work days ($p=<0.01$) and days off ($p=<0.01$), their use of a long-sleeved shirt, wide-brimmed hat and sunscreen is no better than other men.

In the second cross-sectional study of men and women who regularly participate in recreational boating, 48% experienced sunburn from their trip, mostly on the face. For sun protection, 33% of respondents wore a long-sleeved shirt, 51% wore a wide-brimmed hat, and 84% applied sunscreen at least once. The main predictor of sunburn was not wearing a wide-brimmed hat on the day ($p=<0.01$), while the main predictor of people using optimal sun protection – a long-sleeved shirt, wide-brimmed hat and sunscreen together – was that people who did use all three strategies rated the other people’s sun protection practices on the boat as at least “good”.

In addition, the second survey found boaters who worked outdoors reported more previous skin cancer ($p=0.06$) than other boaters. Also, boaters who reported having previous skin cancer were no more likely to use personal sun protection or have a lighter tan, and no less likely to experience sunburn from the boat trip, than boaters not having skin cancer.

The qualitative investigation component of the exploratory stage found many differences between NQ men and women. NQ men usually had less accurate knowledge about the causes and prevention of skin cancer than women; most men did not know that skin redness after 24 hours, having a dark suntan and peeling sunburns after 20 years of age can all cause skin cancer. Men reported they often experience skin redness and have a suntan, while women often reported habitually using sun protection and avoiding going out in the sun during the midday hours. In contrast to women, men also admitted experiencing negative influences from peers regarding use of sun protection, particularly in the workplace.

There were also differences in NQ men and women's perceived susceptibility to skin cancer: women and outdoor working men with fair skin thought they were highly susceptible to developing multiple skin cancer, but indoor working men and men with "good genetics" did not. Men also appeared to have few concerns about developing skin cancer; most considered it an acceptable risk as a result of work or their lifestyle, with some men even describing how they wait so they can get the GP to remove several at once, thus saving time and money. While both men and women perceived epithelial skin cancers as easily treatable, women were quite concerned about scarring after removal, while men were not.

Differences were also found in the perceived benefits of using sun protection; women thought that not going out in the sun during the midday hours and using a long-sleeved shirt, wide-brimmed hat and sunscreen will avoid future skin cancer and the visible signs of sun-damaged skin, while men thought that sun protection was not necessary for exposures <1 hour, and that skin cancer develops only after many years of not using sun protection. While both men and women reported issues with using sun protection, these annoyances were not enough to stop women using sun protection, but they often did stop the men, particularly outdoor working men. The few men who did say these annoyances were not strong enough to stop them using sun protection were older and had visibly sun-damaged skin with many sunspots and scarring.

Finally, women had a variety of motivators to improve sun protection: to avoid sunburn which which was painful and left the skin looking “mottled; vanity, especially avoiding premature aging of the skin; setting a good example in front of their children; and from information provided in magazine articles and television messages about skin cancer and sun-induced skin aging, and the “danger” of melanoma and “risks” of sun exposure. In contrast, men didn’t read many magazines which had health-related articles, thought the same television messages were too emotive, low on facts and of little practical benefit, and outdoor working men regularly commented that their workplace makes a poor attempt at advertising the dangers of sun exposure or promoting the use of sun protection.

Conclusions – exploratory stage

Both quantitative studies found NQ outdoor working men were more likely to report previous skin lesions or skin cancer than other men. In addition, many NQ men regularly experienced sun damage (including a dark suntan and at least skin redness after 24 hours) because they did not consistently or adequately use recommended sun protective behaviours (long-sleeved shirt, wide-brimmed hat, and sunscreen) during work or recreational activities, even if they have already started developing skin cancer.

The qualitative study found NQ men’s knowledge about skin cancer was often inadequate or incorrect compared to NQ women, and men’s sun behaviours did not improve greatly with age; a likely consequence of few motivators and many barriers to using sun protection; perceiving benefits to having a suntan but not to using sun protection; and believing epithelial skin cancer is not a serious health threat. While many women in the interviews had formed good sun protective habits by their mid- or late-twenties, men by their late-twenties often had a well-established habit of not using sun protection.

The literature shows bad habits are hard to break, as habits are established over a long period and often performed automatically; thus, are highly resistant to change. The literaure also shows that trying to improve men's sun protection habits using interventions based on fear-appeals, knowledge-change or attitude-change have resulted in only minor or short-term increases in sun protective practices. The exploratory stage of this work shows that, for the majority of NQ men, there are a wide variety of negative and few positive influences on their likelihood of using sun protection, helping to explain why many NQ men often form poor sun-protective habits early in life. It appears that for many NQ men, only when they develop many skin cancers and sun damage is perhaps irreversible, are they sufficiently motivated to more consistently use recommended sun-protective practices.

Therefore, the author of this work decided that an environmental intervention (also called 'social engineering'; for example, interventions to prevent smoking in restaurants or making it illegal not to wear a seat belt while driving on the road) would likely be the most successful intervention strategy, rather than any attempt to improve behaviour via knowledge-change or attitude-change. For improving the sun-protective practices of the high risk group of NQ men for developing epithelial skin cancer – outdoor workers – the logical social engineering approach is making it mandatory for outdoors workers to use at least some of the recommended sun protection practices of a long-sleeved shirt, wide-brimmed hat, long pants and sunscreen.

Results – intervention stage

Compared to employees working under a voluntary workplace sun protection policy, employees working under a mandatory policy (required to wear a LSS and WBH):

- had lighter suntan levels on right forearm ($p = 0.002$) and dorsum of hand ($p = 0.028$);

- had fewer actinic (solar) keratoses on right forearm (p = 0.004); and
- reported fewer recent sunburns (p = 0.004) and fewer previously excised skin cancers (p = 0.019).

Conclusions – intervention stage

As statistical analysis showed, there were no differences between the two groups with regard to age and skin type; therefore, the reduction in numbers of self-reported skin cancer and recent sunburns and in the observed actinic (solar) keratoses and suntan level on the hands and arms of employees under the mandatory sun protection policy is a likely consequence of outdoor workers consistently practicing good sun-protective behaviours over a long period of time.

Therefore, the overall conclusion of this thesis is that the most effective strategy to reduce sun-induced skin damage and future epithelial skin cancer in NQ men is a mandatory sun protection policy for all who work outdoors in the tropics.

Main recommendations of the thesis

- There should be mandatory use of at least a long-sleeved shirt and wide-brimmed hat for all who work outdoors in high sun-exposure occupations in NQ, and workplaces should at least strongly advocate for, or make easily available, sunscreen, long pants and sun-gloves. The strength of the barriers and the lack of motivators for NQ men using sun protection suggest it is no longer sufficient to merely provide sunscreen in the workplace in tropical regions, or give workers in the tropics a choice of using sun protective clothing when outdoors for significant periods of time. Workplaces in tropical regions need to adopt a much more serious commitment to skin cancer prevention, which must include a mandatory workplace sun protection policy for outdoor workers.
- NQ men should be provided with factual (and less emotive) information about

epithelial skin cancer, as they are often unaware of their increased risk from having a dark suntan or from experiencing skin redness. These misconceptions could be easily targeted by more specific health promotion messages in the media and from medical professionals. Advice should also include using combinations of sun protective measures, but a focus on sun protective clothing with less reliance on artificial shade structures and sunscreen is preferable. This education would be particularly effective for men if social networks were targeted, using identified peer leaders to model recommended sun protective practices. This education strategy should be assessed as a study in the NQ region to determine its potential to improve the sun-protective practices of men participating in social high-sun exposure recreational activities.

- Because of the small sample size and study design of the "intervention" stage of the thesis, it would be highly desirable to investigate, in a future larger, quasi-experimental or randomised, controlled study, the significant reduction in the sun-induced skin damage found in employees from the mandatory sun protection workplace compared to the voluntary sun protection workplace.

Chapter 1

Improving the primary prevention of epithelial skin cancer in adults: A review of the literature

1.1 Scope and limitations of this review

This chapter reviews the published literature on reducing epithelial skin cancer in adults, either by directly targeting a reduction in their incidence of epithelial skin cancer or by improving knowledge, attitudes and/or behaviours associated with the primary prevention of epithelial skin cancer.

As an introduction to the field of epithelial skin cancer, this review also includes an introduction to the clinical characteristics and an overview of the epidemiology of epithelial skin cancer, the risk factors associated with their development, primary prevention approaches to epithelial skin cancer, information about the knowledge, beliefs, attitudes and behaviours relating to the causes and prevention of epithelial skin cancer, and an introduction to the theories of health behaviour and how they relate to the field of epithelial skin cancer prevention in adults.

Specifically, this literature review has been divided into the following sections:

- Clinical characteristics and an overview of the epidemiology of epithelial skin cancers;
- Risk factors associated with developing epithelial skin cancer;
- Primary prevention strategies for epithelial skin cancer;
- Predictors of sun-related behaviours (including a discussion of relevant theoretical models predicting health behaviour, and how well they predict sun-related behaviour);

- Individually-targeted interventions for adults to improve their knowledge, attitudes, intentions or behaviours relating to primary prevention of epithelial skin cancer (including a discussion of the theories of health behavioural change); and
- A Conclusions section describing the author's interpretation of the most important articles based on a critical analysis of previous research. The Conclusions section also suggests how issues identified within this literature review may be addressed.

This work was conducted in response to the extreme levels of epithelial skin cancer in the population of North Queensland (NQ), Australia. In 1998, a study by Buettner and Raasch reported NQ had one of the highest rates of epithelial skin cancer in the world, with men twice as likely to develop skin cancer, and more than three times more likely to develop multiple skin cancer, than women.

The main purpose of this work is to investigate why men have higher rates than women, and then propose and evaluate an effective primary prevention strategy for adult men who are most at risk of developing future epithelial skin cancer. If a successful primary prevention intervention involving sun protection can be developed for NQ men, then this intervention will also reduce the threat of other serious skin malignancies, such as actinic keratoses and cutaneous melanoma.

An underlying philosophy of this review is that individually-targeted interventions, focusing on improving the sun protective behaviours of men at high risk of developing epithelial skin cancers, would be the most suitable type of intervention for NQ men. Australia has used advanced population-based media interventions, such as the 'SunSmart' campaign, for improving people's knowledge, attitudes and behaviours toward sun protection since the early 1980s (Borland et al., 1990). Population-based media campaigns appear to be associated with improvements in the secondary prevention of cutaneous melanoma in Australia – melanomas appear to be identified earlier as evidenced by people presenting with thinner tumour thicknesses (Downing et al., 2008). However, primary prevention of epithelial skin cancer in males does not appear to be as successful, as incidence rates of epithelial skin cancer in adult males have continued to rise for decades (Giles et al., 1988; Staples et al., 1998). Indeed, the literature shows that while media-based interventions are relatively successful in educating people about the risks of a particular health-related habit and in contributing to the motivation to change, they are relatively ineffective at actually changing behaviour (Taylor, 1995). Therefore, media-based campaigns were not considered as an intervention strategy for the PhD thesis, and were not considered for this review.

The literature reviewed here only includes articles published prior to the first publication from this thesis in 2002; relevant studies published after 2002 are referred to in subsequent chapters. Throughout this thesis, the term epithelial skin cancer is inter-changeable with the term non-melanoma skin cancer (or NMSC).

1.2 Clinical characteristics and epidemiology of epithelial skin cancer

While a wide variety of skin cancers arise from the different cell types present in the skin – melanocytes, lymphocytes, vascular endothelial cells, Merkel cells, mesenchymal stromal cells, and cells forming the adnexal structures – the overwhelming majority of skin cancer is basal cell (BCC) and squamous cell carcinomas (SCC) in a ratio of approximately 4:1 (Diepgen & Mahler, 2002).

1.2.1 Clinical description of Basal Cell Carcinoma

Basal cell carcinomas (BCC) are the most common of the epithelial skin cancers; with approximately 30% of the Australian Caucasian population developing a basal cell carcinoma within their lifetime (Wong et al., 2003). They may appear as a pale lump, a small ulcer that does not heal, or a reddish flaky patch. Although usually associated with elderly people, these tumours can occur in young and middle-aged adults.

In 80 percent of all cases, basal cell carcinomas are found on the head and neck, but there appears to be an increase in incidence of basal cell carcinomas on the trunk in recent years (Wong et al., 2003). Even though this form of skin cancer very rarely metastasises, it can be locally destructive and disfiguring, causing considerable morbidity (Wong et al., 2003). These photographs below are typical of basal cell carcinomas.

1.2.2 Clinical description of Squamous Cell Carcinoma

Squamous cell carcinoma (SCC) is the second most common form of skin cancer after BCC. It arises from the cells forming the protective keratin of the epidermis (keratinocytes). The description of these cancers is based on the level of differentiation of the cells – well differentiated, moderately differentiated, and poorly differentiated. The less differentiated the lesion, the lower the quantity of normal tissue preserved and the more aggressive the cancer.

Squamous cell carcinomas (SCC) usually occur in areas of sun-damaged skin and at sites of previous actinic keratoses, burns, scars, or chronic ulcers, but again the head and neck are the most common sites (especially in people over the age of 50 years), although other areas are frequently affected; these include the forearms, dorsum of the hands and the legs of women (Kricker et al., 1994).

The appearance of SCC is more varied than BCC; they also tend to grow more quickly and can, unlike BCC, metastasise to other parts of the body, which occurs in approximately 2% of cases if left untreated (Nixon et al., 1986; Rowe et al., 1992).

SCC usually appears as a red, scaling, well-defined plaque, and may gradually develop an ulcer, scaly crust or a wart-like surface; eventually, they can spread into the deeper or surrounding tissues. Squamous cell cancers are considered superficial when the upper part of the dermis is involved and infiltrative when the lower dermis and fat tissues below the skin (subcutaneous) are invaded.

These photographs below are typical of squamous cell carcinomas.

1.2.3 Clinical description of Actinic (Solar) Keratosis

There are also the non-cancerous (or pre-cancerous) solar or actinic keratoses (AK), commonly known as sunspots. AK can differ in their appearance, but are usually red, or occasionally brown, scaly spots on areas of the skin frequently exposed to sunlight – the majority of AKs are located on the hands and forearms, with the remainder on the head and neck (Frost et al., 2000). Numbers of AK tend to be higher in older subjects (over the age of 50 years), but the distribution is similar in men and women (Frost et al., 2000). Marks et al. (1988) suggest that AK are more sensitive indicators of skin damage caused by sun exposure than epithelial skin cancer.

AK must be briefly mentioned in this review because of their relationship to epithelial skin cancer. Firstly, AK are major risk factors for skin cancer (Green & Battistutta, 1990; Kricker et al., 1990). Secondly, there is a clinical spectrum between invasive SCC, SCC in situ, and AK; however, the boundaries of these conditions are imprecisely defined, resulting in ambiguous diagnoses (Lohman & Soloman, 2001).

There is also some argument in the literature regarding the proportion of AK which progress to SCC, even if all AK should be considered to be SCC (Ackerman & Mones, 2006). Marks (2006) sees AK and SCC as different entities and argued that further education is needed to improve diagnostic accuracy; while other authors (Ackerman & Mones, 2006; Moy, 2000) suggest that differentiating between AK and SCC is futile because they are fundamentally identical. However, potential consequences of considering AK to be SCC in situ include more aggressive treatment regimen and increased anxiety for patients (Moy, 2000), and, depending on the health system, may increase costs (Marks, 2006).

These photographs below are typical of AK.

1.2.4 An overview of the epidemiology of epithelial skin cancer

It is difficult to obtain accurate epidemiological data about epithelial skin cancer because they are often not routinely collected by cancer registries. Incidence rates of epithelial skin cancer vary significantly both around the world and within countries, depending upon the ethnicity and geographic location of the study population. In Table 1, the standardised rates of epithelial skin cancer (divided into BCC and SCC) per 100 000 population from Australia, United States, Canada and Europe, are presented. This table is based on studies from 1990 to 2000.

Table 1.1: Age-standardised rates (world standard population) of epithelial skin cancer per 100 000 of population from Australia, United States, Europe and Canada (1990 to 2000)

Country	Report	BCC#		SCC#	
		Male	Female	Male	Female
Australia	Staples et al., 1998	955	629	419	228
Geraldton, W.A.^	Kricker et al., 1990	1335	817	890	289
Tasmania	Kaldor et al., 1993	145	83	64	20
Nambour, QLD	Green et al., 1996	2074	1579	1035	472
Townsville, QLD*	Buettner & Raasch, 1998	2058	1195	1332	755
United States	Miller & Weinstock, 1994	407	212	81	26
New Mexico	Hoy, 1996	619	399	188	72
New Hampshire	Serrano et al., 1991	159	87	32	8
Hawaii	Reizner et al., 1993 Chuang et al., 1995	576	298	153	92
Minnesota	Chuang et al., 1997a Chuang et al., 1997b	175	124	155	71
Europe					
Netherlands	Coebergh et al., 1991	46	32	11	3
Hull, U.K. ±	Ko et al., 1994	116	103	29	21
Switzerland	Levi et al., 1995	69	62	29	18
Scotland, U.K.±	Scottish Cancer Intelligence Unit, 1998	50	37	18	8
Finland	Hannuksela-Svahn et al., 1999	49	45	7	4
Wales, U.K. ±	Holme et al., 2000	128	105	25	9
Canada	Gallagher et al., 1990	120	92	31	17

BCC; SCC: basal and squamous cell carcinoma; * QLD: Queensland; ^ W.A.: Western Australia;
± U.K: United Kingdom

These surveys found BCC and SCC were the most commonly reported cancers in fair-skinned populations, and that Australia had the highest incidence rates of any of these countries. The Nambour study, the West Australian study, the multi-state Australian study and the United States (U.S.) studies were all epidemiological surveys based on clinically confirmed skin cancers, while the Townsville, Tasmanian, European and Canadian studies were all estimates based on cancer registries.

There are relatively low levels of medical and public interest in epithelial skin cancer and AK, since these are rarely fatal and common only in high-risk countries with Caucasian populations, such as Australia. In addition, accurate monitoring of epithelial skin cancer via cancer registries is difficult (Green & MacLennan, 1989), as many people with skin cancer never present for medical treatment, or have their clinically recognised skin cancers treated destructively without histological diagnosis; these cases escape conventional means of recording by registries. Hence, few cancer registries collect notifications of epithelial skin cancer and, if they do, data from these registries are likely to under-report the true incidence of epithelial skin cancer in populations, thus necessitating the need for special population-based surveys.

As Table 1.1 shows, only a small number of population-based cancer registries routinely monitor and report incidence rates of BCC and SCC. Similarly, the only histologically-confirmed, population-based studies on prevalence of AK were conducted in Queensland, Australia, which showed rates of around 55% in men, and 37% in women (Frost et al., 2000).

In fact, all studies of both epithelial skin cancer and AK in Caucasian populations show higher rates in men than women. As there are no known genetic differences between men and women regarding susceptibility to skin cancer, these higher rates in men are most likely a result of differences in sun protective practices and outdoor occupational and recreational activities.

In many countries with predominantly Caucasian populations susceptible to epithelial skin cancer, incidence rates of BCC and SCC have also been measured over time. In Australia, a series of household surveys were conducted in 1985, 1990 and 1995, with the incidence of both BCC and SCC in males and females increasing over this period. Other countries collected data on epithelial skin cancer through similar surveys; in these, some inconsistencies with gender for SCC rate increases were found. In Table 1.2, the average annual percentage change in incidence of epithelial skin cancer by type of tumour, gender and country is presented; this table is based on studies from 1980 to 2002.

Table 1.2: Average annual percent change in age-standardised incidence of epithelial skin cancer by tumour, gender and country

Country	Years	Basal cell carcinoma		Squamous cell carcinoma	
		Male	Female	Male	Female
Australia (Staples et al., 1998)	1985 - 1995	3%	0.6%	10%	9%
United States (Glass & Hoover, 1989)	1960 - 1988[2]	NS	NS	6%	7%
Finland (Hannuksela-Svahn et al., 1999)	1966 - 1995[1] 1956 - 1995[2]	4%	4%	2%	-1%
Switzerland (Levi et al., 1988)	1976 - 1985	1%	1%	7%	6%
Norway (Magnus, 1991)	1956 - 1986	NS	NS	2%	1%
The Netherlands (Coebergh et al., 1991)	1975 - 1988	3%	6%	3%	-1%
Canada (National Cancer Institute, 1999)	1978 - 1987	5%	5%	4%	5%

[1] For Basal cell carcinoma; [2] For Squamous cell carcinoma; NS = Not Studied

1.2.5 Economic and personal costs of epithelial skin cancer

BCC, SCC and AK are a significant health problem for fair-skinned people world-wide because of the associated morbidity and collateral effects creating high economic costs (Miller & Weinstock, 1994; Frost & Green, 1994). In the U.S., epithelial skin cancer removal incurs a cost of more than $400 million per year (Chen et al., 2001); while in Australia from 2000 to 2001, more than 720,000 skin cancer excisions took place at a cost to the health system of over $264 million (AIHW, 2005). These economic assessments do not take into account the high personal costs of disfigurement.

1.3 Risk factors associated with epithelial skin cancer

There is much evidence that exposure to ultraviolet radiation (UVR) in the sun's rays is the strongest environmental risk factor for epithelial skin cancer, with host factors (age, phenotype, genetic susceptibility to epithelial skin cancer) also being very significant. This section examines the epidemiological evidence linking epithelial skin cancer to solar UVR exposure and host factors, from both descriptive studies of populations and analytical studies of individuals.

1.3.1. Association with ambient solar ultraviolet radiation

1.3.1.1 Changes in ambient solar UVR and incidence of epithelial skin cancer with latitude

Ambient solar radiation at the equator is very high; about 200% that of northern Europe (>45^{o}N) or the northern United States (40-49^{o}N), and about 30% higher than the southern United States (30-39 ^{o}N) (Fears & Scotto, 1983).

Populations living in tropical areas experience high levels of ambient solar radiation throughout the year, with a UVR index in the extreme range for many months (the UVR index is an international standard measurement of the strength of the UVR from the sun at a particular place on a particular day, ranging from 0 to 14+; the higher the number the greater the risk of skin and eye damage). For example, Table 1.3 shows a frequency analysis of the daily maximum UVR index for Townsville (the major city in NQ located at 19^{o}S) during the period 1993–2000, calculated from Biometer measurements that include cloud cover and other atmospheric effects (printed with permission from Moise, 2002, PhD thesis).

Table 1.3: Townsville ultra-violet radiation (UVR) index values (Townsville Biometer data). Shown are number of days per UVR index value, separated by season, with bold figures indicating the majority of the values (>95% of the distribution around the mean) (from Moise, 2002, PhD thesis)

	Summer	**Autumn**	**Winter**	**Spring**
UVR index	Dec/Jan/Feb	Mar/Apr/May	Jun/Jul/Aug	Sep/Oct/Nov
1	0	1	0	0
2	1	0	1	1
3	0	3	4	0
4	2	6	**13**	4
5	0	3	**40**	5
6	1	10	**111**	6
7	3	**17**	**317**	**22**
8	4	**19**	**129**	**66**
9	10	**34**	**47**	**96**
10	**12**	**62**	**17**	**84**
11	**22**	**76**	0	**122**
12	**50**	**71**	0	**108**
13	**54**	**56**	0	**72**
14	**145**	**62**	0	**53**
15	**125**	**49**	0	9
16	**80**	**31**	0	0
17	**37**	**18**	0	1
18	**14**	**15**	0	0
19	2	2	0	0
20	1	0	0	0

According to the Australian classification, the UVR index is at least “very high” (8 - 10) in Townsville for 91% of days during the year, and “extreme” (greater than 10) for 53%;

in comparison, during the European summer, UVR index values usually do not exceed 8-10.

Correspondingly, the incidence of epithelial skin cancer across the state of Queensland, which lies wholly in tropical and sub-tropical latitudes, is very high. Two Queensland population-based studies reported the highest rates of epithelial skin cancer in the world. In 1986, the south Queensland community of Nambour was found to have age-standardised incidence rates of epithelial skin cancer of 2,398 per 100,000 among men and 1,908 per 100,000 among women (Green & Battistutta, 1990). A study conducted ten years later in 1997 in Townsville, north Queensland, found age-standardised incidence rates for epithelial skin cancer to be even higher (Buettner & Raasch, 1998); this study reported incidence rates for epithelial skin cancer of 3,134 per 100,000 for men and 1,713 per 100,000 for women. Later analysis of this data also showed that within the three year study period, 39% of participants suffered from multiple epithelial skin cancer (Raasch & Buettner, 2002).

The 1997, rates of epithelial skin cancer in tropical NQ were over four times higher than those in temperate latitudes (29-37^{o}S) within Australia (Staples et al., 1998), almost nine times higher than those in the United States (Karagas et al., 1999), more than 20 times higher than those in Canada (National Cancer Institute of Canada, 1999), and more than 30 times higher than those in Europe (Parkin et al., 1997).

Similar trends of skin cancer incidence increasing proportionally with proximity to the equator were seen in other Caucasian populations within countries. In the U.S., incidence of BCC and SCC increases with increasing proximity to the equator, with similar gradients for men and women of all ages (Scotto et al., 1974). Similarly, in Australia, Giles and colleagues found the incidence of SCC doubled with each 8-10 degree decline in latitude (Giles et al., 1988), and Bernhard and colleagues (1997) found epithelial skin cancer rates from north of Brisbane, Australia (<27^{o}S), were approximately 4 times those from Sydney southwards (>33^{o}S).

These studies provide strong, though circumstantial evidence, that latitude and, thus, levels of ambient UVR, are strongly correlated with the incidence of epithelial skin cancer.

1.3.1.2 Changes in epithelial skin cancer incidence with migration

Epithelial skin cancer incidence in light-skinned people, who migrate from areas of low to areas of high ambient solar radiation, is higher in those who migrate when very young. In Australia, household skin cancer surveys have found that age-adjusted rates in migrants from the United Kingdom were less than 50% of the Australian-born sample (Marks et al., 1993). Living in a high ambient solar radiation region during childhood was found to increase an individual's risk of developing epithelial skin cancer later in life; two case-control studies of migrants to Australia showed rates of epithelial skin cancer were three-fold lower if they migrated after the first 10 years of life (Kricker et al., 1991; English et al., 1998).

Similar patterns have also been observed in Chinese migrants to the tropical city of Singapore (Shanmugaratnam et al., 1983); these migrants to Singapore had rates four to five times higher than those reported by cancer registries in China itself (Parkin et al., 1997).

These data show that people who migrate to regions of high ambient solar radiation after childhood have less than half the rate of epithelial skin cancer than people who migrate earlier in life, or are born in a region of high ambient solar radiation; suggesting that lifetime potential for epithelial skin cancer is determined, to a substantial degree, by sun exposure in the first decade of life.

1.3.2 Association with body site

There are also strong associations between development of epithelial skin cancer and sun-exposed areas of the body (Buettner & Raasch, 1998; Czarnecki et al., 1994; Urbach, 1969). Green & MacLennan (1994) introduced the concept of age-standardised, site-specific incidence rates adjusted for surface area of subsite, adapting previous work that estimated the extent of burns (Berkow, 1924) and later, UVR exposure and skin lesions (Brodkin et al., 1969; Pearl & Scott, 1986).

Buettner and Raasch (1998), using these age-standardised incidence rates expressed per 100,000 body units, showed that for epithelial skin cancer the highest body-site specific incidence rates were on the lip, orbit and naso-labial area (BCC male 57,111, female 39,780; SCC male 18,780, female 7,308), closely followed by the ear, nose and cheek area (BCC male 56,402, female 29,879; SCC male 16,321, female 7,643). In comparison, rarely exposed areas like the upper limbs, for example, had much lower rates (BCC male 308, female 198; SCC male 251, female 206). These site-specific incidence rates in NQ men and women are summarised below for both BCC and SCC in Figures 1.1 and 1.2, respectively.

As more than 80% of epithelial skin cancers occur on areas of the body that are chronically exposed to sunlight, such as the head, neck and back of hands, this anatomic pattern of BCC and SCC incidence is consistent with an effect of greater cumulative UVR exposure.

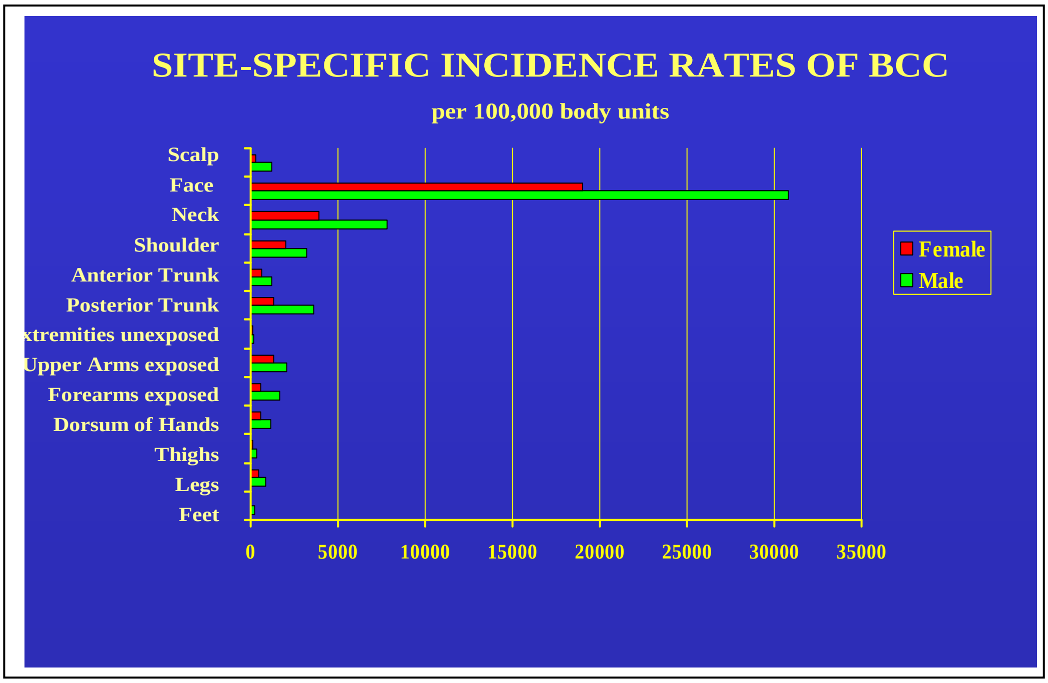

Figure 1.1: Site specific incidence rates of histologically-confirmed basal cell carcinoma, per 100,000 body units, for men and women in Townsville, North Queensland, from 1997-1999 (printed with permission from Buettner & Raasch, 1998)

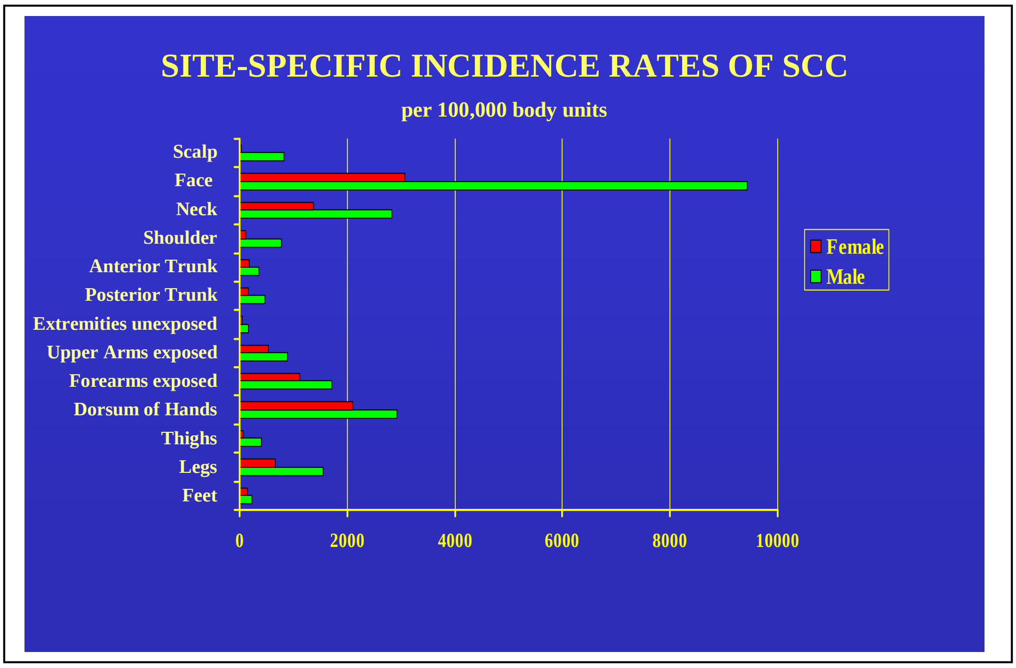

Figure 1.2: Site specific incidence rates of histologically-confirmed squamous cell carcinoma, per 100,000 body units, for men and women in Townsville, North Queensland, from 1997-1999 (printed with permission from Buettner & Raasch, 1998)

1.3.3 Association with "host factors"- age and phenotype

Several studies showed that incidence of BCC and SCC increases exponentially with age (Gilchrest et al., 1999; Scotto et al., 1996; Holme et al., 2000; Harris et al., 2001). For example, Holme and colleagues showed the incidence of BCC in individuals over 75 years was approximately 5 times higher than that of individuals aged between 50 and 55 years, and approximately 35 times higher for SCC.

In addition, studies from both the United States (Harris et al., 2001) and North Queensland (Buettner & Raasch, 1998) have documented a rise in SCC and BCC with age; particularly after the age of 50 years, indicating that cumulative sun exposure plays a role. For the North Queensland study, the incidence rate data for excisions of BCC and SCC per 100,000 of population are shown in Figure 1.3 for both men and women across all age groups, including age-standardised rates (world standard population).

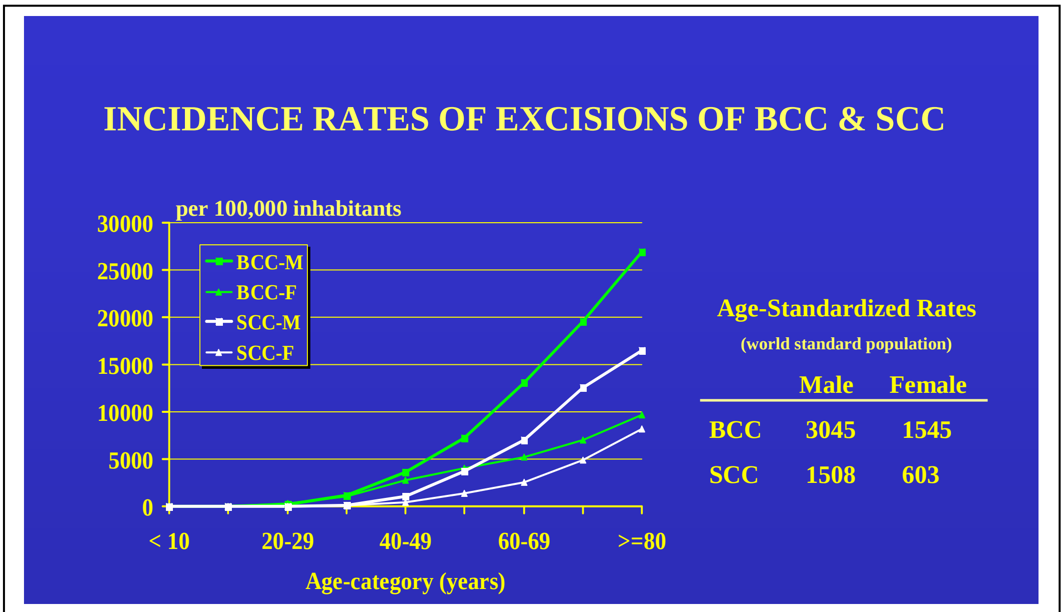

Figure 1.3: Incidence rates for excisions of BCC and SCC per 100,000 of population for both men and women across all age groups (including age-standardised rates) in Townsville, North Queensland, from 1997-1999 (printed with permission from Buettner & Raasch, 1998)

Many studies also showed an increased risk of epithelial skin cancer in people from Caucasian populations across a range of phenotypic characteristics. These characteristics include: lighter hair colour (red/auburn/blonde); light (blue/hazel/green/grey) coloured eyes; a fair complexion (Fitzpatrick skin types I and II); tendency to sunburn; skin damage associated with prolonged sun exposure such as freckling and actinic keratoses; family history of skin cancer and ancestry. These studies are summarised in Table 1.4.

From Table 1.4, it can be seen that light hair was associated with BCC in 8 of 12 studies, and with SCC in 5 of 8 studies, while the association of light coloured eyes with BCC was significant in 7 of 12 studies and with 4 of 6 studies involving SCC, and an association between BCC and skin types I and II in 9 of 12 studies, and with SCC in 5 of 8 studies. A complexion which tended to sunburn rather than tan was associated with development of BCC in 6 of 8 studies, and associated with SCC in 4 of 6 studies. Freckling was shown to be associated with BCC in 5 of 8 studies and with SCC in 3 of 5 studies. A family history of skin cancer or ancestry has also been found to be a significant risk factor for BCC and SCC in all 4 studies.

These phenotypic characteristics all measure more or less the same genetic trait – pigmentation; hence, it is not surprising that not all of these measures showed statistical significance in all studies because of power issues and co-linearity of information.

Table 1.4: Associations between phenotype factors with basal and squamous cell carcinomas (BCC & SCC)

Characteristic	Author(s) & reference	Study design	Factor	BCC Odds Ratio (95% CI)	SCC Odds Ratio (95% CI)
Hair colour	Kricker et al., 1991	Case-control n = 226/1,021 (BCC) n = 45/1,064 (SCC)	Light hair	1.8 (1.2-6.6)	2.4 (0.97-6.0)
	Wei et al., 1994	Case-control n = 131/200 (BCC)	Light blonde hair	2.1 (1.6-3.3)	NS
	Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control n = 226/406(BCC) n = 190/406(SCC)	Red hair Light blonde hair	2.1 (0.7-2.2) 0.6 (0.3-1.4) [b]	4.1 (1.1-15.5) 0.6 (0.3-1.5)
	Zanetti et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	Red hair Light blonde hair	1.3 (0.6-3.0) [a] 1.7 (1.2-2.6) [a]	13.0 (4.3-39.4) [a] 5.0 (2.3-10.9) [a]
	Green et al., 1996	Cross-sectional n = 205/1,751 (BCC)* n = 94/1,751 (SCC)*	Red/auburn hair Blonde/light brown hair	1.8 (1.1-2.8) 1.4 (1.02-1.8)	2.7 (1.4-5.2) 1.3 (0.8-2.1)
	Rosso et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	Red hair Light blonde hair	1.3 (0.6-3.1) 1.7 (1.1-2.5)	14.4 (4.7-44.2) 5.5 (2.5-12.1)
	Wallberg et al., 1998	Case-control n = 110/120 (BCC)	Red/blonde/fair hair	0.7 (0.4-1.2)	NS
	English et al., 1998	Case-control n = 132/1,031 (SCC)	Light blonde hair	NS	1.4 (0.5-4.0)
	Rosso et al., 1998	Case-control (n = 420/419 (BCC)	Light blonde hair	1.4 (0.9-2.7)	NS
	van Dam et al., 1999	Cohort n = 32,73/41,318 (BCC)*	Red hair	1.5 (1.2-1.9)	NS

Table 1.4: Continued

Characteristic	Author(s) & reference	Study design	Factor	BCC Odds Ratio (95% CI)	SCC Odds Ratio (95% CI)
Hair colour	Rosso et al., 1999	Case-control n = 120/144 (BCC) n = 26/144 (SCC)	Light blonde hair	2.2 (1.3-3.3)	2.2 (0.3-16.8)
	Naldi et al., 2000	Case-control n = 528/512 (BCC)	Light blonde hair	9.1 (1.1-73.4)	NS
	Foote et al., 2001	Cohort n = 164/734 (BCC)* n = 129/766 (SCC)*	Light blonde hair	0.9 (0.5-1.6)	1.7 (0.9-3.2)
Eye colour	Vitasa et al., 1990	Cross-sectional n = 35/588 (BCC)* n = 33/588 (SCC)*	Blue eyes	3.4 (1.2-10.2)	3.4 (1.1-9.9)
	Gallagher et al., 1995a	Case-control n = 226/406(BCC)*	Blue eyes	1.4 (0.8-2.4) [b]	NS
	Rosso et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	Blue/hazel/grey/green eyes	1.4 (1.2-1.7)	1.6 (1.1-2.3)
	Zanetti et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	Blue/hazel/grey eyes	1.4 (1.1-1.7)[a]	1.8 (1.1-3.0) [a]
	Rosso et al., 1998	Case-control (n = 420/419 (BCC)	Light coloured eyes	1.2 (0.9-1.7)	NS
	Wallberg et al., 1998	Case-control n = 110/120 (BCC)	Blue/green eyes	0.9 (0.4-2.2)	NS
	van Dam et al., 1999	Cohort n = 32,73/41,318 (BCC)*	Blue eyes	1.1 (1.0-1.2)	NS

Table 1.4: Continued

Characteristic	Author(s) & reference	Study design	Factor	BCC Odds Ratio (95% CI)	SCC Odds Ratio (95% CI)
Eye colour (cont.)	Rosso et al., 1999	Case-control n = 120/144 (BCC) n = 26/144 (SCC)	Light coloured eyes	1.8 (1.1-3.3)	2.9 (0.4-21.7)
	Naldi et al., 2000	Case-control n = 528/512 (BCC)	Light coloured eyes	1.8 (1.3-2.5)	NS
	Foote et al., 2001	Cohort n = 164/734 (BCC)* n = 129/766 (SCC)*	Light coloured eyes	1.2 (0.8-1.8)	0.9 (0.6-1.4)
	Corona et al., 2001	Case-control n = 166/158 (BCC)	Light coloured eyes	1.8 (1.1-3.1)	NS
Skin type	Kricker et al., 1991	Case-control n = 226/1,021 (BCC) n = 45/1,064 (SCC)	Skin types I & II	2.1 (0.99-4.6)	4.3 (1.03-17.6)
	Wei et al., 1994	Case-control n = 131/200 (BCC)	Skin types I & II	2.3 (1.4-3.8)	NS
	Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control n = 226/406(BCC) n = 190/406(SCC)	Light skin colour	4.0 (1.4-11.3) [b]	1.6 (0.7-3.8) [b]
	Green et al., 1996	Cross-sectional n = 205/1,751 (BCC)* n = 94/1,751 (SCC)*	Fair skin colour	2.0 (1.2-3.4)	5.6 (1.4-22.8)
	Rosso et al., 1996	Case-control n = 1,549/1,795 (BCC)	Skin types I & II	2.8 (2.2-3.6)	NS
	Zanetti et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	Skin types I & II	3.1 (2.4-3.9)	2.0 (1.2-3.4)

Table 1.4: Continued

Characteristic	Author(s) & reference	Study design	Factor	BCC Odds Ratio (95% CI)	SCC Odds Ratio (95% CI)
Skin type (cont.)	Rosso et al., 1998	Case-control (n = 420/419 (BCC)	Skin types I & II	1.6 (1.1-2.5)	NS
	English et al., 1998	Case-control n = 132/1,031 (SCC)	Skin types I & II	NS	3.5 (1.5-8.1)
	van Dam et al., 1999	Cohort n = 32,73/41,318 (BCC)*	Skin types I & II	3.1 (2.5-3.8)	NS
	Rosso et al., 1999	Case-control n = 120/144 (BCC) n = 26/144 (SCC)	Skin types I & II	1.6 (0.9-2.7)	1.5 (0.1-33.1)
	Naldi et al., 2000	Case-control n = 528/512 (BCC)	Skin types I & II	2.4 (1.7-3.8)	NS
	Foote et al., 2001	Cohort n = 164/734 (BCC)* n = 129/766 (SCC)*	Skin types I & II	1.6 (0.7-3.4)	1.5 (0.7-3.3)
Tendency to sunburn/tan	Armstrong & Kricker, 2001	Meta-analysis of published (un-named) case-control studies by the authors	Lightest skin colour	1.5 (1.02-2.4)[a]	2.3 (1.3-4.0)[a]
	Vitasa et al., 1990	Cross-sectional n = 35/588 (BCC)* n = 33/588 (SCC)*	Burn, never tan	2.7 (1.1-6.6)	1.8 (0.8-3.9)
	Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control n = 226/406(BCC) n = 190/406(SCC)	Burn, never tan	1.6 (0.8-3.2)[b]	0.7 (0.3-1.6)[b]
	Rosso et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	Burn, never tan	2.8 (2.2-3.6)	2.0 (1.2-3.4)

Table 1.4: Continued

Characteristic	Author(s) & reference	Study design	Factor	BCC Odds Ratio (95% CI)	SCC Odds Ratio (95% CI)
Tendency to sunburn/tan (cont.)	Zanetti et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	Burn, never tan	2.7 (2.1-3.5) [a]	2.0 (1.2-3.3) [a]
	Wallberg et al., 1998	Case-control n = 110/120 (BCC)	Burn, never tan	0.3 (0.1-1.0)	NS
	van Dam et al., 1999	Cohort n = 32,73/41,318 (BCC)*	Painfully burn, then peel	2.1 (1.9-2.4)[b]	NS
	Armstrong & Kricker, 2001	Metaanalysis of published (un-named) case-control studies by the authors	Burn, never tan	3.7 (1.9-7.3)[a]	6.9 (3.2-15.0) [a]
Freckling	Vitasa et al., 1990	Cross-sectional n = 35/588 (BCC)* n = 33/588 (SCC)*	Childhood freckling	3.7 (1.5-8.8)	2.4 (1.1-5.3)
	Kricker et al., 1991	Case-control n = 226/1,021 (BCC) n = 45/1,064 (SCC)	Childhood freckling	1.6 (1.1-2.5)	1.7 (0.7-4.1)
	Wei et al., 1994	Case-control n = 131/200 (BCC)	Childhood freckling	2.2 (1.4-3.6)	NS
	Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control n = 226/406(BCC) n = 190/406(SCC)	Childhood freckling	1.8 (1.2-2.5) [b]	1.6 (1.0-2.4) [b]
	Green et al., 1996	Cross-sectional n = 205/1,751 (BCC)* n = 94/1,751 (SCC)*	Childhood freckling	2.0 (1.2-3.2)	2.0 (1.02-3.9)
	English et al., 1998	Case-control n = 132/1,031 (SCC)	Childhood freckling	NS	14.0 (3.8-52.0)

Table 1.4: Continued

Characteristic	Author(s) & reference	Study design	Factor	BCC Odds Ratio (95% CI)	SCC Odds Ratio (95% CI)
Freckling (cont.)	Wallberg et al., 1998	Case-control n = 110/120 (BCC)	Childhood freckling	1.6 (0.9-2.8)	NS
	Naldi et al., 2000	Case-control n = 528/512 (BCC)	Childhood freckling	0.8 (0.6-1.3)	NS
	Corona et al., 2001	Case-control n = 166/158 (BCC)	Childhood freckling	1.3 (0.7-2.5)	NS
Family history and ancestry	Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control n = 226/406(BCC) n = 190/406(SCC)	Southern European ancestry	0.5 (0.1-2.2) [b]	0.4 (0.1-1.9) [b]
	Wallberg et al., 1998	Case-control n = 110/120 (BCC)	Skin cancer amongst parents or siblings	9.2 (2.7-31.8)	NS
	van Dam et al., 1999	Cohort n = 32,73/41,318 (BCC)*	Non-Caucasian ancestry	0.5 (0.4-0.7)	NS

[a] = Adjusted for gender, age and location of cancer registry. [b] = Relative Risk, adjusted for age, gender, and for the effect of other pigmentary and constitutional factors. [c] = p-value for linear trend. NS = Not studied. * = For cohort and cross-sectional studies, the n values represent people with or without the corresponding epithelial skin cancer.

1.3.4 Association with previous epithelial skin cancer

People with previous epithelial skin cancer are also at high risk of developing further epithelial skin cancer (Table 1.5). In the four European studies listed, patients with epithelial skin cancer had a relative risk of developing more of these skin lesions ranging between 3.8 and 8.9.

Table 1.5: Relative risk for recurrence of epithelial skin cancer

Study	Study design	Number of patients	Mean follow-up period	First tumour to second	Incidence ratio (95%-C.I.)
Levi, La Vecchia, Te, 1998	Retrospective patient audit	11,878	6.4 years	BCC to SCC	4.5 (4.1 – 4.9)
Levi, Randimbison, La Vecchia, et al., 1998	Retrospective patient audit	4,639	6.4 years	SCC to BCC	4.3 (3.8 – 4.8)
Hemminki & Dong, 2000	Prospective Cohort	11,409 males 6,228 females	7 years	SCC to epithelial skin cancer	8.9 (7.7 - 10.1) 8.6 (6.6 – 10.8)
Milan, Pukkala, Verkasalo, et al., 2000	Prospective Cohort	71,924	9 years	BCC to epithelial skin cancer	3.8 (3.6 – 4.0)

* 95%-C.I. = 95% Confidence Interval

A further 3 U.S. and 1 Australian study support these findings: a 5-year prospective study of 1000 people in the U.S. with previously treated BCC found 36% developed another (Robinson, 1987); in a retrospective cohort of 260 patients with BCC (mean follow up of 6.8 years) the 4-year risk of developing another BCC was 40% (Marghoob et al., 1993), while a U.S. study of 169 patients with SCC found the 4-year risk of developing another SCC was 12% (Chuang et al., 1990). Raasch & Buettner (2002) found a similar scenario in NQ; of 6708 patients with epithelial skin cancer, 39% developed another within the 3-year follow up period.

1.3.5 Association with personal sun exposure

Many studies have investigated personal sun exposure and sun-induced skin damage during childhood, adolescence, adulthood and over a lifetime, including occupational and recreational activities; these are summarised in Tables 1.6 to 1.8. The studies suggest sun exposure is strongly correlated with both BCC and SCC; more than two-thirds demonstrated a positive association. However, these studies also show differences in the type of sun exposure and the development of either BCC or SCC. The data suggest that development of BCC is mostly caused by sun exposure at any age that is sufficiently intense to damage the skin (Rosso et al., 1996, Green et al., 1996; Zanetti et al., 1996; Armstrong & Kricker 2001; Wallberg et al., 1998; van Dam et al., 1999; Kricker et al., 1995b; Naldi et al., 2000; Gallagher et al., 1995a), while development of SCC is mostly caused by cumulative exposure to UVR and childhood sunburn (Vitasa et al., 1990; Rosso et al., 1996; Gallagher et al., 1995b; Armstrong & Kricker, 2001; Gamble et al., 1996; Green et al., 1996).

There are also higher rates of BCC and SCC among occupational groups that work outdoors (Table 1.8). Nine studies provided information about occupational exposure; 3 of 8 showed an association with BCC, and 2 of 5 showed an association with SCC. Two further studies from England and Australia also showed that outdoor workers had a significantly higher risk of BCC (Beral & Robinson, 1981; Marks et al., 1989). Non-occupational or recreational sun exposure was associated with BCC in 4 of 8 studies, and with SCC in 2 of 5 studies.

Table 1.6: Associations between sun exposure and sun-induced skin damage over lifetime with basal and squamous cell carcinoma (BCC & SCC) (Note: the top *P*-value relates to BCC, the bottom P-value to SCC)

Author(s) and reference	Study design	Factor	BCC Odds Ratio (95% CI)	SCC Odds Ratio (95% CI)	p-value[c]
Vitasa et al., 1990	Cross-sectional n = 35/588 (BCC)* n = 33/588 (SCC)*	High Ultraviolet-B exposure	1.1 (0.5-2.4)	2.5 (1.2-5.4)	NR
Gallagher et al., 1995a	Case-control n = 226/406(BCC)	Dark tan over lifetime	1.4 (0.9-2.3)	NS	>0.05
Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control (males only) n = 226/406(BCC) n = 190/406(SCC)	At least one episode of sunburn pain ≥ 2 days over lifetime	0.9 (0.6-1.3) [b]	1.2 (0.8-1.8) [b]	>0.05; >0.05
Kricker et al., 1995b	Case-control n = 335/1,340 (BCC)	> 3794 hours of sun exposure on holidays over lifetime	1.9 (1.1-3.1)	NS	>0.05
Kricker et al., 1995b	Case-control n = 335/1,340 (BCC)	> 11 painful sunburns in lifetime	1.5 (1.03-2.3)	NS	>0.05
Rosso et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	At least 2464 hours of beach holidays in a lifetime	1.5 (1.2-1.8) [d]	0.9 (0.8-1.0) [d]	NR
Rosso et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	At least 2112 hours of water-sports in a lifetime	1.7 (1.1-2.5) [d]	5.5 (2.5-12.1) [d]	NR
Rosso et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	3 or more lifetime number of sunburns	1.1 (0.9-1.4) [d]	0.9 (0.6-1.6) [d]	NR
Green et al., 1996	Cross-sectional n = 205/1751 (BCC)* n = 94/1,751 (SCC)*	6 or more lifetime painful sunburns	1.7 (1.1-2.6)	3.3 (1.4-7.6)	0.003; <0.001

Table 1.6: Continued

Author(s) and reference	Study design	Factor	BCC Odds Ratio (95% CI)	SCC Odds Ratio (95% CI)	p-value[c]
Zanetti et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	3 or more lifetime number of sunburns	1.3 (1.0-1.8) [b]	0.5 (0.2-1.2) [b]	NR
Gamble et al., 1996	Case-control n = 174/239 (BCC) n = 59/239 (SCC)	Total lifetime sun exposure	2.0 (0.9-4.2)	1.4 (1.03-2.0)	NR
Wallberg et al., 1998	Case-control n = 110/120 (BCC)	More than 10 blistering sunburns	2.9 (1.2-7.2)	NS	0.018
van Dam et al., 1999	Cohort n = 32,73/41,318 (BCC)*	10 or more blistering sunburns	1.7 (1.3-2.2)	NS	<0.001
Armstrong and Kricker, 2001	Metaanalysis of published (un-named) case-control studies by the authors	Total lifetime sun exposure	1.0 (0.7-1.43)	1.5 (1.04-2.3)	NR
Armstrong and Kricker, 2001	Metaanalysis of published (un-named) case-control studies by the authors	Sunburn at any age	1.4 (1.3-1.53)	1.2 (0.9-1.7)	NR

[a] = Adjusted for gender, age and ability to tan
[b] = Risk adjusted for age, gender, and for the effect of other pigmentary and constitutional factors
[c] = p-value for linear trend
[d] = Adjusted for gender, age and location of cancer registry
[e] = Adjusted for gender, age and skin colour
NR = Not recorded
NS = Not studied
* = For cohort and cross-sectional studies, the n values represent people with or without the corresponding epithelial skin cancer

Table 1.7: Associations between sun exposure in childhood/adolescence with basal and squamous cell carcinomas (BCC & SCC) (Note: the top *P*-value relates to BCC, the bottom P-value to SCC)

Author(s) and reference	Study design	Factor	BCC Odds Ratio (95% CI)	SCC Odds Ratio (95% CI)	p-value
Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control (males only) n = 226/406(BCC) n = 190/406(SCC)	Dark tan from 0 – 19 years	1.5 (0.9-2.4)	NR	>0.05
Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control (males only) n = 226/406(BCC) n = 190/406(SCC)	Two or more episode of sunburn pain a year ≥ 2 days from 5-15 years	4.5 (1.7-12.3) [a]	10.5 (2.9-38.0) [a]	<0.001; 0.001
Zanetti et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	Sunburnt in childhood/adolescence	2.1 (1.5-2.9)	1.2 (0.5-2.8)	NR
Rosso et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	Sunburnt in childhood/adolescence	1.5 (1.2-2.1)	1.3 (0.6-3.0)	NR
Gamble et al., 1996	Case-control n = 174/239 (BCC) n = 59/239 (SCC)	Sunburnt in childhood/adolescence	1.5 (0.2-10.7)	1.2 (0.3-5.0)	NR
Rosso et al., 1998	Case-control (n = 420/419 (BCC)	Sunburnt in childhood/adolescence	1.4 (0.9-2.2)	NS	NR
English et al., 1998	Case-control n = 132/1031 (SCC)	Sunburnt in childhood/adolescence	NS	2.0 (1.03-3.7)	NR
Wallberg et al., 1998	Case-control n = 110/120 (BCC)	Severely sunburnt <20 years	1.6 (0.8-3.3)	NS	0.183
van Dam et al., 1999	Cohort n = 32,73/41,318 (BCC)*	Daily outdoors in swimsuit as teenager	1.4 (1.1-1.8)	NS	<0.05

Table 1.7: Continued

Author(s) and reference	Study design	Factor	BCC Odds Ratio (95% CI)	SCC Odds Ratio (95% CI)	p-value
Naldi et al., 2000	Case-control n = 528/512 (BCC)	Sunburnt in childhood/adolescence	4.0 (1.6-9.0)	NS	NR
Corona et al., 2001	Case-control n = 166/158 (BCC)	Sunburnt in childhood/adolescence	0.9 (0.4-1.6)	NS	NR

[a] = Risk adjusted for age, gender, and for the effect of other pigmentary and constitutional factors
NR = Not recorded
NS = Not studied
* = For cohort studies, the n values represent people with or without the corresponding epithelial skin cancer.

Table 1.8: Associations between sun exposure in adulthood and basal and squamous cell carcinoma (BCC & SCC) (Note: the top *P*-value relates to BCC, the bottom P-value to SCC)

Characteristic	Author(s) and reference	Study design	Comparison	BCC OR (95% CI)	SCC OR (95% CI)	p-value
Adult sun exposure	Gallagher et al., 1995a	Case-control (males only) n = 226/406(BCC)	Dark tan over last decade	1.0 (0.6-1.7)	NR	>0.05
	Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control (males only) n = 226/406(BCC) n = 190/406(SCC)	At least one episode of sunburn pain ≥ 2 days over last decade	2.3 (0.8-6.6) [b]	2.5 (0.9-7.1) [b]	>0.05; 0.08
	Wallberg et al., 1998	Case-control n = 110/120 (BCC)	Severely sunburnt when over 60 years of age	∞ (3.1-∞)	NS	<0.001
Occupational sun exposure	Kricker et al., 1995a	Case-control n = 335/1,340 (BCC)	More than 49.3 hours of weekly sun exposure at work	0.9 (0.5-1.5) [a]	NS	0.460
	Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control (males only) n = 226/406(BCC) n = 190/406(SCC)	Occupational sun exposure	1.4 (0.8-2.4)	4.0 (1.2-13.1)	NR
	Green et al., 1996	Cross-sectional n = 205/1,751 (BCC)* n = 94/1,751 (SCC)*	Work mainly outdoors	1.3 (0.9-1.8) [e]	1.4 (0.8-2.3) [e]	0.221 0.244
	Rosso et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	At least 54,720 hours of outdoor work	0.8 (0.7-1.1) [d]	1.6 (0.9-2.8) [d]	NR
	English et al., 1998	Case-control n = 132/1,031 (SCC)	Occupational sun exposure	NS	1.3 (0.3-2.8)	NR
	Wallberg et al., 1998	Case-control n = 110/120 (BCC)	Outdoor working > 50% of time	0.6 (0.4-1.1)	NS	0.099
	Naldi et al., 2000	Case-control n = 528/512 (BCC)	Occupational sun exposure	1.8 (1.3-2.6)	NS	NR

Table 1.8: Continued

Characteristic	Author(s) and reference	Study design	Comparison	BCC OR (95% CI)	SCC OR (95% CI)	p-value
Occupational sun exposure (cont.)	Armstrong & Kricker, 2001	Metaanalysis of published (un-named) case-control studies by the authors	Occupational sun exposure	1.2 (1.1-1.3)	1.6 (1.3-2.1)	NR
	Corona et al., 2001	Case-control n = 166/158 (BCC)	Occupational sun exposure	4.5 (1.9-10.5)	NS	NR
Non-occupational sun exposure	Gallagher et al., 1995a; Gallagher et al., 1995b	Case-control (males only) n = 226/406(BCC) n = 190/406(SCC)	Non-occupational or "intermittent" sun exposure	2.6 (1.1-6.5)	10.5 (3.0-38.0)	NR
	Kricker et al., 1995a	Case-control n = 335/1,340 (BCC)	> 16.3 hours of weekly recreational sun exposure	1.7 (1.03-3.0) [a]	NS	0.04
	Green et al., 1996	Cross-sectional n = 205/1,751 (BCC)* n = 94/1,751 (SCC)*	Mainly outdoor leisure activities	0.9 (0.6-1.2) [e]	1.3 (0.7-2.5) [e]	>0.05
	Rosso et al., 1996	Case-control n = 1,549/1,795 (BCC) n = 228/1,795 (SCC)	Non-occupational or "intermittent" sun exposure	1.4 (1.2-1.8)	1.6 (1.04-2.4)	NR
	English et al., 1998	Case-control n = 132/1,031 (SCC)	Non-occupational or "intermittent" sun exposure	NS	1.3 (0.6-2.8)	NR
	Rosso et al., 1999	Case-control n = 120/144 (BCC) n = 26/144 (SCC)	Non-occupational or "intermittent" sun exposure	1.2 (0.6-2.3)	NS	NR
	Naldi et al., 2000	Case-control n = 528/512 (BCC)	Non-occupational or "intermittent" sun exposure	1.0 (0.6-1.3)	NS	NR
	Corona et al., 2001	Case-control n = 166/158 (BCC)	Non-occupational or "intermittent" sun exposure	1.7 (0.7-4.1)	NS	NR

Table 1.8: Continued

Characteristic	Author(s) and reference	Study design	Comparison	BCC OR (95% CI)	SCC OR (95% CI)	p-value
Non-occupational sun exposure (cont.)	Armstrong & Kricker, 2001	Metaanalysis of published (un-named) case-control studies by the authors	Non-occupational or "intermittent" sun exposure	1.4 (1.2-1.5)	0.9 (0.7-1.2)	NR

[a] = Adjusted for gender, age and ability to tan
[b] = Risk adjusted for age, gender, and for the effect of other pigmentary and constitutional factors
[d] = Adjusted for gender, age and location of cancer registry
[e] = Adjusted for gender, age and skin colour
∞ = Infinite
NR = Not recorded
NS = Not studied
* = For cohort and cross-sectional studies, the n values represent people with or without the corresponding epithelial skin cancer

This analytical evidence suggests that the pattern of sun exposure and the level of sun exposure operated as independent determinants of risk of BCC and SCC, and also, that reducing sun-induced skin damage in later life could be valuable in preventing both forms of epithelial skin cancer.

1.4 Preventive health behaviours associated with skin cancer

Health behaviours are undertaken by people to enhance or maintain their health (Kasl & Cobb, 1966). Poor health behaviours can easily become poor health habits - a health-related behaviour that is firmly established and often performed automatically, without awareness. Although a health habit may have developed initially because it was reinforced by specific positive outcomes (i.e., parental approval) or by mandatory policy (i.e., “no hat, no play” sun protection policy in Australian primary schools), habits eventually become independent of these processes and are maintained by the environmental factors with which they are associated (Taylor, 1995). As such, habits are highly resistant to change. Instilling good health habits and changing poor ones is the purpose of primary prevention programs. This section discusses the factors that can influence whether or not people adopt primary prevention behaviours.

1.4.1 Determinants of sun protective behaviour

1.4.1.1 Demographic determinants

In a study of five health habits – smoking, physical activity, weight, alcohol consumption and sleep – healthy behaviours were more commonly practiced by better educated, more affluent and younger people (Gottlieb & Green, 1984). While some skin cancer studies from around the world have found more educated persons and those with higher incomes tend to use sunscreen and protective clothing (Purdue, 2002), little, if any, socioeconomic differences have been found in the sun protective behaviours of Australians (Dixon & Borland, 1997). Also, studies from Australia, New

Zealand, Canada, the U.S., United Kingdom and Norway on the use of sun protection found older people and women were more likely to use sun protection. Specifically, young adults and women are more likely to use sunscreen, older people to use clothing cover, and men to wear hats (Carmel et al., 1994; Broadstock, 1991; Cockburn et al., 1989; Foot et al., 1993; Hill et al., 1992; Hill et al., 1993; Hill et al., 1984; McGee et al., 1995; Berwick et al., 1992; Keesling & Friedman, 1987; Robinson 1992; Wichstrom 1994; Melia & Bulman, 1995; McGee & Williams, 1992). Men also spend more time in the sun, use less sun protection (Godar et al., 2001; Schofield et al., 2001; Hall et al., 1997), have more barriers to using sun protection (Cody & Lee, 1990; Hill et al., 1984); and experience more sun damage than women (Godar et al., 2001; Schofield et al., 2001). It may be significant that women are exposed to more skin cancer information and have higher levels of skin cancer knowledge (Keesling & Friedman, 1987; Cody & Lee, 1990; Hill et al., 1984).

With respect to intentional sun exposure (i.e., sunbathing), younger people reported an increased likelihood of intentionally tanning (Robinson et al., 1997). Females and young adults also tended to see more benefits from sunbathing in terms of enhanced physical attractiveness (Eiser et al., 1993; American Academy of Dermatology, 1988; Leary & Jones, 1993). Some studies have shown 50-70% of young adults surveyed intentionally “worked on their tan” with most stating a tan made them feel healthy-looking and attractive (American Academy of Dermatology, 1988; Leary & Jones, 1993). Also, people with positive attitudes toward risk taking are more likely to engage in sun exposure behaviours than those with negative attitudes toward risk taking (Keesling & Friedman, 1987; Blais & Rossi, 1990). Thus, younger people, particularly males, who tend to have more positive attitudes towards risk taking, often have more positive attitudes towards tanning.

1.4.1.2 Social determinants

Health habits are strongly affected by socialisation, especially the influence of parents as social models in childhood and adolescence and peers in early adulthood (Lau et al., 1990). Parents instil certain habits in their children that become almost automatic; these habits can become lifelong (Taylor, 1995, page 78). Other social factors also influence the practice of health habits; social influence of family, peers, friends and co-workers (Broman, 1993; Lau et al., 1990), and values associated with a particular culture or economic group (Donovan et al., 1991; Langlie, 1977). Social factors can act as maintainers of poor or good health habits, because social norms – our beliefs about what people who are important to us think we should do – are related to actual behaviour (Broman, 1993).

Social norms have been associated with use of sunscreens, hats and long-sleeved shirts (Banks et al., 1992; Keesling & Friedman, 1987; Mermelstein & Reisenberg, 1992; Lombard et al., 1991; Boutwell, 1995), while social networks have been associated with sun exposure (Keesling & Friedman, 1987). In addition, females and people with sun-sensitive skin appeared to be more aware of changes in social norms supporting the use of sun protection (Mermelstein & Riesenberg, 1992). Abroms and colleagues (2003) found that while men and women were aware of both positive and negative sources of normative beliefs about sunscreen use, females received more encouragement from their mothers and peers than males. These studies suggest that social environments including family, friends and work colleagues can either support or impede sun protective behaviours.

Eiser et al. (1995) also suggest that people's sun protective behaviours and associated beliefs reflect their environmental and cultural contexts. Chronic exposure to an environmental hazard can sensitise populations to the risks involved; therefore, greater levels of sun exposure may involve a form of habituation to the risk of skin cancer and less recognition of the need for sun protection. Similarly, risk levels may be influenced by cultural patterns such as resting in the middle of the day in southern Europe, or enjoying fishing or beach activities throughout the year in northern Australia.

1.4.1.3 Cognitive determinants

Of all the factors that determine health behaviours, cognitive factors such as beliefs and perceptions about threat and severity of illness, have received the most attention. Specifically, Bandura (1977) proposed that cognitive factors involved in determining whether or not a person undertook a health behaviour included beliefs that a particular health practice is beneficial, and that the practice can also help stave off a particular illness; and also perceptions of vulnerability to the illness, and a sense that one is personally able to practise the recommended health behaviour (self-efficacy).

Perceptions of vulnerability are strongly associated with susceptibility to experiencing sun damage and developing skin cancer, but can also be influenced by a general tendency, termed “unrealistic optimism” (Weinstein, 1982), for people to claim they are less at risk than their peers. It was suggested that unrealistic optimism arises from various processes, such as reducing potential anxiety that may occur if admitting susceptibility, enhancing personal self-esteem, cognitive belief system errors, and judgment of future risk based on past experience. Such an “optimistic bias” has been noted as a serious deterrent for precautionary adoption of a diversity of health behaviours (Weinstein, 1982), and for sun protection in particular (Miller et al., 1990).

Some individuals also appear to have the misconception that their skin burns less easily and tans better than it actually does; as a result, these individuals may be less concerned about protecting their skin from the sun. Studies have shown that almost 40% of the population in NQ overestimate their skin pigmentation and, therefore, may underestimate their risk of sunburn and fail to use sun protection (Harrison & Buettner, 1999).

In addition, as an individual's understanding of the severity of a health problem can influence the practice of preventative health behaviours (Bandura, 1977; Carmel et al., 1994), not all people may believe epithelial skin cancer is a serious threat to their health because epithelial skin cancers are relatively easily treated by excision, and the fatality rate is low (approximately 1% of all deaths in Australia are caused by epithelial skin cancer) (De Llooper & Bhatia, 2001).

Although perceived susceptibility and severity are thought to significantly influence preventative health practices, whether or not practices are actually undertaken are more strongly determined by perceived benefits and barriers. Rosenstock (1974) suggests that if an individual believes that by engaging in a particular behaviour they can reduce the threat of developing a health condition, they may decide to do so; thus, belief in the effectiveness of the action outweighs the risk. If, however, the individual believes that the action has negative consequences, such as being inconvenient or expensive, they may decide to avoid the health action.

This is supported by findings that sun protection practices are associated with barriers along gender lines. Hill et al. (1984) found men felt wearing a hat was an uncomfortable nuisance and could cause baldness, and sunscreen was a nuisance because it stung the eyes, while women thought hats were also an uncomfortable nuisance and spoilt their hairstyle. Both men and women felt long-sleeved shirts restricted movement and were too hot when the weather was humid.

Gerbert et al. (1996) also found many people thought sunscreens were expensive, greasy, smelly and inconvenient, and some thought it “got in the way of obtaining a tan”. In addition, Hill and colleagues (1984) found men who wore hats were more likely to believe that this action prevented sunburn, while women believed that hat use prevented both skin cancer and sunburn. Similarly, both men and women thought sunscreen use prevented skin damage, sunburn and skin cancer, while women (not men) also thought that use of a long-sleeved shirt prevented skin damage, sunburn and skin cancer. It is likely that many of these beliefs were directly knowledge related.

Knowledge is known to strongly influence a person’s beliefs; indeed, people who are more knowledgeable about the harmful effects of sun exposure tend to be more likely to practise skin cancer prevention than those who are not so knowledgeable (Rhodes 1995; Berwick et al., 1992; Girgis et al., 1994; Keesling & Friedman, 1987). However, the relationship between knowledge and sun protective behaviour has been inconsistent. While studies show generally good public knowledge about the potential consequences of sun exposure and the perceived benefits of sun protection (Berwick et al., 1992; Rossi & Blais, 1992; Slenker & Spreitzer, 1988; von Schirnding et al., 1991), actual engagement in sun protection practices is poor (Banks et al., 1992; Berwick et al., 1992; Cockburn et al., 1989; Keesling & Friedman, 1987).

Keesling and Friedman (1987) postulated that motivation to use sun protective practices may be more related to specific knowledge and experiences concerning skin cancer and sun damage, rather than simply knowledge of the risks of sun exposure. Supporting this, Hall and colleagues (1997) and Robinson (1990) both found an association between practising sun protective behaviours and a personal history of skin cancer.

Further, in Rosenman’s study from 1995, previous history of skin cancer increased the likelihood of sun protection in farmers and their spouses; while a case-control study conducted in Israel found patients who had been previously treated for BCC were more likely to use sunscreen than controls (Harth et al., 1995). Cody and Lee (1990) and Gerbert et al. (1996) also found knowing someone with skin cancer was a significant predictor of intention to engage in sun protective behaviours.

Similarly, Keesling and Friedman (1987) found an individual's desire to intentionally expose their skin to the sun was associated with perceived benefits to the individual (such as achieving a suntan and relaxing), knowledge of the causes and prevention of skin cancer (increased knowledge predicted decreased exposure), and a risk-taking personality. Motivation to tan has been shown to be the strongest individual predictor of intentional sun exposure; more than atmospheric temperature, sex, age, skin type, occupation, education, or attitudinal and social normative beliefs (Hill et al., 1992; Hillhouse et al., 1996; Gerbert et al., 1996).

A suntan has also been found to be related to personal enhancement; studies of adults have shown that physical attractiveness, concern for appearance and the perception of a tan as an indicator of good health were the main reasons why people sought a tan and ignored skin cancer warnings (Jones & Leary, 1994; Keesling & Friedman, 1987; Miller et al., 1990; Rossi et al., 1994). Many people believed that the benefits of a tan outweighed the risks involved in obtaining the tan in both the short-term (e.g., sunburn) and long-term (skin cancer) (Miller et al., 1990).

In addition, individuals often have little immediate incentive for practising good health behaviour. At the time when initial health habits develop during childhood and adolescence, most people are healthy, and poor health behaviours have no apparent effect on health. The cumulative damage these behaviours cause may not become apparent for years, and few young people are concerned about their future health at 40 or 50 years of age. Individuals are known to under-value long-term risks (Svenson, 1984), and the value placed on a health issue has been found to be even less when health protective actions need to be taken during an asymptomatic state (Kasl & Cobbs, 1966), or for health problems which may occur more than 15 years into the future (Bonieki, 1980). Therefore, warnings about skin cancer may not be compelling to many younger individuals because skin cancer is perceived as occurring in the distant future (if at all). Thus, younger people may under-value skin cancer as a health concern.

On the other hand, several studies found that more frequent use of sunscreen and protective clothing was significantly associated with sun-sensitive skin (Mermelstein & Riesenberg, 1992; Johnson & Lookingbill, 1984; Robinson & Rademaker, 1995). Clarke and colleagues (1997) demonstrated that skin type was the greatest predictor of sun protection and sunbathing behaviours, and influenced several personal beliefs, including perceived age at which skin cancer developed, greater potential number of years of life lost because of skin cancer, greater severity of skin cancer, and greater susceptibility to skin cancer. Sun-sensitive skin might result in individuals experiencing symptoms they associate with skin cancer – such as tendency to sunburn easily, sunspots, etc; or result in the appearance of freckles and other skin spots that some individuals consider detrimental to attractiveness, thus motivating them to better protect themselves from the sun.

1.4.2 Theories of health behaviour and skin cancer prevention practices

1.4.2.1 Health Belief Model

The most widely researched theory of health behaviour is the health belief model (HBM). A large number of studies suggest that the HBM explains people's practice of health habits well (reviewed in Kirscht, 1983; Janz & Becker, 1984). Specifically, the HBM proposes that an individual's decision to perform a health protective action is predicted by perceptions of risk; e.g., susceptibility to the disease, seriousness of the disease, and general health values such as interest and concern about health. Thus, individuals who believe they are susceptible to the disease and perceive the risks of the disease to be more serious will take precautions, unless these are perceived as unwelcome and/or unreliable. In contrast, those who believe the risks are mild, even if they do nothing to protect themselves, are predicted to continue behaving as before with no feelings of threat.

Overall, an individual's perception of personal risk is thought more likely to determine behaviour than general knowledge of the consequences of that behaviour (Rosenstock, 1974; Janz & Becker, 1984), and perceived barriers to practising the health behaviour and perceived susceptibility to the health problem are the most powerful predictors of whether or not people actually practice particular health behaviours (Janz & Becker, 1984).

The HBM allows both an understanding of why people practice health behaviours, and the opportunity to predict the circumstances under which people's health behaviours will change. Specifically, if something happens in a person's life to alter the sense of susceptibility to a disorder, or the belief that a particular health measure will help overcome that susceptibility, then it is expected that a corresponding change in health behaviour will occur (Kirscht, 1983; Janz & Becker, 1984). A diagrammatic representation of the HBM is shown in Figure 1.4 (over page).

1.4.2.2 Theory of Reasoned Action

Although health beliefs make a significant contribution towards explaining why people practice certain health habits, the focus is increasingly being turned to the analysis of action – what factors immediately precede and strongly determine the likelihood that a person adopts health behaviours. A theory that attempts to link health attitudes directly to behaviour is Azjen and Fishbein's (1980) Theory of Reasoned Action (TRA).

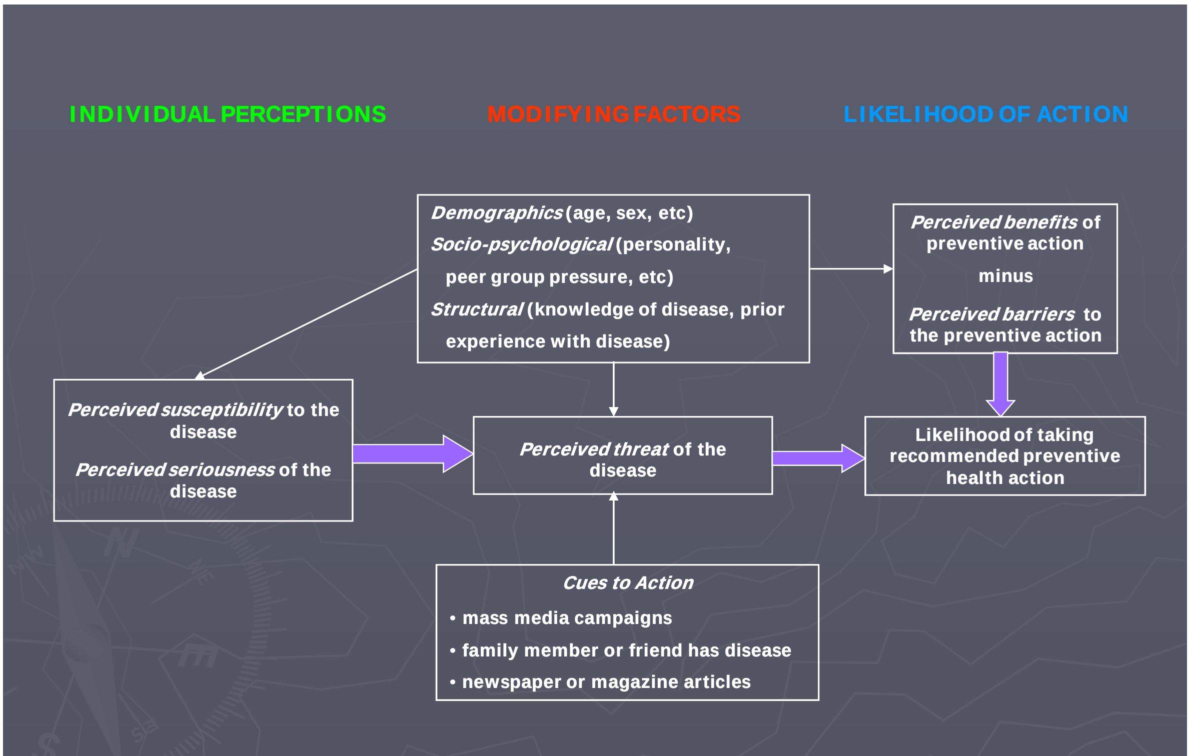

Figure 1.4: The "Health Belief Model" for why people practice preventive health behaviours

According to this theory, health behaviours are a direct result of behavioural intentions (whether or not one intends to perform particular health behaviours). Behavioural intentions consist of two components: attitudes towards the action (based on knowledge/beliefs) and subjective norms regarding the appropriateness of the action. Attitudes towards the action are thought to be based on beliefs about the likely outcomes of the action, and evaluations of those outcomes. Subjective norms derive from what an individual believes other people think they should do (normative beliefs), and motivation to comply with those norms. Inclusion of the normative component in the TRA is an important element; normative influences are known to have profound effects on health behaviours (Taylor, 1995, page 91). These factors combine to produce a behavioural intention, and, ultimately, behaviour change. A diagrammatic representation of the TRA is given in Figure 1.5.

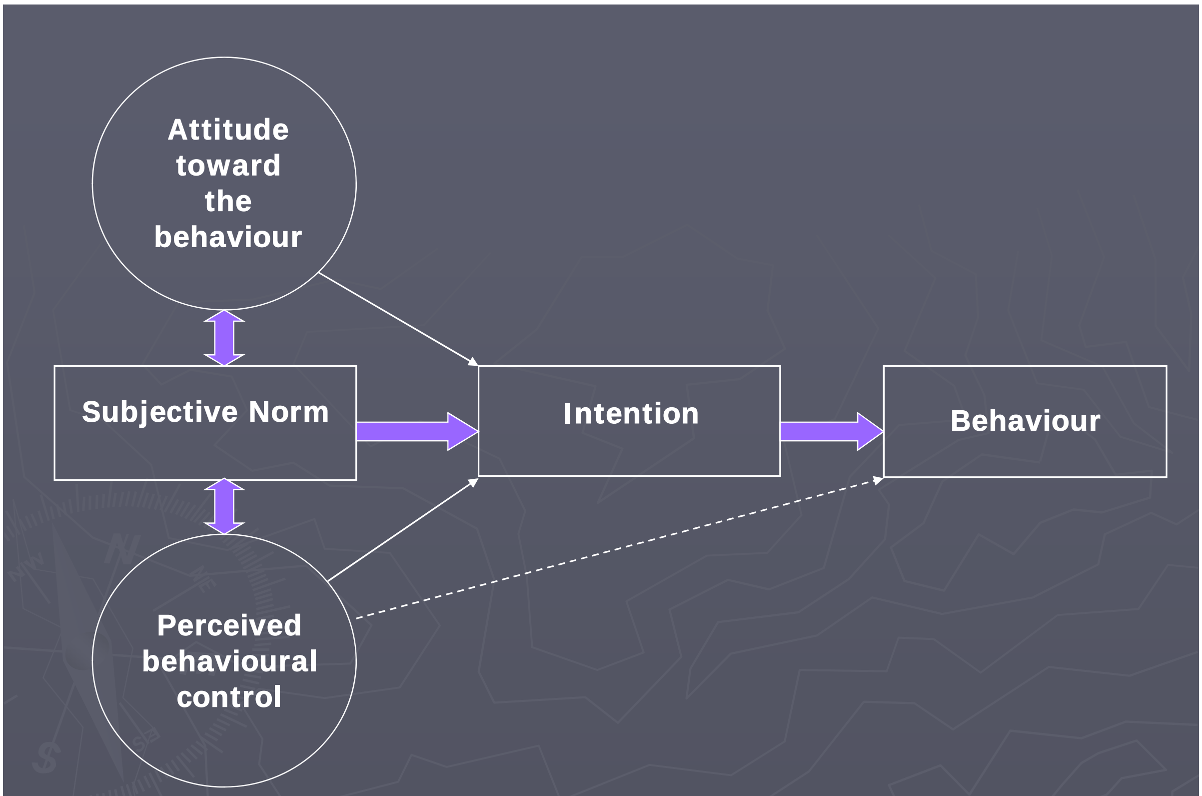

Figure 1.5: The "Theory of Reasoned Action" for why people practice preventive health behaviours

1.4.2.3 Social Learning Theory

Bandura proposed that the social environment has a significant effect on the way people behave, with most human behaviour being learned from observing others – by noting other people's attitudes, behaviours and the outcomes of those behaviours (Bandura, 1977). Specifically, this "Social Learning Theory" proposed that if individuals observe a positive, desired outcome with the observed behaviour (e.g., other people avoiding sunburn by using sun protection), then they are more likely to model, imitate and adopt the behaviour themselves. Bandura further expanded upon Social Learning Theory to suggest that learning will most likely occur if there is a close identification between the observer and the model; with identification allowing the observer to feel a one-to-one connection with the individual being imitated (Bandura, 1988).

1.4.2.4 Do the theories of health behaviour explain skin cancer prevention practices?

The HBM, TRA and the Social Learning Theory have all been found to explain aspects of people's sun protective behaviours. Hillhouse et al. (1996) found stronger support for the TRA model explaining sun protective behaviours than the HBM, with consistent relationships between tanning and sun protection intentions with self-reported sunbathing and sun protection practices (predicted by the TRA), and a lack of association between perceived risk, perceived severity of future skin harm, and at-risk health behaviours (which would have been predicted by the HBM). A later study by Hillhouse et al. (1997) again found attitudes were strongly associated with intentions of whether or not to use sunscreen (predicted by the TRA). This suggests that intentions to undertake a sun protective behaviour are much more strongly associated with sun protective behaviours than perceptions of risk and severity of skin cancer.

A qualitative study by Gerbert et al. (1996) did, however, find many of the main themes of the HBM explained sun protective behaviours; such as the perceived seriousness of sun-induced skin damage, perceived benefits of using sun protection, perceived susceptibility to skin cancer, barriers to using sun protection, and noticing sun protection messages in the media.

The HBM was also found to explain sun protective behaviours in two other quantitative studies; Friedman et al. (1995) found perceived skin cancer risk significantly predicted intention to undertake skin self-examinations and to use sunscreen regularly, while Mermelstein & Riesenberg (1992) found perceived susceptibility to skin cancer was associated with intention to take precautions when out in the sun and actual use of sunscreen.

Social Learning Theory also appears to have some role in explaining sun protective behaviours; Keesling and Friedman (1987) documented that peers and family influence teenagers' sun exposure (sunbathing) habits. No study has yet investigated the influence of peers and family on sun protective behaviours.

1.5 Primary prevention strategies for skin cancer

It has been calculated that 65 to 90% of all skin cancers are attributable to sun exposure (Armstrong & Kricker, 1993). Therefore, primary prevention of skin cancer must involve reducing avoidable sun exposure and protecting the skin when sun exposure is unavoidable (Bargoil & Erdman, 1993). This section summarises the recommended primary prevention strategies for skin cancer, and discusses how effective the use of these primary prevention strategies has been in reducing sun-induced skin damage in Caucasian populations.

1.5.1 Recommended primary prevention strategies

Individuals can use a number of personal strategies to reduce their UVR exposure during occupational or recreational outdoor activities. National groups and consensus panels in the United States and Australia have agreed on a set of optimal individual sun protection strategies (American Academy of Dermatology, 1987; American Cancer Society, 1993; Dobbinson & Borland, 2000). These strategies include avoiding the sun between 10 am and 2 pm and, if out in the sun, covering exposed skin areas by using protective clothing made of tightly woven fabrics with long sleeves and collar, long pants, and wide-brimmed hats, and for those areas of the skin not adequately covered, using a waterproof, broad-spectrum sunscreen with a sun protection factor of at least 15, which should be re-applied every 2 hours. Additionally, Marks (1996) suggests sunscreen should be applied more frequently if perspiring or swimming.

Recommended sun protection practices

- Wide-brimmed hat (>7.5 cm)
- Long sleeved, collared shirt
- Long pants
- Sunscreen on all remaining exposed areas of skin, every 2 hours, or more often if sweating or swimming
- Avoid sun exposure during hours 10am to 3pm

1.5.2 Effectiveness of recommended primary prevention strategies

No study has yet investigated the effectiveness of long-sleeved shirts or wide-brimmed hats in reducing numbers of BCC or SCC, nor the effectiveness of wearing sun protective clothes in the tropics or when participating in high-UVR activities (e.g., beach activities, boating), though it would be likely that all the previously recommended strategies would need to be strictly adhered to and used in combination. Clinical trials have found sunscreens effective in reducing the incidence of AK (Thompson et al., 1993; Naylor et al., 1995), the precursors to SCC, and one randomised controlled trial showed sunscreens to be moderately effective in reducing the number of excised SCC (Green et al., 1999).

However, studies have identified issues with using non-recommended hats and sunscreen. Diffey & Cheeseman (1992) showed that wearing a cap or a narrow brimmed hat offers inadequate UVR protection, and only hats with a wide brim (greater than 7.5 cm) will provide reasonable UVR protection around the nose and cheeks. Other research has shown sunscreen use alone is not an adequate strategy for UVR protection (Cummings et al., 1997). Many people use sunscreens if they intend to stay out in the sun for a long period of time, and they reduce the use of long-sleeved shirts and wide-brimmed hats; as a result, they can receive the same or even higher amount of UVR exposure as they would obtain during a shorter stay without sunscreen (Vaino & Bianchini, 2000; Weinstock, 1999). Some studies have shown a high incidence of sunburning despite relatively high rates of sunscreen use (Geller et al., 2002; Davis et al., 2002), while others have shown sunscreen to be positively associated with development of sunburn (Dobbinson & Borland, 2000) and naevi – a risk marker and potential precursor for developing melanoma (Autier et al., 1998).

These findings may be the result of weakened sun protective qualities of sunscreen when inadequately applied or infrequently reapplied. Typical human failings include:

people usually apply a layer of sunscreen only half the thickness necessary to achieve the sun protection factor (Johnson & Lookingbill, 1984); people do not use sunscreen with sufficient Sun Protection Factor (Pincus et al., 1991); people do not protect all exposed body parts (Wichstrom, 1994); and people also forget to reapply sunscreen after water activities and sweating (Stokes & Diffey, 1997). There are also specific gender failings: Abroms and colleagues (2003) found women adopt a more preventive style of sunscreen use, while males use a more reactive style (i.e., sunscreen is used after skin has already become over-exposed to UVR).

Because of these issues, the Australian SunSmart campaign concluded that wearing protective clothing offers better protection from sunburn than sunscreen application, and sunscreen should only be used to protect areas that are not usually covered by clothing; that is, the face and hands (Dobbinson & Borland, 2000).

1.5.3 Uptake of primary prevention strategies in Caucasian populations

Primary prevention programs are either promoted to the general population via the mass media, or targeted towards those who are at-risk, or vulnerable to a particular problem, due to heredity, health practices, or their living or working environment (Becker & Janz, 1987). There are advantages in targeting people who are at risk for particular diseases; such targeting may change poor habits which contribute to the likelihood of disease, and also provide a specific focus for health interventions.

Several countries with predominantly Caucasian populations have received extensive sun protection education via the public mass media channels since the 1980s, including the United States, Australia, Sweden and Germany (King et al., 1982; Boutwell, 1995; Borland et al., 1990; Kiekbusch et al., 2000; Pfahlberg et al., 1997). These sun protection messages have raised awareness about skin cancer in the general population, leading to early detection of skin cancers and decreased mortality.

For example, recent data from the Queensland Melanoma Registry showed that more recently identified cutaneous melanomas are becoming thinner in comparison to melanomas detected ten years previously (Downing et al., 2008).

However, even with public media campaigns, there is much evidence from population-based surveys that indicates inadequate levels of protective behaviours not only amongst the general public, but also amongst outdoor workers and even amongst people who have had an epithelial skin cancer excised previously (Table 1.9).

The difficulty in motivating people to improve their sun protection behaviours may be related to the fact that many individuals are often not adequately prepared or ready to change their behaviours (Prochaska et al., 1992; Rossi, 1989a; Rossi, 1989b). It has been proposed that behaviour change requires individuals to move through stages that include contemplating the personal cost and benefits of the recommended behaviour, trying the behaviour, making serious attempts to change their habits (and failing to change in some instances), and finally, maintenance of the new behaviour (Prochaska et al., 1992).

Table 1.9: Sun protection behaviours of the general public, outdoor workers and people with a previously excised skin cancer.

	Country and reference	Sun exposure	Sun-induced skin damage	Use of recommended sun protection		
				Wore a long sleeved shirt	Wore a protective hat	Used sunscreen
General public	Pennsylvania, United States. *Johnson & Lookingbill, 1984.*	71% of subjects reported spending >1 hours of sun exposure at least 1 day a week	67% reported at least one sunburn over summer	NR	NR	41% (regularly)
	United States. *Hall et al., 1997.*	NR	NR	28% (likely to wear "protective clothing")	28% (likely to wear "protective clothing")	32% (very likely)
	Alberta, Canada. *Campbell & Birdsell, 1994*	NR	NR	< 50% (routinely use)	< 50% (routinely use)	< 50% (routinely use)
	Ontario, Canada. *Purdue, 2002*.	NR	NR	47% (always/often wear "protective clothing")	47% (always/often wear "protective clothing")	40% (always/often apply sunscreen
	Victoria, Australia. *Dobbinson & Borland, 2000.*	NR	40% had sunburn at least once over summer	49% ('usually' or 'always')	51% ('usually' or 'always')	44% ('usually' or 'always')
	Victoria, Australia. *Hill et al., 1993*. (1990 statistics)	NR	7% had sunburn the previous weekend	0.71 (mean proportion of body surface area)	29% (previous weekend)	21% (previous weekend)
	New Zealand. *McGee et al., 1995.*	72% of the public were outdoors for an average of 2.5 hours on one or both weekend days	12% reported sunburn from previous weekend exposure, mostly on arms and face	NR	38% (last time)	32% (last time)

Table 1.9: Continued

	Country and reference	Sun exposure	Sun-induced skin damage	Use of recommended sun protection		
				Wore a long sleeved shirt	Wore a protective hat	Used sunscreen
Outdoor workers	Canada. *Shoveller et al., 2000.*	70% had at least 2 hours sun exposure	NR	60% ("protective clothing")	58%	23%/18% (face/body)
	Wisconsin, United States. *Marlenga, 1995.*	NR	NR	7% (frequently)	13% (frequently)	8% (frequently)
	Victoria, Australia. *Borland et al., 1991.*	NR	NR	13%	24%	NR
	Queensland, Australia. *Gies & Wright, 2003.*	88% worked in the sun	NR	18%	39%	30%
People with a previously excised epithelial skin cancer	Illinois, United States. *Robinson, 1990 (pre education intervention).*	NR	NR	52% ('protective clothing')	52% ('protective clothing')	62%
	Israel. *Harth et al., 1995.*	NR	NR	49% (regularly wore long sleeved shirt or hat)	49% (regularly wore long sleeved shirt or hat)	64% (regularly)

NR = Not recorded

1.5.3.1 Sun protective behaviours of the general public

Countries with Caucasian populations continue to show inadequate levels of sun protection in their general population, including those with previous public media campaigns about skin cancer prevention. In the United States, less than one third of fair-skinned adults used sunscreen or protective clothing during work or recreational activities (Johnson & Lookingbill, 1984; Hall et al., 1997), while only 40-50% of Canadian and Australian adults reported using sunscreen and wearing protective clothing (Campbell & Birdsell, 1994; Purdue, 2002; Dobbinson & Borland, 2000).

Two studies specifically examined sun protective practices during recreational sun activities. A New Zealand study found low levels of sun protection and high levels of sunburn; 38% of adults who went outdoors during the previous summer weekend reported wearing a hat (including caps), 32% reported applying sunscreen, and 17% reported being sunburnt (McGee et al., 1995). A Victorian (Australia) study on recreational sun exposure of the general public after exposure to the "Slip, Slop, Slap" skin cancer prevention media campaign found significant increases in sunscreen use over the three years of the campaign from 12 to 21%, and in hat use from 19 to 29%, with a corresponding significant reduction in sunburn from 11 to 7%; however, little change occurred in the use of protective clothing (Hill et al., 1993).

1.5.3.2 Sun protective behaviours of outdoor workers

Use of sun protection is little better in people who work outdoors – a group known to be at high risk of skin cancer (Scotto et al., 1983; Holman et al., 1983) and which receives up to six to eight times the dose of UVR that indoor workers receive (Holman et al., 1983). Stepanski and Mayer (1998) found that only 50% of outdoor construction workers in California (United States) used adequate sun protection, while a study of Wisconsin farm workers found only 7% frequently wore long-sleeved shirts, 13% frequently wore wide-brimmed hats, and 8% frequently used sunscreen (Marlenga, 1995). Similarly, a Canadian study (Shoveller et al., 2000) found inadequate levels of sun protection among outdoor workers (58% wore a hat, 60% wore protective clothing, and 18-23% used sunscreen). In Australia, Borland et al. (1991) documented that only 24% of Victorian outdoor workers wore suitable hats and 13% wore long-sleeved shirts, while the situation was no better in Queensland; a recent construction industry study into the use of sun protection found approximately 40% of workers used wide- brimmed hats, 30% used sunscreen, and 20% used long-sleeved shirts (Gies & Wright, 2003).

1.5.3.3 Sun protective behaviours of people with previous epithelial skin cancer

Use of sun protection was also found to be inadequate in people with previously excised epithelial skin cancer. Harth and colleagues (1995) found that, while 85% of people with a previous BCC regularly used sunscreen over summer, only 49% wore a broad-brimmed hat and 19% a long-sleeved shirt. Nor was sun protection adequate when removal of a skin cancer was coupled with sun protection education; a study of people with an excised epithelial skin cancer demonstrated an increase in sunscreen use from 34% at excision to only 62% 12 months after the excision (Robinson, 1990).

1.6 Individually-targeted interventions for primary prevention of skin cancer in adults

Interventions to prevent skin cancer typically seek to educate and motivate individuals toward skin cancer prevention by providing knowledge and teaching behavioural skills. A list of all individually-targeted skin cancer interventions reported in the literature is given in Table 1.10. This list does not include public media-based campaigns. While several countries have used media-based interventions and found these to be relatively successful in raising awareness about the risks of sun exposure and in contributing to the motivation to change by moving people away from a pre-contemplation to a contemplation stage (Prochaska et al., 1992, ‘Stages of Change” model), they appear to be relatively ineffective in changing behaviour. Individually-targeted interventions are needed to provide the necessary information and skills directly relevant to action and behaviour maintenance. For this reason, media-based campaigns were not considered as an intervention strategy for this thesis, and thus, were not included in this review.

1.6.1 Strategies used in individually-targeted skin cancer interventions

Individually-targeted skin cancer interventions have used a variety of strategies (summarised in Table 1.10): five interventions provided sun-safety training to outdoor workers (Glanz et al., 2001; Azizi et al., 2000; Geller et al., 2001; Lombard et al.,1991; Borland et al., 1991), two involved skin examinations by a physician and a sun protection/skin cancer education session (Azizi et al., 2000; Girgis et al., 1994), eleven promoted sun protective behaviours using educational materials (Johnson & Lookingbill, 1984; Reding et al., 1994; Cody & Lee, 1990; Borland et al., 1991; Glanz et al., 2001; Lombard et al., 1991; Azizi et al., 2000; Geller et al., 2001; Dey et al., 1995; Robinson, 1990; Katz & Jernigan, 1991), four involved role-modelling (Glanz et al., 2001; Lombard et al., 1991; Geller et al., 2001; Borland et al., 1991); one provided sunglasses, brimmed hat and sunscreen to outdoor workers (Azizi et al., 2000); two (Glanz et al., 2001; Geller et al., 2001) used environmental strategies (sunscreen dispensers and shade structures) to promote sun protective behaviour; and three provided sunscreen to beachgoers or community members (Weinstock et al., 2002; Green et al., 1999; Thompson et al., 1993). Several studies also investigated the effects of removal of an epithelial skin cancer (Harth et al., 1995; Robinson 1990), being a carer for someone with epithelial skin cancer (Robinson & Rademaker, 1995), fear appeals (Keesling & Friedman, 1995), and using appearance-based messages about prematurely-aged skin (Jones & Leary, 1994; Detweiler et al., 1999).

Table 1.10: Summary of individual-targeted interventions for the primary prevention of skin cancer in adults (listed by year of publication)

AUTHOR(S), TITLE, JOURNAL	SAMPLE	INTERVENTION	FINDINGS AND LIMITATIONS
Johnson EY, Lookingbill DP. Sunscreen use and sun exposure: Trends in a white population. *Arch Dermatol* 1984;120(6):727-31.	342/489 members of the white U.S. population contacted during the summer months.	4-week pre-test:post-test design, via telephone survey, involving provision of an educational pamphlet on sun protection factor of sunscreens, and risks of sun exposure.	Knowledge of sun protection factor and sun exposure risks improved; use of sunscreen increased non-significantly. Limitations: no control group; only changes in sunscreen use and knowledge were investigated.
Robinson JK. Behaviour modification obtained by sun protection education coupled with removal of a skin cancer. *Arch Dermatol* 1990;126:477-481.	1042 people living in the Illinois, U.S. with a surgically removed epithelial skin cancer.	12-month pre-test:post-test design, via questionnaire, of an oral and written education on forms of sun protection.	Use of sunscreen increased from 38 to 62%. Limitations: no control group; only change in sunscreen use was investigated.
Cody R, Lee C. Behaviours, beliefs and intentions in skin cancer prevention. *J Behav Med* 1990;13:373-89.	312 Australian university students.	10-week pre-test:post-test design, via survey, assessing knowledge and health beliefs after provision of one of three video-taped education programme (informational, emotional, control).	Skin protection intentions increased significantly 10 weeks post-video using intervention videos. Limitations: actual behaviours not investigated; short follow-up.
Borland RM, Hocking B, Godkin GA, et al. The impact of a skin cancer control education package for outdoor workers. *Med J Australia* 1991;154:686-688.	985 observations of outdoor staff of Telecom Australia.	Quasi-experimental design, via observation, to assess Telecom's "*Cover yourself against skin cancer"* campaign, involving posters, brochures, video, buttons and role modelling.	Significant increase in shirt use and overall level of sun protection; no effect on hat use or use of shade. Limitations: non-equivalent intervention and control groups at baseline; only 5-10% increase in sun protection.
Lombard D, Neubauer TE, Canfield D, Winett, RA. Behavioural community intervention to reduce the risk of skin cancer. *J Appl Behav Anal* 1991;24:677-86.	Adults (including lifeguards), children and adolescents at two U.S. swimming pools.	1-month, pre-test:post-test design, via observation, of invention involving use of peer modelling, posted feedback, posted goals and a commitment raffle to increase behaviours associated with skin cancer prevention (hats, sunscreen, sunglasses, staying in shade).	Adults (older than 16 years) and lifeguards increased their use of 'all' protective behaviours from 17% to 64% during intervention. Limitations: no tests for significance; follow up was only for 30 days; no description of study population; convenience sampling of 2 swimming pools used.
Katz RC, Jernigan S. Brief report: An empirically derived educational program for detecting and preventing skin cancer. *J Behav Med* 1991;14:421-428.	College and high school students from the United States.	2-week pre-test:post-test design, via questionnaire, assessing knowledge about skin cancer following an educational program.	Significant increase in skin cancer knowledge (risk factors, preventive measures, identification of "warning signs" for early detection). Limitations: no control group; short follow-up; only changes in knowledge investigated.
Robinson JK. Compensation strategies in sun protection behaviours by a population with non-melanoma skin cancer. *Prev Med* 1992;21:754-765.	1022 members of the Illinois population, U.S., who had an epithelial skin cancer surgically removed.	6 year prospective pre-test:post-test design, via a mailed survey, assessing the effect of an education about sun protection, coupled with removal of an epithelial skin cancer, on their choice of sun protection methods.	Significant improvement in the number of participants using sun protection over the 6 years of education, though only about half wore protective clothing; many returned to their previous outdoor habits after one year. Limitations: Not possible to involve a control group that could be restricted from mass media education about skin cancer and sun protection, thus effectiveness can not be evaluated.

Table 1.10: Continued

AUTHOR(S), TITLE, JOURNAL	SAMPLE	INTERVENTION	FINDINGS AND LIMITATIONS
Thompson SC, Jolley D, Marks R. Reduction of solar keratoses by regular sunscreen use. *N Engl J Med* 1993;329:1147-51.	588 subjects from south east Queensland with a previously excised solar keratosis.	Randomised, controlled trial, with 7 months follow-up over summer, to assess effects of daily sunscreen use on incidence of solar keratoses. The Intervention group received free sunscreen and training in its correct application.	Mean number of solar keratoses (SK) decreased in the Intervention Group and increased in the Control group, with the amount of sunscreen used related to remission of existing lesions and development of new lesions. Limitations: only the effects of sunscreen investigated; SK only a proxy outcome measure for epithelial skin cancer.
Girgis A, Sanson-Fisher RW, Watson A. A workplace intervention for increasing workers' use of solar protection. *Am J Public Health* 1994;84:77-81.	142 outdoor workers in New South Wales, Australia.	Randomised, controlled trial, with 30-day follow-up, to assess effects of a 30-minute lecture, pamphlets and skin cancer screening on sun protection knowledge, attitudes and behaviours. Sun protection behaviour was measured by personal diary.	Intervention group had significant (16%) increase in number of workers using sun protection, and in their knowledge; changes in sun protection attitudes were not detected. Limitations: sun protection behaviour measured as a composite score.
Jones JL, Leary MR. Effects of appearance-based admonitions against sun exposure on tanning intentions in young adults. *Health Psychol* 1994;13(1):86-90.	134 university students from North Carolina, U.S.	Randomised, controlled trial, with one month follow up, to assess the effectiveness of health-based versus appearance-based messages on participant's intentions to protect their skin from the sun.	Appearance-based messages were most effective overall in promoting intentions to practice sun protection behaviours, while the appearance-based messages were most effective with people who were low in appearance motivation. Limitations: only intentions to practice sun-safe behaviours were investigated.
Reding DJ, Krauska ML, Lappe KA, Fischer VV. Cancer education interventions for rural populations. *Cancer Practice* 1994;2(5):353-358.	1503 farmer workers from Wisconsin, U.S.	Pre-test:post-test study design, with 2-month follow-up, to assess the appropriateness of educational material on skin cancer delivered by 13 veterinarians (to 284 farmers) or by mail (to 1219 farmers).	Farmers found the education delivered by veterinarians to be more acceptable (82%). Limitations: low response rate, no investigation of effectiveness of educational material on knowledge, attitudes or behaviours related to skin cancer prevention.
Harth Y, Ulman Y, Peled I, Friedman-Birnbaum R. Sun protection and sunscreen use after surgical treatment of basal cell carcinoma. *Photodermatol Photoimmunol Photomed* 1995:11(4):140-142.	63 subjects with a previously excised BCC, and 54 control subjects.	Controlled trial, with 12-month follow up, to assess differences in the sun exposure and sun protection habits of people who have had a BCC excised. Data collected via handed or mailed surveys	Intervention group used significantly more sunscreen after removal of a BCC; however, the amount and method of application were inadequate, level of sun exposure did not change, and other methods of sun protection were neglected.
Robinson JK, Rademaker AW. Skin cancer risk and sun protection learning by helpers of patients with non-melanoma skin cancer. *Prev Med* 1995;24:333-41.	200 carers of a patient with a epithelial skin cancer excised, in the Illinois area of the U.S.	The pre-test:post-test study examined whether a patient's experience with epithelial skin cancer raised the awareness of their carer over 12 months. Data was collected via self-administered questionnaire.	Carers were found to have an increased awareness of skin cancer as a likely result of knowledge transfer from epithelial skin cancer patient, with some improvement in sunscreen use by carers who perceived themselves susceptible to epithelial skin cancer; however, no improvements in attitudes were found. Limitations: poor study design; only the use of sunscreen was investigated as an outcome measure of sun protection.

Table 1.10: Continued

AUTHOR(S), TITLE, JOURNAL	SAMPLE	INTERVENTION	FINDINGS AND LIMITATIONS
Dey P, Collins S, Will S, Woodman CBJ. Randomised controlled trial assessing effectiveness of health education leaflets in reducing incidence of sunburn. *BMJ* 1995;311:1062-1063.	12,385 holiday-makers from Manchester Airport, U.K.	Randomised, controlled trial (no follow-up period) to assess the effectiveness of a health education leaflet on reducing sunburn in long haul (Intervention group) and short haul (Control group) passengers. Data collected by questionnaire on aircraft.	No significant difference between long haul and short haul passengers in the proportion who received severe sunburn. Limitations: passengers not asked if they had seen or read the health education leaflet; only incidence of severe sunburn was used as the outcome measure.
Keesling B, Friedman HS. Interventions to prevent skin cancer: Experimental evaluation of informational and fear appeals. *Psychol & Health* 1995;10:477-490.	136 suntanned adults recruited across 10 Californian beaches, in the U.S.	Randomised, controlled trial, one-month follow-up, to assess effectiveness of fear and informational appeals using an American Cancer Society pamphlet. Intervention groups received 'high' fear photographs or 'high' information educational pamphlet, while Control group received 'low' fear photographs or 'low' information education pamphlet. Data was collected via telephone interview.	Skin cancer knowledge, but not fear, was a significant predictor of attitudes and intentions; simple provision of information affected relevant knowledge. Limitations: short follow-up of only one month; affect on sun protection practices not investigated.
Detweiler JB, Bedell BT, Pronon E, Rothman AJ, Salovey P. Message framing and sunscreen use: Gain-framed messages motivate beach-goers. *Health Psychol* 1999;18(2):189-196.	217 beach-goers (76% female), aged 18 years and older, recruited at a public beach in southern New England, U.S.	Randomised trial to assess the effectiveness of 4 differently framed educational messages (2 highlighting gains, 2 highlighting losses) to persuade participants to obtain and use sunscreen. Attitudes and intentions were measured pre- and 30 minutes post-delivery of the framed information, via face-to-face surveys.	Participants who read either of the 2 gain-framed brochures were significantly more likely to request sunscreen and intend to repeatedly use it, compared to those who read either of the 2 loss-framed brochures. Limitations: short follow-up; only intention to use sunscreen was used as the outcome measure for sun protective behaviour; effect of messages on actual behaviours not investigated.
Green A, Williams G, Neale R, Hart V, et al. Daily sunscreen application and betacarotene supplementation in prevention of basal-cell and squamous cell-carcinomas of the skin: A randomised controlled trial. *Lancet* 1999; 354: 723-9	1,383 residents of Nambour, Queensland, Australia.	Randomised trial with 2 X 2 factorial design, and 4.5 years follow-up, to assess the effect of daily application of free sunscreen on head, neck and arms, and beta-carotene tablets, on the prevention of new non-melanoma skin cancer. Data on epithelial skin cancer was collected via full skin examinations pre- and post-intervention.	The incidence in excisions of squamous cell carcinoma was significantly lower in the sunscreen group than in the no daily sunscreen group. Limitations: only the effect of daily use of sunscreen on the prevention of new epithelial skin cancer was investigated.
Azizi E, Flint, Sadetzki S, et al. A graded worksite intervention program to improve sun protection and skin cancer awareness in outdoor workers in Israel. *Cancer Causes Control* 2000;11:513-21.	144 male outdoor workers of the National Water Company, Israel.	Controlled Intervention trial, with 20 month follow-up, to improve outdoor worker's sun protection and skin cancer awareness. Participants allocated into complete (n=37), partial (n=72) or minimal (n=35) intervention groups. Complete or partial intervention involved training of local safety officers, an educational and medical screening package, and free sunscreen and wide-brimmed hats. Data collected by self-administered survey.	Intervention led to significant improvements in sunscreen use and skin cancer awareness, in particular, with repeated supply of sunscreen and education. Limitations: only sunscreen was used as an outcome measure of sun protective behaviour; small sample size; use of sunscreen by Intervention groups still inadequate after 20 months.

Table 1.10: Continued

AUTHOR(S), TITLE, JOURNAL	SAMPLE	INTERVENTION	FINDINGS AND LIMITATIONS
Glanz K, Maddock JE, Lew RA, Murakami-Akatsuka L. A randomized trial of the Hawaii SunSmart program's impact on outdoor recreation staff. *J Am Acad Dermatol* 2001;44:973-978.	176 outdoor working staff from 14 outdoor recreation sites in Hawaii, U.S.	3-arm randomised, controlled trial, with 3 month follow-up, to assess the effectiveness of staff training, free sunscreen and portable shade tents on staff sun behaviours. Data was collected from staff on-site by self-administered questionnaire.	Significant improvements in sun protection knowledge and sun protection practices of staff. Limitations: reliance on self-reported measures of sun protection practices; short follow up period; and 60-70% response rate to surveys.
Geller AC, Glanz K, Shigaki D, Isnec MR, Sun T, Maddock J. Impact of skin cancer prevention on outdoor aquatics staff: the Cool Pool program in Hawaii and Massachusetts. *Prev Med* 2001;33(3):155-161.	220 aquatics staff from 28 outdoor pool sites in Hawaii and Massachusetts, U.S.	Randomised, controlled trial ("*Pool Cool" project*), with 8 week follow-up, involving sun protection education and skills training to Intervention group. Data collected by self-administered survey pre- and post-summer.	Significant improvement in sunburn rates and pool safety policy in Intervention group; non-significant differences between the two groups in mean score of all sun protection habits. Limitations: reliance on brief, self-report measures; short intervention period.
Weinstock MA, Rossi JS, Redding CA, Maddock JE. Randomized controlled community trial of the efficacy of a multi-component stage-matched intervention to increase sun protection among beachgoers. *Prev Med* 2002;35(6):584-92.	2,324 adult beachgoers (aged 16 to 65 years) recruited on Rhode Island beach, U.S.	Randomised, controlled trial *(Rhode Island Sun Smart project*), with 2, 12 and 24 month follow up, of an intervention including: baseline beach assessment, sunscreen, expert system feedback after 3 weeks and 12 months, "SunSmart" manual, skin micro-topography, UV/polarised light photography and videos. All participants eligible for a $1,000 lottery prize. Data collected by self-administered survey via mail or telephone.	Significant increase in self-reported sun protection behaviours across all gender and age groups. Limitations: self-reported outcomes measured by un-validated questionnaire; no analysis of respondents; no specific information given of participants' pre- and post frequency of sun protection behaviours; sun protection behaviours of Intervention group still inadequate overall after 2 years.

1.6.2 Settings used for individually-targeted skin cancer interventions

Strategies to reduce skin cancer in adults have been aimed primarily at individuals or relatively small groups, usually occurring in an organisational context such as an outdoor recreational facility (Glanz et al., 2001; Geller et al., 2001; Lombard et al., 1991) or an outdoor work setting (Azizi et al., 2000; Girgis et al., 1994; Borland et al., 1991). As outdoor workers receive intense and prolonged exposure to the sun and are at increased risk of developing skin cancer, interventions that educate these workers, increase the use of sun protective behaviours and modify their work environment could provide substantial benefit.

Interventions in outdoor recreational settings promoted sun-protective behaviours in adult outdoor workers (and often the family attending the facility), and included at least one of the following: information via instructional training and/or small media presentations (Glanz et al., 2001; Geller et al., 2001); activities intended to change knowledge, attitudes, or intentions; additional activities (such as modelling) to influence behaviour (Lombard et al., 1991), and environmental approaches such as providing sunscreen or shade (Glanz et al., 2001).

Similarly, interventions in workplace settings sought to promote sun protective behaviours among outdoor workers. These interventions included at least one of the following: provision of information to the workers via instruction and/or small media presentations (Borland et al., 1991; Girgis et al., 1994; Azizi et al., 2000); activities intended to change the knowledge, attitudes, beliefs, intentions or behaviours of workers (Borland et al., 1991; Girgis et al., 1994; Azizi et al., 2000); and environmental approaches including provision of sunscreen and brimmed hats (Azizi et al., 2000).

Some interventions involved public outdoor environments such as the intense UVR environment of the beach (Weinstock et al., 2002; Detweiler et al., 1999; Keesling &

Friedman, 1995). Other interventions did not occur in a specific setting, but used various strategies to recruit participants from the community or via medical or educational organisations (Green et al., 1999; Thompson et al., 1993; Robinson, 1990; Katz & Jernigan, 1991; Reding et al., 1994; Jones & Leary, 1994; Harth et al., 1995; Robinson & Rademaker, 1995).

1.6.3 Outcome measures used in individually-targeted skin cancer interventions

Only one study directly measured the reduction of epithelial skin cancer (Green et al., 1999). Because epithelial skin cancers develop long after any intervention has begun and the relationship between UVR and risk of epithelial skin cancer is well-established (refer Chapter 1.3.), a range of intermediate outcomes relevant to epithelial skin cancer has been used as proxy outcome measures. These proxy outcome measures include knowledge, attitudes, beliefs, intentions, key sun protective behaviours, and a limited number of health outcomes, such as sunburn and AK.

Outcomes measured in the interventions included: changes in sun protective behaviours and UVR exposure (Weinstock et al., 2002; Glanz et al., 2001; Lombard et al., 1991; Azizi et al., 2000; Geller et al., 2001; Girgis et al., 1994; Borland et al., 1991; Robinson, 1990; Robinson & Rademaker, 1995; Johnson & Lookingbill, 1984); changes in knowledge (Johnson & Lookingbill, 1984; Reding et al., 1994; Glanz et al., 2001; Geller et al., 2001; Girgis et al., 1994; Katz & Jernigan, 1991); and changes in attitudes, beliefs and/or intentions (Keesling & Friedman, 1995; Glanz et al., 2001; Geller et al., 2001; Girgis et al., 1994; Jones & Leary, 1994; Detweiler et al., 1999; Robinson & Rademaker, 1995; Cody & Lee, 1990).

Incidence of sunburn was used as an outcome measure in two studies (Azizi et al., 2000; Dey et al., 1995); and incidence of AK in another (Thompson et al., 1993). Two further interventions examined changes in environmental pool policies (Glanz et al., 2001; Geller et al., 2001), while only one study directly measured reduction in incidence and excision numbers of epithelial skin cancer (Green et al., 1999).

1.6.4 Impact of individually-targeted skin cancer interventions

1.6.4.1 Impact of interventions using solely information-based strategies

Information strategies can be effective motivators for people to change their behaviour (Evans et al., 1970). However, the effectiveness of solely information-based dissemination strategies in the field of skin cancer prevention has not been encouraging. While interventions have shown some positive (though inconsistent) effects on skin cancer knowledge, awareness (Johnson & Lookingbill, 1984; Glanz et al., 2001; Reding et al., 1994; Keesling & Friedman, 1995; Robinson & Rademaker, 1995) and intentions (Jones & Leary, 1994; Robinson & Rademaker, 1995), their documented influence on sun protective practices (Cody & Lee, 1990; Johnson & Lookingbill, 1984; Katz & Jernigan, 1991; Geller et al., 2001; Robinson & Rademaker, 1995) and reducing incidence of sunburn (Dey et al., 1995) has only been slight and short-term. This will be discussed in more detail in the following sections.

1.6.4.2 Impact of interventions using information targeted to personal motivators

Three strategies have been used in an attempt to increase success of information-based epithelial skin cancer interventions: targeting interventions at outdoor workers or people with a diagnosed epithelial skin cancer (high-risk groups for developing further skin cancer); using fear appeals, and combining information with a positive appeal (for example, good health or physical attractiveness).

Information-based interventions targeted at outdoor workers have been shown to improve their short-term sun protective behaviour (Azizi et al., 2000; Borland et al., 1991; Girgis et al., 1994; Lombard et al., 1991; Glanz et al., 2001). However, while these five studies probably reflect real behaviour change, the long-term effectiveness of the interventions in maintaining these improvements was not evaluated. Furthermore, the overall number of unprotected or inadequately protected outdoor workers remained high post-intervention, and in the study by Girgis and colleagues, no changes in attitudes to sun protection were detected.

Information-based interventions have sometimes been found to be more effective when participants were personally motivated to change after experience with a health issue, such as those who have had a skin cancer removed (Robinson, 1990; Robinson, 1992; Harth et al., 1995). A more recent educational intervention concluded that both intention to change behaviour and behavioural change itself were more likely to occur in epithelial skin cancer patients who reported a tendency to sunburn (Robinson & Rademaker, 1995). However, while improved sun protective behaviours have been documented following educational interventions with epithelial skin cancer patients, these new sun practices were still inadequate (Robinson 1990; Harth et al., 1995 Robinson & Rademaker, 1995), and worsened with time from the intervention (Robinson, 1992).

One skin cancer study used a 'fear appeal', which assumed that people will change behaviours to reduce their anxiety if they are fearful a particular habit is harming their health or that the absence of a particular health habit is undermining their health. While fear appeals were successfully used in previous decades to influence people to quit smoking, practice better dental hygiene and obtain inoculations (Hovland et al., 1953), Keesling and Friedman (1995) found the use of fear appeals was mostly ineffective in changing skin cancer prevention attitudes, intentions and behaviours. It is thought that while fear appeals often alert people to a health problem and produce greater attitude change and intentions to change behaviour than less-fear arousing messages, these do not necessarily change behaviour, particularly over the long term (Higbee, 1969;

Leventhal, 1970). As the effects of fear appeals are usually short-lived, they are unsuitable for encouraging long-term behaviour change (Taylor, 1995, page 84), such as sun protective behaviours. In addition, the least likely people to change behaviour following a fear appeal are those who are 'hard-core' performers of the problem behaviour, including people who are unconcerned about exposing their skin to the sun (Keesling & Friedman, 1995).

Another strategy implemented to overcome the problems associated with solely education-based behavioural change has been message-framing: combining information with a health- or appearance-related positive appeal message. It is thought that recommendations given via framed appeals are more likely to be adopted because health-related messages can be framed in terms of potential gain, while appearance-related appeals are more effective because the visible effects of sun exposure (photo-aging and skin discolouration) are more immediate than skin cancer. Indeed, three interventions have used either health-orientated (Detweiler et al., 1999) or appearance-orientated (Jones & Leary, 1994; Weinstock et al., 2002) precaution messages with some success in improving sun protective intentions (Jones & Leary, 1994; Detweiler et al., 1999) and practices (Weinstock et al., 2002).

Overall, however, it appears that merely providing information, targeting at-risk groups or those with previous experience of skin cancer, instilling fear or providing gain-framed messages does not suffice to alter most people's sun protection habits in the long-term; these strategies may instil the motivation or intentions to change, but may not provide the skills necessary to actually alter behaviour and maintain that behaviour change over time.

1.6.4.3 *Impact of interventions using peer leaders*

The use of peer leaders has also shown some success in skin cancer prevention, at least in the short-term, in three multi-component, outdoor recreational settings (public swimming pools) in Virginia, Massachusetts and Hawaii (Lombard et al., 1991; Geller et al., 2001; Glanz et al., 2001). Use of peer leaders (lifeguards) to model recommended sun protection (hats, shirts and pants) was a component of all three interventions, which also included staff training, educational material and distribution of free sunscreen. Overall, two of the three interventions found staff members and patrons increased their use of sunscreen (Lombard et al., 1991; Glanz et al., 2001), although frequency of use had started to decline by the end of the one-month intervention (Lombard et al., 1991).

1.6.4.4 *Impact of interventions using a 'stage-matched' approach*

The Rhode Island Sun Smart project, which matched strategies with an individual's stage of behavioural change (Section 1.5.3.4), demonstrated that stage-matched interventions can be effective in reducing unprotected sun exposure and increasing the frequency of sunscreen use (Weinstock et al., 2002). Using a multi-component, stage-matched intervention targeted at beach-goers on Rhode Island, participants were moved through the stages of change with substantial proportions of individuals reaching the 'action stage' at 12 and 24 months. However, while statistically significant increases were reported in sun protective behaviours and self-efficacy for intervention subjects relative to controls, most participants were still using inadequate levels of sun protection by the end of the 2-year study.

1.6.4.5 *Impact of interventions using environmental modification*

Increasingly, health behaviours are being addressed by environmental interventions (also called 'social engineering') that push individuals to undertake certain practices or face legal consequences; for example, using seat belts and child-safety seats. In these situations, the social engineering solution has been far more successful than attempts to persuade each individual to undertake these behaviours using attitude-change strategies (Jeffrey, 1989; Taylor, 1995, page 117).

Attitude-change interventions have not been as successful as hoped in improving adult behaviours across various health issues such as smoking cessation, dietary change, weight control, exercise and HIV risk reduction (Prochaska et al., 1992; Rogers, 1983; Weinstein, 1988). Behaviour change is known to be a complex process; many personal barriers are involved in the uptake of good health habits, and often people are not adequately prepared or ready to change their behaviours (Prochaska et al., 1992; Rossi, 1989a; Rossi, 1989b).

As outdoor habits and lifestyle evolve over many years, trying to change people's behaviours to be more sun protective may also be very difficult; for example, Johnson and Lookingbill (1984) in their education-based skin cancer intervention found 70% of participants did not wish to increase their use of sunscreen.

Currently, there is no overarching "Sunsafe" environmental policy for day care centres, schools or outdoor working sites. While sun protection strategies are recommended in the workplace occupational health and safety policies for all Australian workplaces, there is much anecdotal evidence that these policies are often not enforced; and, at least in the NQ region, few workplaces enforce the use of long-sleeved shirts and wide-brimmed hats by their outdoor working employees. There is evidence to suggest that strategies which enforce people to use sun protection more regularly may help them develop long-term sun protective habits, and that people who regularly use sun protection do so because they have formed a long-term habit (Hillhouse et al., 1996; Shoveller et al., 1998). Therefore, workplace policies to support or enforce sun protection in outdoor working employees may be the key element in sustaining sun protective behaviour in this high-risk group for sun exposure and skin cancer.

No skin cancer intervention has yet used a social engineering approach to determine the impact of mandatory use of sun protection by outdoor workers. However, two studies (Glanz et al., 2001; Geller et al., 2001) have demonstrated positive effects from providing environmental supports of sunscreen dispensers and portable shade structures at swimming pools, while two other interventions (Thompson et al., 1993; Green et al., 1999) showed significant reductions in AK and SCC, respectively, by providing free sunscreen to motivated individuals in the community over several years.

1.6.5 Summary discussion of individually-targeted epithelial skin cancer interventions

Over the last two decades, relatively few intervention programs have been targeted towards improving the sun protective practices of adults. Of these, most were guided by little or no theoretical underpinnings, and were focused around health education approaches to improve individual sun protective knowledge, attitudes and behaviours, with the intended outcome of assisting individuals to reduce their exposure to ultra-violet radiation.

While most individually-targeted skin cancer interventions have measured changes in one or more sun-protective behaviours: seeking shade, avoiding the sun, using sunscreen and wearing protective clothing (hat, long-sleeved or collared shirt, long pants), several interventions measured changes in sunscreen use alone as an intermediate outcome measure of success (Robinson, 1990; Harth et al., 1995; Johnson & Lookingbill, 1984; Azizi et al., 2000). Given concerns about the adequacy of sunscreen as a sole protective strategy (Chapter 1.4.2.), additional behavioural and health outcomes should always also be measured.

Further, some interventions reported only composite sun protective behaviours rather than individual sun behaviours (Girgis et al., 1994; Glanz et al., 2001; Azizi et al., 2000; Weinstock et al., 2002). As a result, these studies do not allow measurement of the effect of the intervention on a specific sun protective behaviour. Also, as it is unclear what particular behaviour is contributing to the improved overall behaviour, results of these interventions cannot be considered as evidence for reducing exposure to UVR to the whole body; e.g., the intervention may only have resulted in hat use, and not use of long-sleeved shirts and sunscreen to adequately protect the rest of the body.

Only one intervention gathered information about particular barriers and facilitators for sun protective behaviours in the target group before the main study was conducted (Glanz et al., 2001), which used in-depth interviews and focus groups to investigate multi-ethnic groups in Hawaii.

Finally, the duration of more than half of the interventions was less than three months; most studies used intermediate outcomes relevant to epithelial skin cancer. Even with this generally short duration, few were successful. Given the seasonality of sun protective behaviours and the importance of encouraging habitual as opposed to short-term behaviour change, a long-term follow-up (several years) would be desirable.

1.7 Overall conclusions of the review

Personal exposure to solar UVR is known to be the major environmental risk factor for BCC and SCC. Therefore, the high rates of epithelial skin cancer in North Queensland adults are a likely consequence of a genetically-susceptible population, living in a region with extreme levels of year-round ambient UVR, who do not adequately protect themselves from the sun at work or during recreational activities.

It appears men are the main group in NQ who are not protecting themselves adequately from the sun at work or during recreational activities; rates of epithelial skin cancer are twice as high for men as women, and men are three times more likely than women to develop multiple skin cancers. Therefore, significant differences must exist in skin cancer-related knowledge, beliefs, attitudes or behaviours between men and women; indeed, this literature review suggests there are many demographic and psycho-social factors that reduce the likelihood of adult males adopting sun protective behaviours.

A deeper understanding of gender, psycho-social and peer factors that influence the barriers to adequate sun protection in NQ men are required in order to be able to develop more targeted skin cancer interventions. Such information could be obtained with qualitative studies among those men who regularly experience sun exposure at work or during recreational activities, or who have had a skin cancer previously excised.

However, the literature suggests that any attitude-change intervention to improve sun protective practices in adult males is likely to be unsuccessful; men have long-term sun protective habits that have evolved over many years and are often unprepared or resistant to change, even for those men who have already developed epithelial skin cancer. The most appropriate skin cancer intervention for NQ men may be one that is designed to include a mandatory workplace sun protection policy, which also may in time improve their sun protective behaviours during outdoor recreational activities.

Chapter 2

Identifying groups at most risk of developing epithelial skin cancer in North Queensland

2.1 Introduction

This chapter identifies groups of North Queensland (NQ) men at high risk of developing epithelial skin cancer, and the factors associated with this high risk.

The literature shows epithelial skin cancer in adults is strongly associated with having previous epithelial skin cancer, occupational and recreational sun exposure (especially recreational activities involving the beach or water), and “host factors” such as age and phenotype. This first exploratory phase of the PhD, conducted in Townsville, NQ, involved undertaking two separate cross-sectional studies to characterise the sun exposure, sun protection, and recent and accumulated (over time) sun-induced skin damage of specific groups at high risk of future skin cancer: one study included men with a previous histopathologically-confirmed epithelial skin cancer, and the other study involved a predominantly male sample of NQ recreational boat users returning from a day fishing or sailing trip.

Analyses conducted sought to contrast occupational and recreational sun exposure, and to establish the personal, group and situational factors which predict recent sun-induced skin damage (experience of sunburn), accumulated sun-induced skin damage (suntan level), previous epithelial skin cancer, and use of recommended sun protective practices. Cross-sectional studies are well suited to exploratory studies of this nature.

Both cross-sectional studies investigated factors known to be associated with the development of epithelial skin cancer in adults: host factors such as age and phenotype (skin type, ability to tan), time spent in the sun at work and during recreational activities, recent and accumulated sun-induced skin damage (sunburn, suntan level), sun protective behaviours (use of a wide-brimmed hat, long-sleeved shirt, sunscreen and sunglasses), social norms, influence of peer groups, and beliefs related to the causes and prevention of epithelial skin cancer. Copies of the questionnaires used in the two cross-sectional studies are provided in Appendices 1 and 2.

A summary of the main results of the two cross-sectional studies will be described in the "Conclusions to Chapter 2" section (page 175). The main findings of these two cross-sectional studies have also been published; copies of the following five publications are presented in Appendices 9 to 13:

(1) Woolley T, Buettner PG, Lowe J. Sunburn in Australian Men with a History of Non-Melanoma Skin Cancer. *American Journal of Health Behaviour* 2003; 27(3):195-207.

(2) Woolley T, Buettner PG, Lowe J. Predictors of sun protection in northern Australian men with a history of nonmelanoma skin cancer. *Preventive Medicine* 2004; 39:300-307.

(3) Woolley T, Buettner PG, Lowe J. Sun-Related Behaviours of Outdoor Working Men with Previous Non-Melanoma Skin Cancer. *Journal of Occupational and Environmental Medicine* 2002; 44(9):847-854.

(4) Woolley T, Raasch BA. Predictors of sunburn in north Queensland recreational boat users. *Health Promotion Journal of Australia* 2005; 16: 26-31.

(5) Woolley T, Buettner P. Similarity of sun protection attitudes and behaviours within north Queensland peer groups. *Health Promotion Journal of Australia* 2009; 20(2):107-111.

2.2 Sunburn in northern Australian men with previous epithelial skin cancer

Published as:

Woolley T, Buettner PG, Lowe J. Sunburn in Australian Men with a History of Non-Melanoma Skin Cancer. American Journal of Health Behaviour 2003; 27(3):195-207.

2.2.1 Abstract

Objective: This study aims to identify predictors of recent sunburn in north Australian men with a history of non-melanoma skin cancer (NMSC).

Methods: A survey of men with previous NMSC was conducted (n=300, response rate 62%).

Results: 54% of participants reported recent sunburn. Predictors identified included: younger age, believing that NMSC is caused by childhood sun exposure, believing that sun protection will not help prevent further NMSC, wearing casual clothes, and using shade as the main sun protection strategy.

Conclusions: Health promotion messages should emphasise the importance of sun protection throughout life and the use of stringent sun protection measures.

2.2.2 Introduction

Basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) are the two major histologic types of non-melanoma skin cancer (NMSC), and are the most frequently reported malignancies in Caucasian populations.[1] A northern Australian study conducted in 1997 found age-standardised incidence rates for NMSC to be among the highest in the world.[2] This study reported incidence rates for BCC were 2058 per

100,000 inhabitants for men and 1195 per 100,000 inhabitants for women, while incidence rates for SCC were 1076 per 100,000 for men and 518 per 100,000 for women. These rates are a likely consequence of the northern Australian population consisting of predominantly Caucasian individuals who are genetically susceptible to skin cancer, and a tropical location with high, year-round levels of ambient ultra-violet radiation (UVR).[3] Northern Australian rates of NMSC are over four times higher than for temperate latitudes within Australia,[4] almost nine times higher than in the United States,[5] more than 20 times higher than in Canada,[6] and approximately 30 times higher than in Europe.[7]

The northern Australian study also showed rates of NMSC for men to be twice those for women, and men were three times more likely to develop further NMSC.[2] Men have been shown to have higher rates of NMSC in previous studies.[4-9] As there are no known genetic differences between men and women regarding the susceptibility to NMSC, these higher rates in men are most likely a result of behavioural differences. However, only one previous risk factor study for NMSC specifically targeted males.[10] This study concluded that adult sun exposure increases the risk of developing BCC.

Sun exposure is regarded as the major environmental risk factor for NMSC.[10-15] Studies suggest that cumulative sun exposure is responsible for the development of SCC,[12,13] while mixed effects of cumulative and intermittent sun exposure seem to account for the development of BCC.[10,12,14,15] Because recent sun exposure adds to the overall cumulative sun exposure of an individual, a reduction in recent sun exposure must be regarded to be an important target in the prevention of NMSC. Risk factor studies in skin cancer usually rely on the participants' recall of personal history of sun exposure, information that is considered to be of debatable validity. On the other hand, risk factor studies for skin cancer produced the most consistent results when the personal history of sunburns was utilised as a marker for sun exposure and cutaneous sun damage.[16]

As sun exposure and sun protection are at least partly under individual control, improving at-risk sun-related behaviours seems a logical strategy to prevent future NMSC. According to current models of behavioural change, not only knowledge but also beliefs must be determined as both are highly interrelated and both influence behavior.[17,18] Thus, identifying at-risk knowledge, beliefs and behaviours which lead to sunburn is a first important step in developing behavioural interventions to reduce the risk of future NMSC. The present study explored knowledge, beliefs and behaviours regarding sun protection and sun exposure of north Australian men susceptible to NMSC, and determined how these variables related to cutaneous sun damage, as measured by self-reported recent sunburn.

2.2.3 Methods

2.2.3.1 Participants: The present cross-sectional study was conducted in Townsville, North Queensland (latitude 19^{o}S; population 127,000). 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.[2] Only men were asked to participate in the present study, as men were identified as being under much higher risk of developing skin cancer than women (see Introduction). Men selected for the present study had one NMSC (BCC or SCC) excised in 1997, and no record of melanoma. Participants were randomly selected proportional to the age structure of men in the Townsville Skin Cancer Survey. Data for the present study were collected by self-administered questionnaire between October to December 1999. The questionnaire, together with an introductory letter and self-addressed return envelops, was sent by mail directly to the randomly selected group of men (n = 680). If a person did not reply within three weeks, a second questionnaire was sent out. Due to ethical concerns about privacy, men could not be contacted by telephone or other means if they didn't respond to the initial two mail-outs. Men who had moved residence (n = 196, 28.8%) could also not be traced. A total of 300 men responded to the questionnaire (response rate 62% of 484). Ethical approval for the questionnaire was obtained from the JCU Ethics Committee, number H871 (see Appendix 3 for a copy of the approval).

2.2.3.2 Questionnaire: Demographic questions included age, marital status, time in childhood and adolescence spent in the tropics, life-time spent in the tropics, current and life-time occupation, and history of skin cancer. Based on answers given for “If you are currently employed or self-employed, what is your job?”, categories of current occupation with high (for example, fisherman, farmer) and low (for example, tradesman) sun exposure were defined. Socio-economic status was determined by questions on employment, total 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”).

The main part of the questionnaire was developed utilising the Health Belief Model and the Theory of Reasoned Action.[17,18] Questions relating to the Health Belief Model included perceived susceptibility to future skin cancers, and perceived severity of the consequences of skin cancer, as well as questions relating to perceived benefits and barriers of acting sun-safe. Based on the Theory of Reasoned Action, questions referring to social norms, knowledge, beliefs, and attitudes towards skin cancer and sun protection were included.

Knowledge questions determined whether participants knew when and how sunscreen should be applied for optimal sun protection. Beliefs were investigated with respect to sun exposure, sun protection, obtaining and having a suntan, developing further NMSC, aspects of outdoor lifestyle, and recent and adolescent sun exposure. Questions assessing beliefs used a five point Likert scale, allowing participants to answer from strongly agree to strongly disagree. Recent sun behaviours were assessed by questions on the use of sun protection (such as hats, clothing, sunscreen, and shade), regular daily activities, daily work and recreational sun exposure, seasonal sun exposure, and specific questions on fishing as one of the favourite past-times in North Queensland. One item asked the men whether they typically wear casual clothes (such as T-shirt, singlet, etc.) during midday. In tropical North Queensland, "casual clothes" implies for men wearing shorts and a short-sleeved shirt or less. Also, participants were asked specifically how many hours they spent out in the sun during an average working day and during an average day off. Questions referring to recent sun behaviours were stated like: “The last time you were out ….” followed by a question asking whether this behaviour was typical. Only typical behaviours were considered in the analyses.

Recent skin damage was self-reported as the number of mild and severe sunburns the men experienced since their last excised NMSC. The questionnaire described mild sunburn as “some redness or tenderness” and severe sunburn as “blistering or peeling”. Skin type, an index of sun-sensitivity which represents both the propensity to sunburn and the capacity to develop a tan, was assessed according to Fitzpatrick’s classification.[19] Skin type I refers to the most sun sensitive skin (“always burns, never tans”), skin type II “always burns, tans with difficulty”, skin type III “sometimes burns mildly, has moderate tan”, and skin type IV refers to the least sun sensitive Caucasian skin (“rarely burns, tans with ease”).

Initially, the questionnaire was administered face-to-face to five men from the target population to ensure that phrasing and terminology of each question was well understood and questions were answered as intended. The questionnaire remained unchanged after these interviews were conducted. Thirty men were then randomly selected from the target population and approached by telephone for consent to trial the questionnaire. Nine men (30%) returned the questionnaire twice. Reliability of numerical variables were assessed by means of I-Kuei Lin's concordance correlation coefficient, while Kappa statistic was used for categorical variables.[20,21] The analysis of this small pilot study showed at least moderate agreement for most items used in the questionnaire and, in particular, for those items identified as important during the main analysis. Reliability of recall of "number of sunburns since last NMSC was excised" was low (concordance correlation coefficient = 0.439, p = 0.220), however, the main analysis was based on the dichotomised variable “experienced sunburns since last excision of NMSC yes/no” which showed 100% reproducibility in the pilot study.

2.2.3.3 Statistical Analysis: Data were coded numerically and entered into the computerised statistical package for social sciences, SPSS Release 6.1.3 for Windows. The number of mild and severe sunburns were added together for each participant, and dichotomised into the dependent variable “experienced a sunburn/did not experience a sunburn since last excised skin cancer”. A complete list of the independent variables as they were considered in the statistical analysis is given in Table 2.2.1. Bivariate relationships between knowledge, beliefs and behaviours and the dependent variable were assessed by means of t-tests, non-parametric Wilcoxon tests and Chi-square tests, as appropriate. Mean values and standard deviation (SD), or median values and inter-quartile ranges (IQR) described numerical variables.

The data were analysed in two different ways: (1) with multiple logistic regression analysis to identify independent predictors of recent sunburn and to estimate their impacts and (2) with explorative classification and regression tree (CART) analysis to define meaningful risk groups of recent sunburn experience and identify interactions between variables.[22] During CART-analysis, first the entire sample and thereafter all newly defined subgroups were investigated at every step of the analysis to determine which variable yielded the most significant subdivision into a higher and lower risk group with respect to recent experience of sunburn. The CART procedure stopped when either no further significant predictor was detected or the sample size was below 10% of total sample size. The resulting final groups were most homogenous with respect to recent sunburn experience; that is, some groups presented with a low prevalence of recent sunburns, and other groups with a high prevalence of recent sunburns. In the entire sample, the variable with the strongest relationship to "recently experienced sunburns" was age (< 50 years, ≥ 50 years). These two age groups define the first two subsets in which the CART procedure continued. Percentages of men who experienced sunburns in final groups defined by CART-analysis were presented with exact or approximate 95%-confidence intervals (95%-CI), as appropriate.

All variables described in Table 2.2.1 have also been initially considered in multivariate logistic regression analysis, but only independent significant predictors and identified confounders were accepted into the final model. During the analysis, skin type was identified as a confounder, and logistic regression analysis was adjusted accordingly. No interactions were found in the multiple logistic regression model. Results of the multiple logistic regression analysis were 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.

Table 2.2.1: Bivariate description of predictors of "sunburn since last excised skin cancer" in north Australian men (n = 292[a]) with a previous history of epithelial skin cancer

Predictors of recent sunburns	Sunburn since last excised skin cancer? No (n= 133)	Yes (n= 159)	p-value
Demographics			
Age in years (mean ± SD[b])	53 ± 4	48 ± 4	0.0010
Live in married or defacto relationship	78%	82%	0.3966
Less than a university level education	81%	87%	0.1415
Currently employed	72%	89%	0.0003
Total yearly household income greater than $25,000	77%	88%	0.0239
Currently working in a high sun exposure occupation	19%	26%	0.2273
Total years lived in the tropics (mean ± SD)	39 ± 8	34 ± 8	0.5244
Years lived in the tropics as a child (mean ± SD)	17 ± 2	17 ± 2	0.2820
Age when first skin cancer diagnosed (mean ± SD)	40 ± 6	38 ± 5	0.1185
Number of skin lesions previously excised (median; IQR[c])	4; 2 – 8	3; 2 – 10	0.7455
Skin type I (Fitzpatrick classification)	16%	19%	0.4773
Beliefs			
I will get more skin cancers if keep getting sunburns	95%	97%	0.5427
I cannot prevent myself from getting another skin cancer	52%	60%	0.1730
Having a suntan is not risky	12%	15%	0.5147
Using sun protection will not help prevent another skin cancer	28%	38%	0.0655
Getting a skin cancer mainly depends on skin type	66%	62%	0.4391
My skin cancer was caused by age	37%	43%	0.2715
My skin cancer was caused by childhood sun exposure	87%	94%	0.0656
My skin cancer was not caused by sun exposure in last few years	44%	47%	0.5963
I like the sun	39%	48%	0.1380
I feel better with a suntan	48%	59%	0.0745
I look better with a suntan	23%	34%	0.0506
My risk of another skin cancer is not low	84%	94%	0.0041
I don't use sufficient sun protection when in sun for 1 hour or more	18%	32%	0.0069
I do not worry about protecting myself from further sun damage	22%	23%	0.8328
I do not always think about using sun protection	62%	73%	0.0563
Skin cancer is an easily treatable disease	23%	25%	0.7322
Finding out I could get skin cancer was traumatic	32%	35%	0.5073
Skin cancer is not a serious risk to my health	12%	15%	0.5500
Knowledge			
The last time I protected myself with sunscreen, I applied it:			0.1936
Not at all, because I do not use sunscreen	23%	17%	
20 to 30 minutes before I went out in the sun	11%	9%	
Just before I went out in the sun	59%	62%	
After I was in the sun for a while	6%	12%	

Table 2.2.1: Continued

Predictors of recent sunburns	Sunburn since last excised skin cancer? No (n= 133)	Yes (n= 159)	p-value
Behaviours			
Time spent out in the sun on an average day last week			0.0009
Spent less than 15 minutes working in the sun	32%	16%	
Spent between 15 and 30 minutes working in the sun	8%	15%	
Spent between 30 minutes and 2 hours working in the sun	32%	25%	
Spent more than 2 hours working in the sun	28%	44%	
Spent more than 2 hours in the sun on days off	45%	58%	0.0316
Did regular activities in sun between 10am and 2pm last week	69%	83%	0.0057
Did not try to avoid going out in the sun between 10am and 2pm	35%	43%	0.1942
Spent some daylight hours fishing most months	39%	55%	0.0119
Went boating or fishing between 10am and 2pm	52%	70%	0.0037
Went out in the sun less in winter months	27%	34%	0.1603
Did not wear a long-sleeved shirt the last time in the sun	56%	63%	0.2322
Did not wear a wide-brimmed hat the last time in the sun	26%	41%	0.0141
Did not use sunscreen the last time in the sun	50%	57%	0.2533
Use shade as primary sun protection strategy	8%	15%	0.0444
Wore casual clothes in sun between 10am and 2pm last week	52%	71%	0.0008
Why do you have a suntan?			0.2367
I do not have a suntan	55%	47%	
I work on getting a suntan because I prefer to have a tan	0%	2%	
I have a suntan because it is unavoidable due to my job	23%	23%	
I have a suntan because I spend time outdoors on my days off	23%	28%	

[a]n = 292, as eight men provided no information concerning recent sunburns;
[b]SD = Standard deviation;
[c]IQR = Inter-quartile range

2.2.4 Results

2.2.4.1 Description and bivariate analysis (Table 2.2.1.): A total of 300 men (response rate 62%) who previously experienced NMSC participated in the study. Their mean age was 51 years (SD ± 4) and they had spent on average 36 years (SD ± 8) of their life in the tropics. The mean age at which the participants first experienced problems with their skin was 39 years (SD ± 5) and they reported that a median number of 4 (IQR = [2, 10]) skin cancers or suspicious skin lesions had been previously excised. Overall, 16.4% of the men had a university degree, 81.4% were currently working, and 77.2% (n = 237; excluding 43 retired men, 11 men currently not working, and 9 men not answering the question) of the men currently worked in a low sun exposure occupation. Twenty-six point nine percent of these indoor working men (n = 183) and 75.9% of the men who worked in a high sun exposure occupation (n = 54) reported to spend more than two hours in the sun on an average work day.

Overall, 159 men (54.5%) had experienced at least one sunburn since their last excised skin cancer. A total of 155 (53.1%; 8 missing values) men had experienced mild and 27 (9.3%; 8 missing values) men had experienced severe sunburns since their last NMSC was excised.

The median number of sunburns experienced since the last skin cancer excision was 1 (IQR = [0, 3], range = 0 to 200) for mild and 0 (IQR = [0, 0], range 0 to 15) for severe sunburns. Men who had experienced sunburns (mild or severe) since their last excised skin cancer were younger (p = 0.0010), more likely to be employed (p = 0.0003), and were more likely to have a total household income of more than $25,000 per annum (p = 0.0239) compared to men who had not experienced sunburns recently.

Men who had experienced sunburn since their last excised skin cancer were more likely to think that they were under increased risk for future skin cancers (p = 0.0041), that they did not use sufficient protection when in the sun for an hour or more (p = 0.0069), and were more likely to agree with the following statements “my skin cancer was caused by childhood sun exposure” (p = 0.0656), “I do not always think about using sun protection” (p = 0.0563), “I look better with a suntan” (p = 0.0506), and “I feel better with a suntan” (p = 0.0745). However, these last three associations did not reach statistical significance.

Men who had experienced sunburn since their last excised skin cancer had spent more time working in the sun during the previous week (p = 0.0009). These men were also more likely to have spent more than two hours in the sun on their days off during the previous week (p = 0.0316), pursued regular activities in the sun between 10am and 2pm during last week (p = 0.0057), spent some daylight time boating or fishing during most months of the year (p = 0.0119), and spent time boating or fishing between 10am and 2pm (p = 0.0037). Men who had experienced sunburn since their last excised skin cancer were less likely to have worn a wide-brim hat during their last significant period of sun exposure (p = 0.0141), were more likely to have worn casual clothes in the sun between 10am and 2pm during the previous week (p = 0.0008), and used staying in the shade as their chief method of sun protection (p = 0.0444).

2.2.4.2 Multivariate Analysis (Table 2.2.2): Multivariate logistic regression analysis identified younger age as the strongest predictor of recent sunburn. Men aged 30 to 39 years and men aged 40 to 49 years had an 11.8 and 14.1 times increased risk of recent sunburn, compared to men aged 60 years or older. Men with the most sun-sensitive skin type (skin type I) had a 2.4 fold increased risk of recent sunburn compared to men with skin types II, III, or IV. Men who spent between 15 and 30 minutes, and more than 2 hours in the sun on an average workday during the last week had significantly increased risks of sunburn compared to men who did not work. Men who wore casual clothes when in the sun between 10am and 2pm during the last week had a higher risk of sunburn (POR = 1.9), as did men who did not wear a hat (POR = 2.8), or those who used staying in the shade as their chief method of sun protection (POR = 4.0).

Table 2.2.2: Results of multiple logistic regression analysis identifying predictors of "sunburn since last excised skin cancer" in north Australian men (n = 275 [a]) with previous history of epithelial skin cancer

Predictors	Total sample (n = 275)	Recent sunburn (%)	POR [95%-CI] [b]	p-value
Age				
60 years or more	27	18.5%	1	
50 – 59 years	138	46.4%	4.2 [1.4-13.0]	0.0127
40 – 49 years	84	70.2%	14.1 [4.1-48.4]	0.0000
30 – 39 years	26	76.9%	11.8 [2.8-50.6]	0.0009
Skin type				
Skin types II, III and IV	227	52.9%	1	
Skin type I	48	58.3%	2.4 [1.0-5.3]	0.0379
I believe childhood sun exposure caused my skin cancer				
Disagree/Not sure	46	41.3%	1	
Agree	229	56.3%	2.5 [1.1-5.6]	0.0238
I believe using sun protection will not help prevent another skin cancer				
Disagree/Not sure	185	50.3%	1	
Agree	90	61.1%	1.9 [1.0-3.4]	0.0496
I believe I look better with a suntan				
Disagree/Not sure	194	50.5%	1	
Agree	81	61.7%	2.4 [1.2-4.8]	0.0117
Time spent in the sun on an average workday last week				
Did not work	53	32.1%	1	
Less than 15 minutes	50	38.0%	0.7 [0.3-1.9]	0.5333
Between 15 and 30 minutes	29	69.0%	3.2 [1.0-10.0]	0.0448
Between 30 minutes and 2 hours	59	57.6%	1.5 [0.6-3.8]	0.3562
More than 2 hours	84	69.1%	4.1 [1.7-9.6]	0.0016
Last week, did you wear casual clothes in the sun between 10am and 2pm?				
No	103	40.8%	1	
Yes	172	61.6%	1.9 [1.0-3.5]	0.0416
Last time in the sun, what hat did you wear?				
Broad-brimmed hat	179	47.5%	1	
Narrow-brimmed hat or cap	56	62.5%	1.9 [0.9-4.1]	0.1042
Did not wear a hat	40	70.0%	2.8 [1.2-6.7]	0.0207
Use staying in the shade as primary sun protection strategy				
No	244	51.2%	1	
Yes	31	74.2%	4.0 [1.5-10.8]	0.0066

[a] Only the data of men with no missing values for all predictors accepted into the model were analysed;
[b] POR [95%-CI] = Prevalence odds-ratio and 95%-confidence interval.

Participants had an increased risk of sunburn if they believed that their skin cancer was caused by childhood sun exposure, or that using sun protection does not help prevent further skin cancer. This was also true for men who believed that they look better with a suntan. None of these three beliefs significant in multiple logistic regression analysis was significant in bivariate analysis.

2.2.4.3 *CART-Analysis*: In the first step of the CART-analysis based on the entire sample of 292 men (8 missing values for “number of sunburns since last NMSC was excised”) age (< 50 years, ≥ 50 years) showed the strongest significant bivariate relationship with recently experienced sunburns (yes, no)($p < 0.00001$). According to the CART procedure, the sample was split into two subsets: men aged less than 50 years and men aged greater or equal to 50 years and the variable with the strongest significant bivariate relationship to recent sunburns was identified for each of the first two subsets.

2.2.4.4 *Figure 2.2.1*: For men aged less than 50 years of age, four final groups were identified, of which two were high-risk groups for recent sunburns: (1) men who currently worked in high sun exposure occupations (92.6%, 95%-CI = [74.9%, 99.1%]); and (2) men who currently worked in low sun exposure occupations, who didn’t almost always think about sun protection, and who usually used sunscreen (92.3%, 95%-CI = [74.9%, 99.1%]).

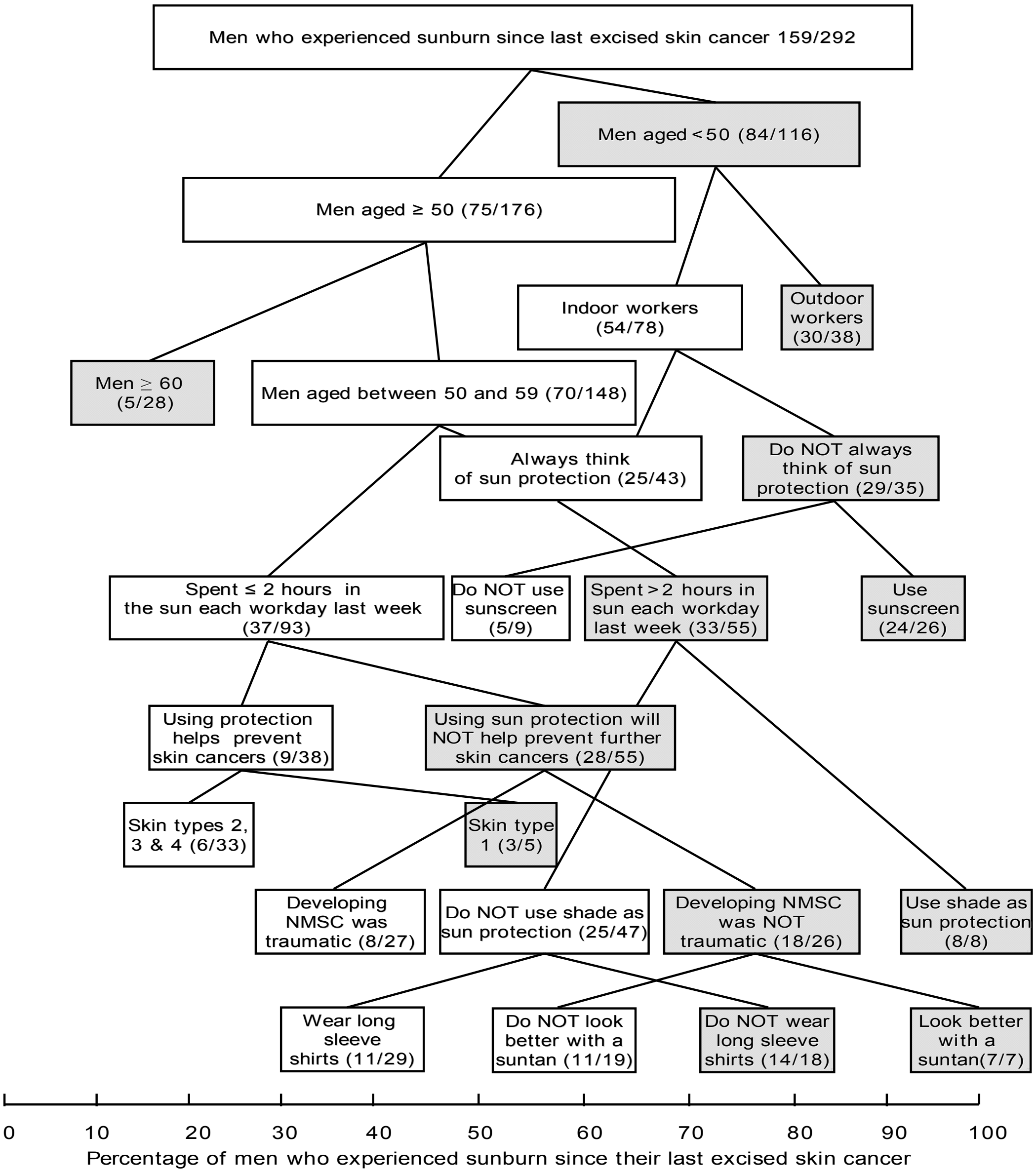

Figure 2.2.1:

Result of Classification and Regression Tree analysis identifying risk groups for recent sun damage in north Australian men who previously had NMSC excised (n = 292). Recent sun damage was measured as "experienced a sunburn/did not experience a sunburn since last excised skin cancer". The size of the boxes represents the size of the groups defined. The location of the centre of the boxes is in relation to the target variable of recent sun damage. Shaded boxes represent final groups. Defining variables are described with percentage of men who experienced sunburns since last excised skin cancer and total size of group given in brackets.

For men aged 50 years or above seven final groups were identified, of which two were high-risk groups for recent sunburns: (1) men aged between 50 and 59 years, who spent more than two hours in the sun on an average working day, and who use shade as their prime method of sun protection (100%, 95% = [63.1%, 100%]); and (2) men aged between 50 and 59 years, who spent two hours or less in the sun on an average workday, who didn't believe that using sun protection will help prevent further skin cancer, who stated that finding out that they had skin cancer was not traumatic, and who believed that they look better with a suntan (100%, 95%-CI [59.0%, 100%]). Men aged 60 years or above formed the final group with the lowest risk of recent sunburn (17.9%, 95%-CI = [6.1%, 36.9%]).

2.2.5 Limitations of the study

The overall response rate for the study was not high. Men have been well-documented as being difficult to study,[23] particularly, when it involves research into skin cancer.[24] It is likely that respondents were more health concerned than non-respondents, but health concerned people with previous NMSC might tend to avoid the sun and might protect themselves better from the sun. Thus, the results of the present study might give an under-estimation of sun exposure and an over-estimation of sun protective behaviour in north Australian men with previous skin cancer.

As sun exposure and sun protection were assessed by retrospective self-report, the possibility of misclassification has to be considered. The self-reported outcome variable "experienced/did not experience a sunburn since last excised skin cancer" appears to be prone to potential recall problems, as the excision could have occurred up to two years prior to the present study. This misclassification is likely to produce an under-estimation of the number of sunburns experienced.

The previously described skin type variable is also prone to misclassification. Earlier studies have shown that self-report of skin reaction to the sun tends to exaggerate the tanning ability of the skin.[25] In general, it may be argued that information collected might under-estimate sun exposure and over-estimate sun protection. In an attempt to minimise this misclassification, respondents were asked to recall events from the previous week or the last time they were out in the sun, and whether the events recalled were considered "typical". This information bias could potentially be reduced in a prospective cohort study.

2.2.6 Discussion

This cross-sectional study is the first to identify specific sun-related knowledge, beliefs, and behaviours that predict recent sunburn in men with previous NMSC who live in a high-risk environment for skin cancer. In concordance with studies of general populations,[26-31] younger age was found to be the strongest predictor of recent sunburn, while men aged 60 years or older were identified as the group with lowest risk of sunburn. Older persons tend to prefer a more sedentary lifestyle which may lead to a reduction of their recreational time spent in the sun.[32] In the present study, 75% of younger but only 39% of older men spent more than two hours in the sun on weekend days. It has also been discussed that attitudes towards risk-taking behaviour change with age.[28,33] With increasing age men may act more health-aware in general, and more sun-safe, in particular.[28,33]

Both logistic regression and CART-analysis identified men who worked long hours in the sun as predictive of recent sunburn. Previous studies have demonstrated that outdoor workers may use inadequate sun protection. Stepanski and Mayer discovered that only 50% of outdoor workers used adequate protection, while Borland and colleagues found that only 24% of workers wore suitable hats and 13% wore long-sleeved shirts.[34,35] It seems likely that outdoor workers in northern Australia may have even worse sun protection behaviours.

Due to its geographical location, Townsville experiences extreme levels of ambient solar UVR, and an average year has more than 180 days with more than 8 hours of sunshine per day.[3] The tropical summers are generally hot and humid, while the winters are experienced as pleasantly warm. In this climate, outdoor workers might perceive sun protective clothes and hats as uncomfortable, while frequent sweating might hinder the effectiveness of sunscreen. However, the impact of outdoor working on recent sun damage might even be underestimated in the present study, as all participating men had a history of NMSC, an experience that might lead to increased sun protective behaviour.

In addition to inadequate clothing, the present study identified the sole reliance on shade as the primary method of sun protection as a strong risk factor for sunburn. This finding might again be explained by the particular environment, in which north Australian men live and work. Studies on UVR measurements of shaded locations in a tropical setting show that shade alone may not provide sufficient protection against solar radiation.[36] In the tropics the amount of diffuse radiation is usually high enough to induce sunburn even under shaded structures, particularly on partially cloudy or overcast days. This is significant, as sun protection messages often refer to staying in the shade as a valid method of protection, probably creating a false sense of security in people who live in high-risk environments.[37] On the other hand, shade might be a valuable means of sun protection in more temperate climates. Professionally developed shade structures, that also limit the intrusion of scattered and reflected sunlight, are important improvements to otherwise totally unprotected beach areas, swimming pools, or sport stadiums wherever they are installed.[36,38]

The CART-analysis showed that the use of sunscreen led to an increased likelihood for sunburns in young men who currently worked in a low sun exposure occupation, and who admitted that they did not always think about sun protection. The fact that these men were using sunscreen is surely indicative that they, at least sometimes, think about sun protection. However, the use of sunscreen might not be the best way of sun protection as previous studies have noted several human failings that reduce the effectiveness of sunscreens. Studies have found that people usually apply a layer of sunscreen only half the thickness necessary to achieve the sun protection factor (SPF) of the sunscreen,[39] did not use sunscreen with sufficient SPF,[40] did not protect each exposed body part,[41] and frequently forgot to reapply sunscreen after water activities and sweating.[42] It appears highly likely that these failings had occurred in men who admitted that “they do not always think about sun protection”. It is interesting to note that the evaluation of the ‘SunSmart’ campaign conducted in Victoria, Australia, in 1997/98 also found a positive association between the regular use of sunscreen and sunburn, and concluded that wearing protective clothes offered better protection from sunburn than other measures.[31]

Almost all respondents of the present study held the belief that they will acquire more skin cancers if they keep getting sunburns. In general, the Australian population is regarded to be well-educated about the dangers of sun exposure and awareness seems to be highest in the youngest age-group.[31] In the present study this high awareness of risk did not, however, appear to lead to the adoption of strict sun protective behaviours. It is likely that men do not view NMSC as a serious health threat. NMSC is relatively easily treated by excision and the fatality rate is generally low. According to Australian statistics of 1999 only approximately 1% of all deaths caused by malignant neoplasms were related to NMSC.[43] These facts might explain why only one third of the participating men stated that it was traumatic for them to have skin cancer.

In addition, less than 50% of men thought that recent sun exposure might be responsible for their skin cancer. Interestingly, the majority of men (53.6%, data not shown) who believed that they will get more skin cancers if they keep getting sunburns, denied that recent sun exposure will add to their risk of skin cancer. Thus, although sunburn was understood to be a risk factor for skin cancer, apparently no strong connections were drawn between recent sun exposure, sunburns and skin cancer. In concert, these two important beliefs influence sun protection and follow a similar pattern that might be expected based on the Health Belief Model.[18] Men appear to not perceive the severity of another NMSC as great or feel susceptible to acquiring another NMSC. Until either of these factors can be shifted, men would not be expected to change their current behaviour.

Of greatest concern was the finding that over 90% of men linked childhood sun exposure with skin cancer, and that 42% of men denied any effect from recent sun exposure. The multivariate model showed that men who recently experienced sunburns were more likely to believe that skin cancer is caused by sun exposure in childhood, and that using sun protection will not help to prevent further skin cancer. Skin cancer prevention messages often try to stress the risk of sun exposure during childhood and adolescence,[44,45] as exposure during the early years of life has been identified as an important risk factor in the development of cutaneous melanoma.[46,47] However, more recent studies come to the conclusion that the combination of high sun exposure in childhood and adulthood may be the crucial risk factor in the development of cutaneous melanoma.[48,49] Adult respective life-time cumulative sun exposure has been identified as a risk factor for NMSC.[10,12-15]

These findings strongly suggest that health promotion messages should emphasise the importance of sun protection throughout life. Messages that solely target sun exposure during childhood and adolescence might have encouraged the prevailing belief that it is almost pointless to reduce sun exposure during adulthood.

In conclusion, the present study exposed some misconceptions about the causation and prevention of NMSC, which were found to be prevalent in north Australian men with previous skin cancer, and which could be easily targeted by more specific health promotion messages. Medical professionals should advise male patients with a history of NMSC that recent sun exposure will add to their risk of developing further skin cancers and should recommend using combinations of sun protective measures, but preferably sun protective clothing. In particular, people living in high-risk environments should be advised to take extra care by using more stringent and less fallible measures.

The study further suggests two target populations for future intervention projects: outdoor workers and young men. A recent study concluded to target young adulthood in future health promotion campaigns as sun-protective behaviours is likely to improve during this stage in life[50] – an encouraging result for which young men should be the test-case.

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2.3 Sun protection in northern Australian men with previous epithelial skin cancer

Published as:

Woolley T, Buettner PG, Lowe J. Predictors of sun protection in northern Australian men with a history of nonmelanoma skin cancer. Preventive Medicine 2004; 39:300-307.

2.3.1 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 non-melanoma 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 fifty.

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 behaviours of some men may improve only 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.

2.3.2 Introduction

Basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) are the two major histologic types of non-melanoma skin cancers (NMSC). Studies have identified ultra-violet 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-standardised 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 1997/98 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 one 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.

2.3.3 Methods

2.3.3.1 Participants: The present cross-sectional study was conducted in Townsville, North Queensland (latitude 19^{o}S; population 127,000). Ethical approval for the questionnaire was obtained from the Human Ethics Sub-Committee, James Cook University, approval number H871 (see Appendix 3 for a copy of the approval letter). Men were randomly selected for the present study from the Townsville Skin Cancer Survey database, which contains data of all excised, histologically-confirmed skin cancers from 1997 to 1999.[7] Men selected had one NMSC (BCC or SCC) excised in 1997 and no record of melanoma. 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 over-response towards younger men, in particular, those aged from 40 to 60 years.

Data for the present study were collected by self-administered questionnaire between October and December 1999. The questionnaire, together with an introductory letter and self-addressed return envelope, was sent by mail directly to the randomly selected group of men (n = 680). If a person did not reply within three weeks, a second questionnaire was mailed. Due to ethical concerns with privacy, men could not be contacted by telephone if they didn't 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%.

2.3.3.2 Questionnaire: Participant demographics were determined using questions on age, skin type, employment status, socio-economics, and history of skin cancer. Skin type, an index of sun-sensitivity which 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 categorising the men's current occupation into high (for example, fisherman, farmer) or low (for example, tradesman) sun exposure. Socio-economic status was determined by questions on total yearly household income, and highest level of education (categories: "not finished primary school", "finished primary school, some high school", "junior certificate (grade 10)", "senior certificate (grade 12)", "apprenticeship, diploma or certificate", 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 behaviours 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 favourite 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 behaviour was typical. Only typical behaviours were considered in the analyses. Further details of the methodology used have been previously published [16].

The main part of the questionnaire was developed utilising the Theory of Reasoned Action (TRA) and the Health Belief Model (HBM).[17-18] Based on the TRA, questions referring to attitudes towards 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 participants to answer from strongly agree to strongly disagree.

2.3.3.3 Statistical Analysis: Data were coded numerically and entered into the computerised statistical package for social sciences, SPSS Release 6.1.3 for Windows. Whether or not the men typically used sunscreen was dichotomised into the dependent variable "typically used/did not use sunscreen when in the sun for at least 20 minutes". Whether or not the men typically wore both a wide-brimmed hat and a long-sleeved shirt was dichotomised 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 minutes". A complete list of the variables as they were considered for statistical analysis is given in Tables 2.3.1 and 2.3.2. Bivariate relationships between demographics, attitudes, beliefs and behaviours and the dependent variables were assessed by means of Chi-square tests, t-tests and non-parametric Wilcoxon tests, as appropriate. Mean values and standard deviation (SD), or median values and inter-quartile 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.

Table 2.3.1: Bivariate description of "typically use sunscreen when in the sun" in north Australian men with a history of non-melanoma skin cancer

Predictors of using sunscreen	Typically use sunscreen when in the sun? No (n=118)	Yes (n=176)	p-value
Demographics			
Age (mean; SD[a])	52 ± 4	49 ± 4	<0.0001
Have skin type I or II (lighter skin)	59%	65%	0.3310
Have a Grade 12 level education	51%	66%	0.0106
Currently work in a high sun exposure occupation	30%	18%	0.0332
Have spent at least most of my life in the tropics	19%	35%	0.0020
Number of skin lesions excised previously (median; IQR[b])	3; 2 - 10	4; 2 - 7	0.5380
Beliefs			
I use sufficient protection when out in the sun	41%	73%	<0.0001
My risk of further skin cancer is high	75%	85%	0.0343
I want to protect myself from further skin cancer	66%	85%	0.0002
Using sun protection will help prevent further skin cancer	37%	50%	0.0408
My skin type helped cause my skin cancer	57%	69%	0.0493
A suntan is risky to my health	85%	88%	0.4048
Skin cancers are not easily treatable	75%	76%	0.7164
Skin cancer is a serious risk to my health	77%	80%	0.4748
Attitudes			
I do not like exposing myself to the sun	52%	57%	0.3937
I do not look better with a suntan	63%	67%	0.4695
I do not feel better with a suntan	78%	83%	0.3352
The benefits of a suntan do not outweigh the risks	68%	81%	0.0108
I do not have barriers to using sun protection	22%	60%	<0.0001
Behaviours			
I typically use a wide-brimmed hat for protection in the sun	59%	71%	0.0340
I typically use a long-sleeved shirt for protection in the sun	32%	37%	0.4048
I use much less sun protection in the cooler months	33%	26%	0.1968
My workplace requires the use of sun protection	69%	69%	0.9747
I have experienced sunburn since my last excised NMSC	55%	55%	0.9825
I do regular activities in the sun between 10 and 2	78%	76%	0.6344
I try to avoid going out in the sun around midday	47%	68%	0.0005
I spend time doing recreational activities on my days off	9%	25%	0.0007

[a] SD = Standard deviation;
[b] IQR = Inter-quartile range.

Table 2.3.2: Bivariate description of "typically wearing a long-sleeved shirt with a wide-brimmed hat when in the sun" in north Australian men with a history of non-melanoma skin cancer

Predictors of wearing a LSS with a WBH	Typically wear a long-sleeved shirt with wide-brimmed hat in the sun? No (n=217)	Yes (n=83)	p-value
Demographics			
Age (mean; SD[a])	50 ± 4	52 ± 4	0.0096
Have skin type I or II (lighter skin)	59%	75%	0.0103
Have a Grade 12 level education	60%	58%	0.7733
Currently work in a high sun exposure occupation	18%	21%	0.6178
Have spent most or all of my life in the tropics	44%	59%	0.0197
Number of skin lesions excised previously (median; IQR[b])	3; 2 - 6	6; 2 - 10	0.0001
Beliefs			
I use sufficient protection when out in the sun	54%	77%	0.0005
My risk of further skin cancer is high	79%	85%	0.2544
I want to protect myself from further skin cancer	75%	85%	0.0740
Using sun protection helps prevent further skin cancer	45%	44%	0.9611
My skin type helped cause my skin cancer	59%	79%	0.0026
A suntan is risky to my health	83%	96%	0.0028
Skin cancers are not easily treatable	55%	71%	0.0137
Skin cancer is a serious risk to my health	76%	88%	0.0224
Attitudes			
I do not like exposing myself to the sun	49%	76%	<0.0001
I do not look better with a suntan	30%	48%	0.0040
I do not feel better with a suntan	38%	68%	<0.0001
The benefits of a suntan do not outweigh the risks	84%	95%	0.0113
I have barriers to using sun protection	41%	58%	0.0099
Behaviours			
I typically use sunscreen for protection in the sun	38%	66%	<0.0001
I use much less sun protection in the cooler months	32%	16%	0.0037
My workplace requires the use of sun protection	25%	43%	0.0024
I have experienced sunburn since my last excised NMSC	61%	38%	0.0006
I do regular activities in the sun between 10 and 2	77%	76%	0.8418
I try to avoid going out in the sun around midday	58%	66%	0.2253
I spend time doing recreational activities on my days off	19%	16%	0.4597

[a] SD = Standard deviation;
[b] IQR = Inter-quartile range.

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 2.3.1 and 2.2.2 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.

2.3.4 Results

2.3.4.1 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 $\pm$ 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 minutes, 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 "didn't 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%).

2.3.4.2 Bivariate analysis – Sunscreen use (Table 2.3.1): 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 non-users of sunscreen with respect to experiencing recent sunburn.

2.3.4.3 Bivariate analysis – Use of long-sleeved shirt and wide-brimmed hat (Table 2.3.2):

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 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.

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.

2.3.4.4 Multivariate analysis (Tables 2.3.3 and 2.3.4): 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 minutes.

Table 2.3.3: Results of multiple logistic regression analysis identifying predictors of "typically using sunscreen when in the sun" in north Australian men (n = 281[a]) with a history of non-melanoma skin cancer

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

[a] Only the data of men with no missing values for all predictors accepted into the model were analysed;
[b] POR [95%-CI] = Prevalence odds-ratio and 95%-confidence interval.

Table 2.3.4: Results of multiple logistic regression analysis identifying predictors of "typically wearing a long-sleeved shirt and wide-brimmed hat when in the sun" in north Australian men (n = 277[a]) with a history of non-melanoma skin cancer

Predictors	Total sample (n = 277)	Wear LSS and WBH (%)	POR [95%-CI][b]	p-value
I like exposing myself to the sun				0.0007
Agree/Not sure	119	14%	1	
Disagree	158	38%	3.4 [1.7-6.7]	
I have barriers to using sun protection				0.0005
Yes	149	17%	1	
No	128	40%	3.5 [1.6-5.7]	
My workplace requires the use of sun protection				0.0002
No	193	22%	1	
Yes	84	41%	3.8 [1.9-7.7]	
I think the benefits of a suntan outweigh the risks				0.0445
Yes	36	11%	1	
No	241	30%	2.0 [1.0-11.0]	
Number of previously excised skin cancers				0.0440
1	55	16%	1	
2	54	19%	0.9 [0.3-2.7]	
3 – 5	61	23%	1.3 [0.4-3.6]	
6 or more	107	41%	2.6 [1.0-6.5]	
I think skin cancers can be easily treated				0.0136
Yes	112	20%	1	
No	165	33%	2.5 [1.2-4.6]	
Age				0.0138
< 40 years	25	24%	1	
40 – 49 years	84	14%	0.4 [0.1-1.4]	
50 – 59 years	142	36%	1.5 [0.5-4.4]	
60 or more years	26	31%	1.7 [0.4-7.1]	

[a] Only the data of men with no missing values for all predictors accepted into the model were analysed;
[b] POR [95%-CI] = Prevalence odds-ratio and 95%-confidence interval.

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.

2.3.5 Limitations of the study

The present study has several limitations, in particular, its relatively low response rate. Men have been well documented as being difficult to study,[39] in particular, when it involves skin cancer.[40-41] It is likely that respondents were more health concerned than non-respondents, 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 under-representation of sun exposure and an over-representation of sun protective behaviour in north Australian men with previous skin cancer.

However, the over-response of participants between the ages of 40 to 60 years would also likely affect 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 over-representation of sun exposure and an under-representation of sun protective behaviours, 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 support for the assumption that these men had a high awareness of issues relating to their skin and to skin cancer.

2.3.6 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 minutes 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. 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 towards 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 also 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 NQ 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 human failings that reduce the effectiveness of sunscreen.[30-33] The evaluation of the "SunSmart" campaign conducted in Victoria, Australia, in 1997/98 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 NQ.

The present study also suggests that the more negative experience men have with skin cancer (that is, 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 suggests 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 behaviour 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 minimise the heat factor by having thermal characteristics more suitable to hot and humid conditions: having lightweight, high vapour 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 employees to use brimmed hats, long-sleeved shirts and sunscreen do actually affect the men's use of brimmed hats and long-sleeved shirts, though 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 - appropriate sun protective clothing and sunscreen - should be mandatory for all those who work outdoors in high sun exposure occupations, as the sun protection attitudes and behaviours of some men may only improve after significant sun damage.

2.3.7 References

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2.4 Sun-related behaviours and skin damage of northern Australian outdoor working men with previous epithelial skin cancer

Published as:

Woolley T, Buettner PG, Lowe J. Sun-Related Behaviours of Outdoor Working Men with Previous Non-Melanoma Skin Cancer. Journal of Occupational and Environmental Medicine 2002; 44(9):847-854.

2.4.1 Abstract

Objectives: Outdoor workers are at increased risk for developing non-melanocytic skin cancer (NMSC). The present study aimed to describe sun exposure and sun protection behaviours of northern Australian outdoor working men with previous NMSC.

Methods: In 1999, a cross-sectional study of northern Australian men (n = 300; response rate 62%) with a history of histologically-confirmed NMSC was conducted by self-administered questionnaire.

Results: Compared to other men, outdoor working men spent more time in the sun on average working days ($p < 0.0001$) and days off ($p < 0.0001$), and outdoor workers with sun-sensitive skin reported more skin lesions had been removed ($p = 0.0461$). The workplace did not reinforce sun-safe practices of 36.8% of workers who spent half their

time or more outdoors. Sun protective behaviours were not different between in- and outdoor workers.

Conclusions: Outdoor workers experienced a high level of occupational and recreational sun exposure; however, sun-protective behaviour was similar to other workers. Workplaces should be targeted to enforce sun-safe policies.

2.4.2 Introduction

Non-melanocytic skin cancers (NMSC), separated patho-histologically into either basal cell carcinoma (BCC) or squamous cell carcinoma (SCC), are the most frequently reported malignancies in Caucasian populations.[1] Studies conducted in northern Australia consistently report incidence rates for BCC and SCC which are among the highest in the world and there are indications that these already high rates are still rising.[2-4] Sun exposure is regarded as the major environmental risk factor for NMSC.[5-6] Studies suggest that life-time cumulative sun exposure is responsible for the development of SCC,[6-9] while mixed effects of cumulative and intermittent sun exposure seem to account for the development of BCC.[6,9,10-13] Therefore, the extreme rates of NMSC experienced in northern Australia seem a likely consequence of the resident population consisting of predominantly White individuals who are genetically susceptible to skin cancer, and who are living in a subtropical to tropical location with high, year-round levels of ambient ultra-violet (UV) radiation.[14]

Consistent with results from other studies,[15-20] a northern Australian survey showed rates of NMSC for men to be twice those for women, and men were three times more likely to develop further NMSC.[3] As there are no known genetic differences between men and women regarding susceptibility to NMSC, these higher rates in men are most likely a result of behavioural differences with respect to sun exposure. A recent study estimating annual average erythemal UV doses of Americans showed that females experienced 78.6% of the dose of males.[21]

It is not surprising that studies have recognised that outdoor workers acquire higher amounts of erythemally effective UV exposure than indoor workers, in particular in subtropical and tropical climates.[22-24] These findings, as well as results from studies analysing incidence rates of skin cancer by occupation,[25-26] provide evidence that outdoor workers are at elevated risk for developing NMSC.[27] This suggestion is consistent with previous results from our cross-sectional study of northern Australian men with a history of NMSC, which identified working outdoors as a strong predictor for recently experienced skin damage through sunburns.[28]

The present analysis aimed to characterise behaviours regarding sun exposure and sun protection of northern Australian men with a history of NMSC who work mainly outdoors and to contrast these findings with the behaviour of men who work mainly indoors.

2.4.3 Methods

2.4.3.1 Participants: The present cross-sectional study was conducted in Townsville, North Queensland (latitude 19^{o}S; population 127,000). Participants for this study were identified from the Townsville Skin Cancer Survey database, which contains data of all excised, histologically confirmed skin cancers from 1997 to 1999.[3] Participants were randomly selected proportional to the age structure of men in the Townsville Skin Cancer Survey. Men chosen for the present study had one recorded NMSC (BCC or SCC) and no record of melanoma between 1997 and 1999. Data for the present study were collected by self-administered questionnaire between October to 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 three weeks, a second questionnaire was mailed. Men who had moved residence (n = 196, 28.8%) could not be traced. A total of 300 men responded to the questionnaire (response rate 62% of 484). Ethical approval for the study was obtained from the James Cook University Human Ethics Sub-Committee, number H871 (see Appendix 3 for a copy of the approval letter).

2.4.3.2 Questionnaire: Demographic questions included age, marital status, 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”), and total yearly household income. Participants were asked to classify themselves as mainly indoor working, mainly outdoor working, or half in- and half outdoor working. Retired (n = 43, 14.3%) and currently non-working participants (n = 11, 3.7%) as well as men who did not provide an answer to the question of current employment status (n = 9, 3.0%) were excluded from the present analysis.

Skin type, an index of sun-sensitivity which 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).[29] The questionnaire asked about the years of childhood and adolescence spent in the tropics as well as the total years of life-time spent in the tropics. Previously experienced skin damage was reported as the number of skin cancers or other skin lesions that had been excised, as well as age when the first skin cancer or skin lesion was diagnosed. Recent skin damage was self-reported as the number of mild and severe sunburns the men experienced since their last excised NMSC. The questionnaire described mild sunburn as “some redness or tenderness” and severe sunburn as “blistering or peeling”.

Recent sun behaviours were assessed by asking questions regarding the use of sun protection measures (such as hats, clothing, sunscreen, and shade), regular daily activities, daily work and recreational sun exposure, seasonal sun exposure, and specific questions on fishing as one of the favourite past-times in northern Australia. One item asked the men whether they typically wear casual clothes (such as T-shirt, singlet, etc.) during midday. In tropical North Queensland, "casual clothes" implies for men wearing shorts and a short sleeved shirt or less. Participants were asked how many hours they spent in the sun during an average working day and during an average day off. Questions referring to recent sun behaviours were stated like: “The last time you were out ….” followed by a question asking whether this behaviour was typical. Only typical behaviours were considered in the analyses. In addition, men were asked to describe why they do not always wear protective clothing or sunscreen while out in the sun for a significant period of time. A list of perceived barriers to sun protective behaviour was provided and men were also given the choice to add to this list.

2.4.3.3 Statistical Analysis: Data were coded numerically and entered into the computerised statistical package for social sciences, SPSS Release 6.1.3 for Windows. Numerical variables were described as mean values and standard deviations (SD) or median values and inter-quartile ranges (IQR) depending on their distribution. The associations between demographic variables, variables describing sun exposure, variables describing sun protective behaviour, variables describing barriers to sun protective behaviour and the men's indoor/outdoor status were assessed with Chi-square tests, one-way analyses of variance, and non-parametric Kruskal-Wallis tests, as appropriate.

Depending on the type of the variable considered, either multiple logistic regression analyses or analyses of variance were used to assess whether differences in sun exposure, previously experienced sun damage, sun protective behaviour, or barriers to protective behaviours between indoor, half in- and half outdoor, and outdoor workers could be associated with the potential confounding effects of skin type. If skin type (I or II versus III or IV) showed a significant effect, a stratified analysis was conducted and these results were presented. Throughout the study a significance level of 0.05 was assumed.

2.4.4 Results

Of the 300 men who responded to the questionnaire (response rate 62%), 63 (21.0%) were excluded from the present analysis as these men were either retired, currently unemployed, or did not provide information on their current employment status, leaving a total of 237 northern Australian working men who previously experienced NMSC in the study. The mean age of the participants was 49 years (SD $\pm$ 7.5). Participants were asked to classify themselves as "mainly indoor" working (n = 119, 51.1%), "mainly outdoor" working (n = 72, 30.9%), or "half in- and half outdoor" working (n = 42, 18.0%). Most (86.6%) of the mainly indoor working men had sun sensitive skin (skin type I or II), while 73.8% of half in- and half outdoor workers, and 53.5% of the mainly outdoor workers reported to have sun sensitive skin (p = 0.0444) (Table 2.4.1).

2.4.4.1 Sun exposure (Table 2.4.1): Compared to mainly indoor working men, outdoor workers were likely to spend a higher proportion of their entire life (p = 0.0481) and of their childhood (p = 0.0199) in the tropics. The reported time spent in the sun on an average working day varied significantly with the self-classification into in- and outdoor workers (p < 0.0001). Fifty-one percent of mainly outdoor working men spent more than six hours in the sun on an average working day. Of the 114 currently working men who classified themselves as mainly outdoor or half in- and half outdoor workers, 36.8% reported that their workplace did not require them to use sun protection when working in the sun.

Table 2.4.1: Bivariate relationships between demographic characteristics, sun exposure and indoor/outdoor working status as reported by north Australian men with a history of non-melanoma skin cancer who are currently in the work force

	Indoor workers (n = 119)	Half in- & half outdoor (n = 42)	Outdoor workers (n = 72)	p-value[#]
Demographics				
Age in years (mean ± SD*)	49 ± 7.0	49 ± 8.9	48 ± 7.1	0.5140
Live in married or de-facto relationship	86.6%	92.9%	80.3%	0.1702
With university level education	27.8%	11.9%	5.8%	0.0002
Total yearly household income greater than $50,000	60.6%	50.0%	50.9%	0.2793
Skin type I or II (Fitzpatrick's classification)	86.6%	73.8%	53.5%	0.0444
Sun exposure				
Median proportion of life spent in the tropics	64.1%	90.4%	96.3%	0.0481
Median years spent in the tropics up to age 20	7	19	19	0.0199
"I am more than 2 hours in the sun on an average working day "	5.1%	47.6%	86.1%	< 0.0001
"I am more than 2 hours in the sun on an average day off"	43.7%	50.0%	76.4%	< 0.0001
"I usually go out in the sun more in the cooler months"	44.4%	23.8%	16.7%	0.0002
"I go 10 hours or more per month fishing during daylight"	15.5%	15.4%	39.1%	0.0012
"More than half of the time I go fishing, I will go between 10 am and 2 pm "	16.2%	17.9%	23.5%	0.0877
"I have a suntan"	44.1%	46.2%	49.3%	0.7936
"I like the sun "	42.7%	45.0%	47.1%	0.8472
Age when first skin lesion was excised (mean ± SD)	39 ± 10.7	36 ± 9.7	35 ± 11.7	0.0860
Number of skin lesions excised (median, IQR**)	3, 2-8	5, 2-10	4, 2-8.75	0.0570
"I was sunburnt since my last excised skin cancer"	53.5%	74.4%	68.1%	0.0290

* SD = Standard deviation;
** IQR = Inter-quartile range;
[#] P-values given are unadjusted for effects of skin type. If skin type acted as a confounder, P-value in table was bolded and result was described in detail in the text.

Compared to 43.7% of indoor workers, 76.4% of outdoor workers experienced more than two hours of sun exposure on an average weekend day or day off ($p < 0.0001$). Compared to 6.7% of mainly indoor working men, 25.0% of mainly outdoor workers stated that they typically spent more than six hours in the sun on an average weekend day or day off. Typical recreational activities during the previous week that involved being out in the sun for one hour or more between 10 am and 2 pm included gardening (22.4%), participating in or watching sport (22.4%), and fishing (8.9%).

Regularly participating in or watching sport was more common in indoor workers (28.6%), than in half in- and half outdoor workers (11.9%), or outdoor workers (16.7%)($p = 0.0350$). Mainly outdoor working men were more likely to go fishing for long hours during daylight ($p = 0.0012$) and reported a tendency to go fishing around midday ($p = 0.0877$). Compared to mainly indoor working men, outdoor workers and half in- and half outdoor workers were more likely to have experienced at least one sunburn since their last skin cancer was excised ($p = 0.0290$).

In the multivariate analyses, skin type showed confounding effects on the variables age when first skin cancer or skin lesion was excised ($p < 0.0001$), number of skin lesions excised ($p = 0.0030$), and whether or not workers "liked the sun" ($p < 0.0001$). Men with skin types III or IV ($n = 84$) reported a mean age of 41 years (SD ± 8.5) when their first skin cancer was excised with no significant difference between the indoor/outdoor classification ($p = 0.8230$). Men with skin types I or II ($n = 151$) reported a mean age of 35 years (SD ± 11.3) for their first excision, with mainly indoor working men reporting 37 years (SD ± 11.2, $n = 79$), half in- and half outdoor workers 34 years (SD ± 10.2, $n = 31$), and mainly outdoor workers 30 years (SD ± 11.6, $n = 36$) ($p = 0.0090$).

While all participants had previously had at least one skin cancer excised, men with skin types III or IV reported a median number of two excisions (IQR = [1, 6]) with no significant difference between the indoor/outdoor classification ($p = 0.4085$). Men with skin types I or II stated a median number of excisions of prior skin cancers or skin lesions of 5 (IQR = [2, 10]), with mainly indoor working men reporting 4 (IQR = [2, 10], n = 80), half in- and half outdoor workers reporting 6 (IQR = [4, 15], n = 31), and mainly outdoor workers reporting 6 (IQR = [2, 10.75], n = 38) ($p = 0.0461$).

Men who agreed to the statement "I like the sun" were more likely to have skin types III or IV (n = 84; 65.4%) than skin types I or II (n = 151, 32.7%) ($p < 0.0001$), while the effect of the indoor/outdoor classification remained insignificant in either strata of skin type ($p = 0.8181$, $p = 0.9707$, respectively).

2.4.4.2 Sun protective behaviours (Table 2.4.2): Overall, 43.6% of all men reported that they usually wear long-sleeved shirts and 53.5% noted that they usually wear short-sleeved shirts when out in the sun around midday for 20 minutes or more. When out in the sun around midday, 77.2% of men stated that they usually wear a wide-brimmed hat, 3.5% a narrow-brimmed hat, and 19.3% a cap.

These sun protective behaviours were not statistically different between in- and out-door workers. Whether men wore a long or a short-sleeved shirt, or a wide or a narrow-brimmed hat last time out in the sun around midday was related to skin type ($p = 0.0938$, $p = 0.0085$, $p = 0.0168$, $p = 0.0380$; respectively) with men with sun sensitive skin types I or II being more likely to wear sun protective clothing. Taking the effect of skin type into account did not alter the non-significant relationships between these sun protective behaviours and the indoor/outdoor classification.

Table 2.4.2: Bivariate relationships between sun protective behaviours, barriers to sun protection, and indoor/outdoor working status as reported by north Australian men with a history of non-melanoma skin cancer currently in the work force

	Indoor workers (n = 119)	Half in- & half outdoor (n = 42)	Outdoor workers (n = 72)	p-value#
Sun protective behaviours				
"Last time I spent 20 minutes or more in the sun between 10 am and 2 pm, I…."				
wore a shirt	93.2%	100%	97.2%	0.1351
wore a long-sleeved shirt	41.4%	35.9%	52.4%	0.4481
wore a hat	89.7%	85.4%	91.5%	0.5851
wore a wide-brimmed hat	77.2%	80.0%	77.4%	0.7466
"I wear casual clothes when in the sun between 10 am and 2 pm half the time or more often "	19.5%	19.0%	29.0%	0.1833
"I usually put on sunscreen when out in the sun for a significant time"	71.2%	53.7%	50.0%	**0.0080**
"I never use sunscreen"	13.6%	19.0%	19.4%	0.4973
"I try to avoid going out in the sun between 10 am and 2 pm"	67.8%	68.3%	35.8%	**<0.0001**
"I use shade as the sole method of sun protection"	14.3%	9.5%	12.5%	0.7259
"I use less sun protection during the cooler months"	42.9%	63.4%	45.7%	0.0713
Barriers to sun protective behaviours				
"I don't have the time to worry about sun protection"	14.3%	19.0%	27.8%	0.0727
"I often forget to bring sun protection along"	21.0%	19.0%	22.2%	0.9226
"I often don't get around to put on sun protection"	19.3%	28.6%	29.2%	0.2281
"Sun protection is inconvenient to use"	20.2%	19.0%	26.4%	0.5333
"Hats and long-sleeved shirts are uncomfortable in the tropics"	16.0%	26.2%	15.3%	0.2692
"I have a suntan because it is unavoidable with my job"	22.5%	23.1%	21.1%	0.9650

P-values given are unadjusted for effects of skin type. If skin type acted as a confounder, the P-value in table was bolded and result was described in detail in the text.

Overall, 17.4% of men reported that they never used sunscreen, 10.6% of men stated that they put on sunscreen 20 to 30 minutes before going out, 61,9% said that they put on sunscreen just before going out in the sun, and 10.2% reported that they use sunscreen after they have been out in the sun for a while. Compared to the other participants, men who mainly worked indoors were more likely to report that they put on sunscreen when out in the sun for a significant time ($p = 0.0080$).

Skin type ($p = 0.0405$) and the indoor/outdoor classification ($p = 0.0004$) significantly influenced sun avoidance between 10 am and 2 pm. Of all men with skin types I or II ($n = 151$), 64.9% “tried to avoid going out in the sun between 10 am and 2 pm”. Seventy-five percent of mainly indoor workers ($n = 81$), 67.7% of half in-and half outdoor workers ($n = 31$), and 38.9% of mainly outdoor workers ($n = 36$) agreed with the above statement ($p = 0.0007$). Of all men with skin types III or IV ($n = 84$), 46.8% agreed with the above statement, along with 51.4% of mainly indoor workers ($n = 37$), 70.0% of half in- and half outdoor workers ($n = 10$), and 33.3% of mainly outdoor workers ($n = 30$)($p = 0.0975$).

2.4.4.3 Barriers to sun protective behaviours (Table 2.4.2): A total of 51 men (21.5%) thought that sun protection was inconvenient to use. The most frequently named barrier to the use of sun protective measures was that men "didn't get around to putting it on" ($n = 57$; 24.1%). Overall, 41 men (17.3%) noted that hats and long-sleeved shirts are uncomfortable to wear in the tropics. Three men (1.3%) ticked "because I have olive skin, I probably will not ever develop another skin cancer" as a reason for not wearing protective clothing or sunscreen when out in the sun for a significant time. Only two men (0.8%) found hats, long-sleeved shirts and sunscreen to be too expensive. In addition to the prompted answers given in the questionnaire, three men (1.3%) noted that sunscreen is greasy and, therefore, avoided using it. The frequencies of perceived barriers to the use of sun protective measures were not statistically different between in- and outdoor workers or between men with different skin types. Overall, 101 men (44.3%) said that they would like to change their sun protective behaviour.

2.4.5 Limitations of the study

The results of the present study need to be interpreted with caution as 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 and skin lesions or the age of first excision with medical records. On the other hand, 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.

Another potential problem might arise with the definition of "indoor" and "outdoor" worker being based on self-classification. However, this self-classification agreed very well with the information given on hours typically spent in the sun during an average working day as well as with the information recorded on current occupation.

A further limitation of the present study is its relatively low response rate. Men have been well-documented as being difficult to study, particularly in research regarding skin cancer.[36-38] It is likely that respondents were more health concerned than non-respondents, but health concerned people with previous NMSC might tend to avoid the sun and might protect themselves better from the sun. Thus, the results of the present study might give an under-estimation of sun exposure and an over-estimation of sun protective behaviour in north Australian men with previous skin cancer. We attempted to minimise recall bias in relation to sun exposure and sun protection by asking participants to recall events from the previous week or the last time they were out in the sun, and whether these events were typical. Again, it seems likely that personal sun exposure may have been under-reported while sun-protective behaviours may have been exaggerated.

Indeed, the uptake of sun protective behaviours appeared to be appreciably higher in this sample compared to previous studies which involved participants from the general American, Canadian, or Australian populations,[33-38] or from American or Canadian outdoor workers.[39-41] However, an over-estimation of sun-protective behaviour cannot be excluded for any of these studies. Therefore, it can be argued that the likely explanation for differences between this and other studies resulted from the fact that the current sample included only men with a history of NMSC, as persons who already experienced their susceptibility to skin cancer might be more thoughtful towards sun protection. In Rosenman's study from 1995, previous history of skin cancer increased the likelihood of sun protection in farmers and their spouses,[40] and a case-control study conducted in Israel found patients who had been previously treated for BCC were more likely to use sunscreen than controls.[42]

In addition, Robinson's studies that investigated the effects of educational interventions after treatment of NMSC showed improved sun protective behaviours, with the greatest change being associated with the education linked to removal of the skin cancer.[43-44] In a later educational intervention study, Robinson and Rademaker concluded that both intention to change behaviour and behavioural change itself were more likely to occur in NMSC patients who reported a tendency to sunburn.[45] Indeed, many previously conducted studies reported an increased use of sun protective measures in persons with more sun sensitive skin.[33-37,39,46]

2.4.6 Discussion

This is one of the few studies that documents sun exposure and sun-protective behaviours of outdoor working men who live in a high-risk environment for skin cancer. In comparison to indoor workers, most outdoor workers appeared to accumulate a rather high level of sun exposure. They had spent a larger proportion of their entire life and of their childhood in the tropics, and while they naturally spent longer hours in the sun while working, they also spent more time in the sun for recreation.

This study was conducted in a regional coastal centre of tropical North Queensland with a yearly average of more than 170 days with more than 8 hours of sunshine, creating an extreme UV environment with no pronounced break during the winter time.[14] Recreational activities of the people living in North Queensland are typically located outdoors and it seems likely that men who were brought up in tropical Australia, such as the majority of participating outdoor workers, are more likely to fully adopt this outdoor life-style. This speculation might provide an explanation for the high recreational sun exposure reported by outdoor workers participating in the present study, as this result is in contradiction to a previously published American study which found that indoor workers experience a greater duration of weekend outdoor exposure. [33]

The climatic conditions may explain much of the differences observed in sun exposure between different countries. For example, studies from Canada reported considerably lower working and recreational sun exposures for the adult population than the present study. [34,35,39] A typical example of a favourite year-round pastime of North Queensland men is fishing. Although, there was only a slight and non-significant difference in the proportions of indoor and outdoor workers who regularly went fishing, outdoor working men who reported this pastime spent on average much longer hours on the water, that is, under intense sun exposure created by ambient and reflected UV radiation.

In the present study, outdoor working men were less likely to have sun-sensitive skin. This finding lends support to results of Green's study in which a self-selection process towards an under-representation of persons with a tendency to sunburn in long-term outdoor workers was documented.[2] The same study was unable to establish an association between incidence rates of skin cancer and occupation.

In contrast, the present study found that outdoor workers with sun sensitive skin type (I or II) developed more (median difference of 2) skin cancers or skin lesions earlier (mean difference of 7 years) compared to indoor workers. These findings support the hypothesis that outdoor workers are under increased risk for developing NMSC and are consistent with results from two previous studies conducted in England and Australia which compared incidence rates of skin cancer by occupation.[25-26] It is of interest to note, that Beral and Robinson's study (1981) clearly identified an excess risk for NMSC in outdoor workers, but not for cutaneous melanoma.[25] Several subsequent studies also failed to link outdoor work with cutaneous melanoma.[47,48] These findings support the current understanding of the different etiological processes involved in the development of the different types of skin cancer, which identify intermittent sun exposure and exposure during childhood to be important in the development of cutaneous melanoma.[49]

Skin type had little effect on sun protective behaviour in the present study, which could be attributed to the fact that every man in the sample had experienced skin cancer, dominating the usually differentiating effect of frequent sunburn experience. Although the findings of the present study regarding sun protective behaviour were encouraging overall, it is apparent that these men did not protect themselves sufficiently, as the majority reported sunburns since their last skin cancer was excised.

Previous studies in patients with NMSC, including the studies with educational interventions likewise documented (although improved) but still inappropriate sun protective behaviour.[42-44] Most of the sun protective behaviours documented in the present study did not differ between indoor and outdoor workers, despite the quite significant differences regarding their sun exposure. The only differences occurring referred to the potential avoidance of midday sun, which is unlikely to be achieved by outdoor workers because of their working constraints, and in the use of sunscreen which seemed to be more accepted by indoor working men.

Likewise, frequencies of perceived barriers to sun protective behaviours did not vary much between in- and outdoor workers. Overall, the most frequently noted barriers to the use of sun protection were “not getting around to putting it on” (24%), “inconvenience” (22%), and “forget to bring it along” (21%). Again, these results were encouraging when compared, for example, to a recent study of Canadian adults in which 63% of participants admitted to forgetting to use sun protection and 47% found it inconvenient to use.[35] Nevertheless, the question remains as to whether men susceptible to NMSC perceive skin cancer to be a serious health issue.

Intervention studies directed at outdoor workers have been able to improve sun protective behaviour and skin cancer awareness.[31,50-52] However, there is a need for policies to support sun protection and this may be a key element to sustain behaviour. Today, sun-safe policies are implemented in many workplaces, however, as the present study revealed, there might be still a high prevalence of work-sites where policies are not in place or are not enforced. A recent Western Australian study concluded that trade unions could have an important role in the creation of sun-safe workplaces.[53] As sun protection is a life-long activity, workplaces provide an ideal setting for creating healthy public policies. Approaches, such as changing the sun-safe policies on work-sites, should be further investigated to promote a more comprehensive sun protection strategy for outdoor workers.

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2.5 Sunburn in northern Australian recreational boat users

Published as:

Woolley T, Raasch BA. Predictors of sunburn in north Queensland recreational boat users. Health Promotion Journal of Australia 2005; 16: 26-31.

2.5.1 Abstract

Issue addressed: Identify personal and situational factors predicting sunburn in North Queensland recreational boat users over summer.

Methods: Cross-sectional survey with prospective 24-hour follow up for sunburn, conducted in Townsville, North Queensland, during the summer of 2003. Ninety-three out of 100 boat users returning after a day trip agreed to participate. All were followed up, with three later excluded from analysis due to prior sunburn (n=90, response rate=93%).

Results: Overall, 48% of participants experienced sunburn as a result of their boat trip; 57% of these developed sunburn on the face, and 43% on both the V of the neck and the legs. Factors found to increase the occurrence of sunburn were longer time on the water between 10am-2pm, not wearing a wide-brimmed hat, not working outdoors, and going boating less than once per month.

Conclusions: The survey shows unacceptably high levels of sunburn in North Queensland boat users. Sunburn appears related to not using optimal sun protection between 10am and 2pm. Boat users in the tropics need to wear a brimmed hat to better protect the face, a collared long-sleeved shirt buttoned up at the throat to protect the V of the neck and arms, long pants, and rely less on sunscreen and on darker skin types that are perceived to sunburn less readily.

So what? North Queenslanders who participate in high risk recreational sun activities, particularly those with less experience of the tropical midday sun, must be educated to use a combination of sun protection measures.

2.5.2 Background

Excessive exposure to ultra-violet radiation (UVR) significantly increases an individual's risk for developing both melanoma and non-melanoma skin cancer (NMSC).[1-4] Throughout the world, rates of skin cancer are nowhere higher than in North Queensland (NQ), Australia.[5]

These high rates of skin cancer can be at least partly explained by the high risk environment. North Queensland is located in the dry tropics; throughout most of the year it has extreme levels of solar UVR combined with cloudless and relatively clean skies. For example, annual UVR levels in Townsville are 55-70% higher than in Germany.[6] Further, the predominantly Caucasian population is at high risk; with a genetic disposition to skin cancer[7] and prevailing social norms that favour high risk, water-based recreational activities.

Water-based recreational activities are very popular in NQ. It has been estimated that over 25% of Townsville households own a boat and 40% of the Townsville population participate in recreational fishing at least once a year.[8] From these statistics, it appears that a significant number of individuals in NQ spend time engaging in boating or fishing activities.

While it is not known how well these individuals are protecting themselves from the sun, a recent study in NQ men with previously diagnosed skin cancer found those who spent time fishing or boating to be significantly more likely to have experienced recent sunburn.[9] As sunburn caused during beach and water-related activities is known to be the most dangerous for later development of melanoma and NMSC,[1,4] the risk of skin cancer as a result of inadequate use of sun protection during water-related activities in NQ is potentially very high. Many factors will influence an individual's use of sun protection on the day; including season, comfort, convenience, planning, social norms and personal attitudes.[10] The present study seeks to identify personal and situational factors associated with sunburn in NQ recreational boat users to more effectively target sun protection campaigns for this vulnerable group.

2.5.3 Methods

2.5.3.1 Participants: The study was designed as a cross-sectional study with a prospective 24-hour follow up. It was conducted in the city of Townsville, North Queensland (latitude 19^{o}S, population 127,000) on three separate Sundays between February and March 2003 over summer. During a Townsville summer, measured UVB shows average levels of between 24 and 25 MEDS per day, peaking at 5-7 MEDS per hour in the middle of the day.[6] The study population was adults (≥ 18 years) who had undertaken a recreational boat trip, and who either docked at the Townsville Sailing Club or used boat ramps at the Breakwater, South Townsville National Park, Bohle or Giru. Participants were recruited between the hours 11am to 5pm when returning from their boat trip. Data collection was by verbally administered questionnaire.

If there were several persons in a boat, all adults were invited to participate. However, on 85% of occasions data were obtained from only one member of the boating party, as either there was only one person on the boat or the boat owner had insufficient time to participate.

To determine if sunburn was experienced as a result of the boat trip, all participants were followed up after 24 hours by telephone. Of 100 boat users approached, 93 consented to participate. The 93 participants each gave a first name and contact telephone number, and were all able to be contacted for prevalence and location of sunburn. Eighty-nine were contacted the evening after their trip, with the remaining four contacted on the second day. Three respondents were further excluded from the analysis as they reported having sunburn before going boating, giving a sample population of 90 participants and a response rate of 93%. Ethical approval for the study was obtained from the James Cook University Ethics Committee, number H1334 (see Appendix 3 for a copy of the approval letter).

2.5.3.2 Questionnaire: Demographic questions included age, gender, skin type, level of suntan on the face, and total years of life-time spent in NQ. Skin type, an index of sun-sensitivity representing both the propensity to sunburn and the capacity to develop a tan, was self-assessed according to Fitzpatrick's classification (scale I to IV from most sun sensitive to least sun sensitive Caucasian skin).[11] Respondents also self-assessed the suntan level on their face by choosing from one of five Likert scale categories: very light, light, moderate, dark or very dark.

Experience with skin cancer was determined as the number of self-reported previous skin cancers, and experience with sun damage as how many months ago they experienced their last peeling sunburn. Sunburn arising directly from the boat trip was determined by self-report after 24 hours follow-up. Sunburn was defined as "at least skin redness or tenderness after 24 hours". Body site of the sunburn was also determined.

A time scale was used to obtain data on sun exposure during the boat trip, which allowed the investigation of both the time spent in the sun in total, and during the peak UVR period around midday. Recent sun exposure was assessed by asking frequency of boat trips, and hours of sun exposure on a typical workday in the previous week. Participant's beliefs relating to sun exposure and sun damage were assessed by 'yes' or 'no' answers to questions about enjoyment of exposing their skin to the sun; if an occasional sunburn is an acceptable risk; if a boat canopy is adequate sun protection; and if sun reflection off the water is a "big problem".

Sun behaviours were self-assessed by asking questions about use of sun protection measures on the boat trip. A specific question asked whether or not participants wore a brimmed hat, cap, sunscreen, long-sleeved shirt and long pants. Further questions included “What types of sun protection do you leave on the boat for next time?”, “Did you use a canopy or covered area when boating today?”, and “If you used sunscreen today, how many times did you apply it?”.

2.5.3.3 Statistical Analysis: Data were coded numerically and entered into the statistical computer package for social sciences, SPSS Release 6.1.3 for Windows. Table 2.5.1 shows a complete list of the variables as they were considered for statistical analysis. Numerical variables were described as mean values and standard deviations (SD) or median values and inter-quartile ranges (IQR) depending on their distribution.

The bivariate associations between demographic variables, variables describing sun exposure, variables describing sun protective behaviour, and the participant’s experience of sunburn from the trip were assessed with Chi-squared tests, t-tests and non-parametric Wilcoxon tests, as appropriate. For the bivariate analysis, a significance level of 0.05 was assumed.

Multiple logistic regression analyses were used to identify independent predictors of sunburn arising from the boat trip and to estimate their impacts. While all variables in Table 2.5.1 were considered in multivariate logistic regression analyses, only independent 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). The model has been adjusted for the potential confounder of skin type. As the study is primarily explorative, all variables with a p-value of less than 0.10 were included in the model.

Table 2.5.1: Bivariate relationships between self-reported sunburn and demographic characteristics, sun-protective beliefs and behaviours of North Queensland recreational boat users

	Not sunburned (n = 46)	Sunburned (n = 44)	P-value
Demographics			
Age in years (mean +- SD*)	36.5 ± 11.6	36.7 ± 11.1	0.64
Male gender	78%	84%	0.37
I have skin type III (Fitzpatrick's classification)	35%	59%	**0.05**
I have a moderate suntan level	33%	57%	0.14
I have had a previously diagnosed skin cancer	24%	27%	0.23
I went out on a sailboat	22%	43%	0.39
Sun exposure			
Years of life spent in the tropics (median, IQR)	13 (6-26)	14 (6-30)	0.49
Hours spent in the sun during the boat trip	5.0 ± 1.9	5.8 ± 1.4	0.83
Hours spent boating between 10am and 2pm:			
0 – 2 hours	33%	7%	
2.5 – 3.5 hours	20%	23%	
4 hours	48%	71%	**0.02**
"I do not spend anytime in the sun at work"	11%	32%	**0.05**
"I go boating less than once per month"	2%	16%	0.08
Months since last serious sunburn (median, IQR)	11 (2-13)	6 (1-13)	0.10
Sun protective beliefs			
"Sun reflection off the water is a problem"	98%	98%	0.76
"A canopy alone is not adequate sun protection"	77%	77%	0.56
"I enjoy exposing my skin to the sun"	33%	43%	0.59
"An occasional sunburn is an acceptable risk"	46%	50%	0.98
"I have reasons why I do not use sun protection"	35%	32%	0.29
Sun protective behaviours			
I applied sunscreen:			
20 minutes before going out in the sun	28%	39%	
Just before going out in the sun	46%	41%	
After I was in the sun for a while	26%	21%	0.30
I applied sunscreen:			
Not at all or only once	65%	37%	
Two or more times	35%	64%	0.07
I did not wear a brimmed hat	41%	63%	**0.01**
I wore a cap	26%	52%	**0.008**
I did not wear a long sleeved shirt	57%	71%	0.34
I did not wear long pants	80%	96%	0.07
I did not wear sunglasses	20%	11%	0.32
The boat I was on used a canopy	46%	61%	0.33

All results adjusted for peak hours of UVR (10am to 2pm) spent boating, and skin type.

IQR = Inter-Quartile Range.

2.5.4 Results

Quantitative data were collected via a cross-sectional survey (n=90, response rate 93%) of adults involved in recreational boating. The mean age of the participants was 36 years (SD ± 11.3), and most (81%) were male. Thirty-two percent were out on a sailing boat, while the remaining 68% were in small motorboats.

Eighty-four percent reported they used sunscreen while boating, 47% wore a brimmed hat, 35% wore a cap, 37% wore a long-sleeved shirt, and 12% wore long pants. Eighty-two percent reported they left the sunscreen on the boat for the next trip, while 17% left a brimmed hat and 4% left a long-sleeved shirt.

At follow-up, it was identified that 48% of participants had experienced sunburn as a result of the boat trip. Of the 48% who experienced sunburn, 57% developed sunburn on the face, 43% on the V of the neck, 43% on the legs, 27% on the forearms and 18% on the hands.

Sunburn as a result of the boat trip was associated with going out for more than two hours between 10am and 2pm ($p = 0.02$), not spending anytime in the sun at work ($p = 0.05$), going out on a boat less than once a month ($p = 0.08$), having a medium skin type ($p = 0.05$), having a moderate suntan level ($p = 0.14$), applying sunscreen two or more times ($p = 0.07$), not wearing a brimmed hat ($p = 0.01$), wearing a cap ($p = 0.008$), and not wearing long pants ($p = 0.07$). All results have been adjusted for skin type, and time spent boating between the peak UVR hours of 10am to 2pm. The bivariate analysis is summarised in Table 2.5.1.

Multivariate logistic regression analysis identified the strongest predictors of sunburn on the boat trip were not wearing a wide-brimmed hat (POR = 4.0), and spending longer time boating during 10am and 2pm (POR = 4.6 for 2.5 to 3.5 hours, and POR = 5.9 for 4 hours, respectively).

Multivariate analysis identified the other predictor of sunburn as those who went out on a boat less than once a month (POR = 10.7), though caution must be used in the interpretation of this result due to low numbers in the analysis.

As this was an exploratory study, the borderline significant variable "spend less than one hour in the sun on a typical workday" (POR = 3.2) was also included in the model. This model has also been adjusted for the potential confounder of skin type. The multivariate analysis is summarised in Table 2.5.2.

Table 2.5.2: Multivariate predictors of sunburn in North Queensland recreational boat users

Predictors	Sample (n = 90)	Sunburned (%)	POR [95%-C.I.]*	P-value
Time spent boating during the peak UV hours of 10am to 2pm				**0.013**
0 – 2 hours	18	17%	1	
2.5 – 3.5 hours	19	53%	4.6 [0.8-25.5]	
4 hours	53	59%	5.9 [1.3-27.1]	
I wore a brimmed hat on the trip				**0.008**
Yes	43	35%	1	
No	47	62%	4.0 [1.4-11.0]	
I go boating less than once a month				**0.04**
No	82	45%	1	
Yes	8	88%	10.7 [1.1-88.9]	
I work less than one hour in the sun each day				**0.08**
No	72	43%	1	
Yes	18	72%	3.2 [0.9-11.7]	
Self-reported skin type (Fitzpatrick's)				0.30
Skin type I or II	26	39%	1	
Skin type III	42	62%	2.9 [0.9-9.5]	
Skin type IV	22	36%	1.7 [0.4-7.2]	

* POR [95%-C.I.] = Prevalence Odds Ratio [95%-Confidence Interval]. The model includes skin type to adjust for the possible effects of confounding.

2.5.5 Limitations of the study

The present study may have several limitations. While the response rate was high, data collection occurred at only four of the seven boat ramps around Townsville, which may have resulted in possible selection bias for motorboat users. However, a selection bias for sailing boat users is unlikely, as only one sailing club operates in the Townsville area, and most members participated. Recall bias would be minimal, as sun protection and sun behaviour information was obtained immediately after participants returned from the boat trip and then followed up the next day, except for four participants who were followed up on the second post-trip day. Misinformation bias is unlikely to significantly affect the study, as almost half the respondents reported experiencing sunburn and using less than optimal sun protection. If anything, prevalence of sunburn is likely to be under-reported.

2.5.6 Discussion

This is the first study to examine sun damage arising from recreational boating; a common activity in many regions with Caucasian populations susceptible to skin cancer. This study found almost half the boat users experienced sunburn after their day out on the water. This sunburn was found to be a direct result of people not using optimal sun protection between the hours 10am to 2pm, in particular, a wide-brimmed hat. Other factors associated with sunburn were limited experience of high UVR conditions, that is, people who do not work outdoors or only infrequently go boating, and having a Fitzpatrick's skin type III.

The prevalence of sunburn in the present study is significantly higher than in a New Zealand study[12] of recreational sun damage, which found 17% of adult subjects reported sunburn after participating in outdoor activities the previous weekend. The much higher prevalence of sunburn in this study in North Queensland is more likely to be due to higher levels of exposure to UVR in the middle of the day that occur in the tropics due to the latitude difference between the two places, as more than double the percentage of participants in the present study used sunscreen and wore a hat, compared to the New Zealand study. The cooler climate of New Zealand may also encourage a greater use of long-sleeved clothing than in North Queensland, but unfortunately, the New Zealand study did not record clothing type.

The present study provides evidence that recreational boat users in North Queensland do not optimally protect themselves from the sun during high UVR activities, and that this makes sunburn more likely on all body parts. The face and V of the neck areas were found to be particularly susceptible, reflecting the higher vulnerability of the face to develop sunburn than the arms and legs,[5] but the leg was also a common location for sunburn. Sunburn is a likely consequence of both overhead and water-reflected UVR striking unprotected body parts.

With respect to sun protective activity, this study suggests that wearing a brimmed hat will significantly reduce the chance of sunburn while boating, while wearing a cap significantly increases risk. This is supported by a previous study, which found baseball style caps only offer good protection to the nose, while-brimmed hats (brim wider than 7.5 cm) provide sufficient protection for the nose, cheeks and back of the neck.[13]

Optimal sun protection in NQ over the summer months needs to include a combination of practices: a brimmed hat, long-sleeved shirt, long pants and applying (and re-applying) sunscreen regularly to the remaining sun exposed areas on the face and hands. This is the sun protection message given for many years in the Australian media. It appears, however, that many people in NQ who participate in recreational sun activities are blasé about the necessity of using such a combination of protective measures to prevent sunburn.

Half the participants reported they wore a wide-brimmed hat and only one third wore a long-sleeved shirt, while over half commented that occasional sunburns are an acceptable risk. Significantly, while nearly all reported they used sunscreen at least once, there was a non-significant trend for those who re-applied sunscreen to develop sunburn. Therefore, it is possible that participants over-relied on sunscreen to protect the face, legs and arms. Cummings et al. (1997), have previously shown that using only one sun protection behaviour does not provide adequate protection,[10] while other studies show an association between the sole use of sunscreen for protection and the development of both sunburn and naevi.[14-15]

The present study suggests that an individual's previous experience with the tropical midday sun had a significant influence on how they protect themselves. Boating less than once a month and working little or no time outdoors were both associated with risk of sunburn. This suggests that individuals who lack regular experience of the peak midday hours do not adequately protect themselves by using wide-brimmed hats and long-sleeved shirts together with sunscreen because it is not a habit borne of experience, or simply may not expect to develop sunburn in the time they are out in the sun.

One reason individuals may not expect to sunburn in the time they are out in the sun could be related to the fact they interpret their skin type incorrectly as burning less easily and tanning better than they really do. Studies have shown that almost 40% of the population in North Queensland overestimate their skin pigmentation and, therefore, may underestimate their risk of sunburn.[16] Sunburn is a likely outcome if this misconception occurs during a recreational activity that involves extreme UVR levels over several hours.

The present study found those most likely to sunburn self-reported a skin type III. Regular experience would likely have taught those with lighter skin types (I and II) to well protect themselves with clothing and sunscreen because they easily burn if they do not, while those with the darkest skin (type IV) can afford to be less diligent in their sun protection because they have a naturally high level of protection from sunburn. Participants with skin type III, however, appear to be unrealistically optimistic about the tanning ability of their skin, and may not feel they need to use adequate sun protection. Supporting this, a previous NQ study identified men with light skin types I and II to be significantly more likely to use all methods of sun protection than those with darker skin types III and IV.[17] Another possibility is that participants with darker skin types have pro-tan attitudes, and therefore, a lower motivation to protect themselves from sunburn in the first place.

The implications of this study are that there are unacceptably high levels of sunburn occurring in NQ boat users, usually as a result of inadequate sun protection between 10am and 2pm. Recreational boat users need to be educated to wear a brimmed hat, a collared, long-sleeved shirt buttoned up at the throat, and sunscreen on all exposed body parts; in particular, on the face and V of the neck. Boat users with less personal experience with the tropical sun should be targeted in the education; in particular, on those who do not work in the sun, those who do not go boating regularly, and those who rely on their skin type to prevent sunburn. It should also be made very clear in the education that sunscreen is used only on the face and other areas that cannot be covered by clothing, rather than as the primary method of sun protection.

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2.6 Sun protection attitudes and behaviours within northern Australian recreational peer groups

Published as:

Woolley T, Buettner P. Similarity of sun protection attitudes and behaviours within north Queensland peer groups. Health Promotion Journal of Australia 2009; 20(2):107-111.

2.6.1 Abstract

Issue addressed: The study investigates whether the perceived sun protective practices of the peer group during a day-time recreational boat trip were associated with the sun protective attitudes and behaviours of individuals on the same boat.

Methods: Cross-sectional survey of recreational boat users conducted in Townsville, North Queensland, during the summer of 2003. One hundred and twenty-four out of 134 boat users returning from a day trip agreed to participate, with 10 later excluded from analysis due to either being the sole person on the boat or because they were in the sun for less than an hour between 9 am and 3 pm (n=114, response rate=92%).

Results: The more positively respondents perceived the sun protective behaviours of other people on the boat, the more likely they were to report that they: did not enjoy exposing their unprotected skin to the sun (p=0.004); believed an occasional sunburn is not an acceptable risk (p=0.006); wore sunglasses on the trip (p=0.002); wore a wide-brimmed hat together with a long-sleeved shirt and sunscreen (p=0.006), and; they did not report reasons for neglecting to use sun protection (p=0.019).

Conclusions: The perceived sun protection practices of the peer group majority were significantly associated with the sun protection practices of the observer.

So what? Educating North Queenslanders about avoiding UVR-induced skin damage from social recreational sun activities should involve adapting sun protection messages to target peer and family social networks, and identifying peer leaders who can be used to model recommended sun protective practices.

2.6.2 Introduction

Excessive exposure to ultra-violet radiation (UVR) significantly increases an individual's risk for developing both melanoma and non-melanoma skin cancer (NMSC).[1-4] Reported incidence rates of skin cancer are amongst the highest in the world in North Queensland (NQ), Australia.[5-6] These high rates of skin cancer can be at least partly explained by the high risk environment. NQ is located in the tropics of Australia, and throughout most of the year it has extreme levels of solar UVR combined with cloudless and relatively unpolluted skies. Further, the predominantly Caucasian population has a genetic disposition to skin cancer,[7] and a culture of enjoying recreational activities based around water or the beach; activities shown to be high risk for later development of skin cancer.[8]

During these activities, North Queenslanders should adequately protect themselves from the sun because of the extreme levels of overhead and water-reflected UVR. Since the 1980s, the Australian "SunSmart" campaign has suggested an "optimal" sun protection strategy of covering up exposed skin areas through the use of wide-brimmed hats and protective clothing with long sleeves and collar; and for those areas of the skin not adequately covered, using a waterproof, broad-spectrum sunscreen with a sun protection factor of at least fifteen,[9] which should be re-applied every two hours, or more frequently if perspiring or swimming.[10] More recently, these messages have been altered to also include the wearing of sunglasses.[11]

Many factors are known to influence an individual's use of 'optimal' sun protection; including season, comfort, convenience, social norms, planning and personal attitudes.[12] Influence of peers and family on the sun exposure (sunbathing) habits of teenagers and adults has also been documented.[13,14] Bandura proposes that the social environment has a significant effect on the way people behave, with most human behaviour being learned from observing others – through noting other people's attitudes, behaviours and the outcomes of those behaviours.[15] Specifically, this Social Learning Theory proposes that if individuals observe a positive, desired outcome with the observed behaviour (e.g., other people avoiding sunburn by using sun protection), then they are more likely to imitate and adopt the behaviour themselves.

In addition, Bandura expanded in Social Learning Theory to suggest that learning will most likely occur if there is a close identification between the observer and the model; with identification allowing the observer to feel a one-to-one connection with the individual being imitated.[16] Supporting this, recent evidence has shown that the influence of an individual's close circle of friends is a significant factor in health-related attitudes, and other studies have suggested that people generally adopt the attitudes of valued peers.[17,18] As people are likely to go recreational boating with their more immediate friends and family, it is possible that this social environment may be influencing the sun-related attitudes and behaviours of individuals.

The present study sought to identify whether the observed sun protective behaviours of the majority of other people on a recreational boating trip were associated with the sun-related attitudes and behaviours of the observer. This information may be applied to more targeted sun protection campaigns based on family or peer social networks.

2.6.3 Methods

2.6.3.1 Participants: The study had a cross-sectional design with a prospective 24-hour follow up. Data were collected first by a face-to-face verbally administered questionnaire, then later by telephone after 24 hours. The survey was conducted in the city of Townsville, NQ (latitude 19°S, population 127,000) on three separate warm (>30°C) and sunny Sundays between February and March 2003. During a typical Townsville sunny summer's day, measured UVB peaks in the middle of the day, but levels are at least 1 Standard Erythemal Dose (SED) between the hours 9am to 3pm.[7] The SED is the proposed 'measure' for erythemally-effective UVR exposure (equivalent to 100 J m^{-2} of erythemally-weighted irradiance), and is a standard measure that can be used for all individuals, regardless of skin type. [19]

The study population was adults (≥ 18 years) who had undertaken a recreational boat trip; only adults were invited to participate because of issues with obtaining consent from minors and the potential influence of parents on the sun protection practices of minors. Participants were approached after docking their boat at either the Townsville Sailing Club, or boat ramps at the Townsville Breakwater, South Townsville National Park, Bohle or Giru. Recruitment occurred between the hours 11am to 5pm, allowing participants to experience at least one hour in the sun between 9am to 3pm – the extreme period for UVR during the NQ summer.[7]

Of 134 boat users approached, 124 consented to participate. While all adults in a boat were invited to participate, on 83% of occasions data were obtained from only one member of the boating party, as usually the other person(s) was involved in placing the boat on their trailer and driving it from the busy boat ramp area. All but six returning boats that were approached had at least two persons in the boat; those six persons who were boating by themselves were asked to fill out the survey, but were not included in the bivariate analyses. A further four persons reported that they had not spent any time boating between the hours 9 am to 3 pm; these participants were later removed from the database. This resulted in a sample population of 114 participants for the bivariate analysis, with a response rate of 92%. Ethical approval for the study was obtained from the James Cook University Ethics Committee, number H1334 (see Appendix 3 for a copy of the approval letter).

2.6.3.2 Questionnaire: Demographic questions included age, gender, and total years of life-time spent in NQ. Skin type, an index of sun-sensitivity representing the propensity to sunburn, was self-assessed according to Fitzpatrick's classification (scale I to IV from most sun sensitive to least sun sensitive Caucasian skin).[20] Respondents also self-assessed the suntan level on their face by choosing from one of five categories: very light, light, moderate, dark or very dark.

With regard to the dependent variable, participants were asked to categorise how well the majority of other people on the boat protected themselves from the sun on the boat trip into either "poor", "OK" or "good" use of sun protection. No definitions were included to assist participants in categorising other people's sun protection practices into "poor", OK" or "good", as accurate definitions would vary based on the time the boat was out on the water, how many times people re-applied sunscreen, if long-sleeved shirts were rolled up on the forearms, if their hat brim was more or less than 7 centimetres, how long sun protection was actually used, etc. However, this question followed immediately after the sun behaviour question listing all recommended sun protection practices, which should have assisted participants in making a more informed judgment.

Personal sun behaviours were self-assessed by questions to participants about their sun protection measures used. Specific questions asked whether or not participants used the following sun protective measures on the boat trip: a wide-brimmed hat, long-sleeved shirt, sunglasses and long pants; a 'yes' or 'no' response was obtained for each measure respectively. Three further questions then asked: if they applied sunscreen on the boat trip ('yes' or 'no' response) and if yes how many times; whether there was a canopy or covered area in use on the boat, and; if participants had any reasons why they did not use sun protection (if reasons were given, these were later dichotomised into a 'yes' or 'no' response).

Experience with skin cancer was determined as the number of self-reported previous skin cancers. Sunburn arising directly from the boat trip was determined by self-report after 24 to 48 hours through telephone follow-up, as all participants were asked to provide a first name and contact telephone number. Sunburn was defined as “at least skin redness or tenderness after 24 hours”.

A time scale was used to obtain data on sun exposure during the boat trip, which allowed the investigation of both the total time in the sun, and time during peak UVR hours between 9am to 3pm. Recent sun exposure was assessed by asking frequency of boat trips and hours of sun exposure on a typical workday in the previous week. Participant’s beliefs relating to sun exposure and sun damage were assessed by ‘yes’ or ‘no’ answers to questions about: enjoyment of exposing their skin to the sun; if an occasional sunburn is an acceptable risk; if a boat canopy is adequate sun protection, and; if sun reflection off the water is a “big problem”.

While the questionnaire was not validated for the present study, a very similar questionnaire was piloted with 81 recreational boat users as part of a small undergraduate student project investigating sunburn incidence the year previously. Further, many of the measures relating to sun protection, sun exposure, sun damage and demographics used in the present questionnaire were borrowed from a previous skin cancer survey administered by the authors to NQ men with a histologically diagnosed NMSC.[21]

As part of the validation process for this previous survey, five men from the target population were interviewed to ensure the phrasing and terminology of each question was well understood and questions were answered as intended, and analysis of a pilot study involving 30 participants showed at least moderate agreement for most items.

2.6.3.3 Statistical Analysis: Data were coded numerically and entered into SPSS release 14 for Windows. Table 2.6.1 shows a complete list of the variables as they were considered for statistical analysis. Numerical variables were described as mean values and standard deviations (SD) or median values and inter-quartile ranges (IQR) depending on their distribution.

The bivariate associations between demographic variables, variables describing sun exposure, variables describing sun protective attitudes and behaviour, and how the respondent reported the sun protection behaviours of other people on the boat, were assessed with Chi-squared tests for trend, unpaired ANOVA and non-parametric Kruskal-Wallis tests, as appropriate. P-values were adjusted for the confounding effects of age and skin type and for the effect of cluster sampling (primary sampling unit = boat). The multivariate adjustment was conducted using the survey commands of STATA (STATA cooperation, College Station, Texas, USA), release 8.

2.6.4 Results

A total of 119 (response rate 92%) NQ adults involved in recreational boating participated in the study. The mean age of the participants was 36.0 years (SD ± 11.1), and most (78.9%) were male. Almost thirty percent (28.1%) were out on a sailing boat, while the remaining 71.9% were in small motorboats. Almost twenty percent (18.4%) of participants reported having a dark tan. Overall, 84.2% reported that they used sunscreen while boating, 50.9% wore a wide-brimmed hat, 33.3% wore a long-sleeved shirt, 85.1% wore sunglasses, 12.3% wore long pants, and 18.4% wore the recommended sun protection combination of a long-sleeved shirt, wide-brimmed hat and sunscreen.

Table 2.6.1: Bivariate relationships between how North Queensland recreational boat users (n=114) reported the sun protection behaviours of fellow boaters on the same boat, and their own sun behaviours, sun exposure and attitudes.

	Other people's sun protection was "poor" (n = 46)	Other people's sun protection was "OK" (n = 48)	Other people's sun protection was "good" (n = 20)	P-value#	P-value adjusted##
Demographics					
My age in years (mean ± SD*)	35.5 ± 10.6	35.0 ± 10.4	39.3 ± 13.2	0.320	0.375
My gender is male	78.3%	79.2%	80.0%	0.877	0.982
I have skin type I or II (Fitzpatrick's classification)	39.1%	29.2%	35.0%	0.591	0.575
I have a "dark" suntan level	28.3%	10.4%	15.0%	0.098	0.084
I have had a previously diagnosed skin cancer	10.9%	25.0%	25.0%	0.106	0.225
Median number of previously diagnosed skin cancers (IQR)**	0 (0, 0); range 0-8	0 (0, 0.75); range 0-10	0 (0, 0.75); range 0-4	0.164	0.520
Median years spent living in tropics (IQR)	13.5 (6.0, 26.5)	12.5 (4.25, 26.75)	25.5 (11.0, 36.75)	0.051	0.053
Sun exposure					
Median hours spent in the sun on this boat trip (IQR)	5.0 (3.5, 6.0)	4.5 (3.1, 5.9)	3.3 (3.0, 5.1)	0.089	0.107
Median hours I typically spend in the sun at work (IQR)	2.0 (0.5, 8.0)	2.0 (1.0, 5.0)	4.0 (1.0, 7.75)	0.809	0.636
Median number of times I go boating per month (IQR)	2.0 (1.0, 4.25)	4.0 (1.0, 4.0)	2.5 (1.0, 4.75)	0.761	0.796
I experienced sunburn as a result of the boat trip today	51.4%	47.5%	58.3%	0.878	0.956
Sun protective attitudes					
"Sun reflection off the water is a big problem"	97.8%	95.8%	100%	1.000	0.974
"A canopy alone is <u>not</u> adequate sun protection"	69.8%	72.3%	80.0%	0.466	0.525
"I do <u>not</u> enjoy exposing my skin to the sun"	50.0%	68.8%	90.0%	**0.006**	**0.004**
"An occasional sunburn is <u>not</u> an acceptable risk"	39.1%	64.6%	70.0%	**0.002**	**0.006**
Sun protective behaviours on the boat trip					
I wore a wide brimmed hat today	45.7%	43.8%	80.0%	**0.039**	0.059
I wore a long sleeved shirt today	23.9%	31.3%	60.0%	**0.009**	**0.046**
I applied sunscreen today	73.9%	89.6%	95.0%	**0.002**	**0.008**
I wore a brimmed hat + long sleeved shirt + sunscreen	8.7%	14.6%	50.0%	**<0.001**	**0.006**
I wore sunglasses today	71.7%	91.7%	100.0%	**0.001**	**0.002**
I wore long pants today	10.9%	10.4%	20.0%	0.437	0.539
Median number of times I re-applied sunscreen today (IQR)	1.0 (0.75, 2.0)	1.0 (1.0, 2.0)	2 (1.0, 2.0)	0.454	0.251
The boat I was on used a canopy today	41.3%	37.5%	60.0%	0.301	0.473
I had reasons why I did not use sun protection today	41.3%	37.5%	5.0%	**0.013**	**0.019**

*SD = Standard deviation; **IQR = Inter-quartile range; #Chi-square test for trend for comparisons of percentages; ##p-values adjusted for cluster sampling (demographics) and cluster sampling, age and skin type (sun exposure and sun protective attitudes and behaviours).

Overall, 40.4% of participants reported that they perceived the sun protective behaviours of others on the boat as “poor”, 42.1% as “OK”, and 17.5% as “good”. The more positively the respondents perceived the sun protective behaviours of other people on the boat, the more likely they were themselves to report that they did not enjoy exposing their unprotected skin to the sun (p=0.004), did not consider an occasional sunburn is an acceptable risk (p=0.006), to wear sunglasses on the trip (p=0.002), to wear a wide-brimmed hat together with a long-sleeved shirt and sunscreen (p=0.006), and not report barriers to sun protection (p=0.019) (Table 2.6.1).

2.6.5 Limitations of the study

The present study has several limitations. The sun protection practices of the individual who participated in the study and of their peers on the boat were subjectively assessed, and as a consequence, the resulting relationships between these two groups might be over-estimated.

In addition, generally only one of the peer group members per boat was interviewed; for a full understanding of the peer group, each member of the group may need to have been interviewed, though this would have been time-consuming, required more interviewers and a different timing of the interviews. Future studies are needed to confirm the suggested relationships of the present study. Finally, caution is required for application of these findings to a wider audience; boaters were mostly male, and it is uncertain whether these findings are applicable to a predominantly female recreation group.

Notwithstanding these limitations, selection bias for both sailing-boat and motor-boat users was unlikely; only one sailing club operates in Townsville and most members participated, and data were collected from all four major motor-boat ramps within 50 kilometres of the Townsville city. Furthermore, recall bias would likely be minimal, as sun protection and sun behaviour information was obtained immediately after participants returned from the boat trip. Misinformation bias is also unlikely to significantly affect the study, as almost half the respondents reported using less than optimal sun protection, about half reported experiencing sunburn as a result of the trip, and about 40% reported that other people in their boat generally used “poor” sun protection practices.

2.6.6 Discussion

The present study provides evidence that the social environment during recreational boating trips, likely based around family or peer group friendships, is associated with an individual’s sun-related attitudes and behaviours. An individual’s decision to engage in particular behaviours has long been known to be associated with the social environment.[15] People tend to form friendships with others who exhibit similar behaviours, attitudes or mode of dress; in turn, the peer group will also influence member’s attitudes, behaviours and mode of dress.[22] As three or four people together are generally enough to produce very strong real or imagined peer pressure effects from the social group,[23] it is feasible that the social environment on small boats, which consisted of between two to four people in the present study, was having an influence on people’s sun-related attitudes and behaviours.

Association should never be confused with causality, but if the results of this study are reflective of an underlying relationship between friendships and sun-related attitudes and behaviours, then they might also be used to improve sun protective behaviours. For example, the delivery of sun protection messages or health promotion initiatives could be adapted to include group efforts aimed at peer and family social networks. In addition, new intervention strategies that identify and involve ‘peer leaders’ to model optimal sun protection behaviours might lead to better sun protective behaviours by the peer group, as the social environment is known to reinforce the adoption of new behaviours.[15]

An appropriate person to be used as a ‘peer leader’ with respect to improving sun behaviours on recreational boat trips may be the owner of the boat, as they are more easily identifiable and go out every time. People with previously diagnosed skin cancer might also be good peer leaders for a sun protection intervention. If the boat owner or other appropriate peer leaders can be educated to be more concerned about skin cancer, wear recommended sun protection, remind others to bring sun protection for the trip, and keep sunscreen and spare brimmed hats and long-sleeved shirts on the boat, then perhaps others on the boat may become more concerned about better protecting themselves, and maintaining these practices over time.

The social environment has already been used successfully in various health promotion efforts to improve the health behaviours of individuals: spreading health-promoting behaviours amongst older persons,[24] increasing the fruit and vegetable intake of children,[25] improving worker’s use of personal protective equipment,[26] and getting people to quit smoking.[27] Use of peer leaders has also been shown to be effective for skin cancer prevention, at least in the short-term, in another high-risk, recreational setting in the United States.[28] Use of recommended sun protection was increased by patrons attending public swimming pools through a multi-component intervention using peer leaders (lifeguards), skin cancer education and distribution of free sunscreen; though frequency of protective behaviours had started to decline by the end of the one-month intervention.[28]

While the authors acknowledge that using peer leaders and adapting sun protection messages or skin cancer health promotion initiatives to target peer and family social networks is a new approach and would likely require significant resources, given the high incidence of skin cancer in NQ, these results at least provide an interesting alternative foundation for addressing this important public health issue.

In conclusion, educating North Queenslanders about avoiding UVR-induced skin damage as a result of participating in social recreational sun activities should involve adapting sun protection messages to target peer and family social networks, and identifying peer leaders who can be used to model recommended sun protective practices.

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2.7 Sun protective behaviours amongst recreational boaters in northern Australia: Associations with personal experience of skin cancer

Accepted by the Journal of Rural and Tropical Public Health, November 2009.

2.7.1 Abstract

Objective: To identify whether personal experience of skin cancer in people who regularly participate in recreational boating is associated with their level of midday sun exposure, current sun protective behaviours and sun-induced skin damage.

Methods: Cross-sectional survey with 24-hour follow-up of recreational boat users who regularly go boating between 9am and 3pm. The study was conducted in Townsville, North Queensland (latitude 19°S), during the summer of 2003. Of the 134 boat users approached, 124 consented to participate, with 5 later excluded from analysis (n=119, response rate=92%).

Results: In comparison to people reporting no personal experience of skin cancer, people with personal experience of skin cancer were more likely to: (1) report spending fewer hours on the boat between 9am to 3pm (p=0.010), (2) report using a canopy during the boat trip (p=0.038), (3) report wearing sunglasses (p=0.013), and (4) spend more than one hour in the sun on a typical workday (p=0.059). People who reported having previous skin cancer were no more likely to use personal sun protection or have a lighter tan, and no less likely to experience sunburn from the boat trip, than people not having skin cancer.

Conclusions: During recreational boating, people reporting a previous skin cancer were more likely to use a shade structure and spend less time in the sun during peak UVR hours (particularly those who typically work indoors), but not to use any more individual sun protection practices excepting sunglasses, than people not having skin cancer.

2.7.2 Background

Exposure to ultra-violet radiation (UVR) from the sun is regarded as the major environmental risk factor for squamous cell carcinoma (SCC), basal cell carcinoma (BCC) and cutaneous melanoma.[1-4] Specifically, intense, intermittent sun exposures (peeling sunburn) in childhood and adulthood appear to significantly contribute to the development of melanoma,[3-6] while cumulative sun exposure (long-term outdoor working and sun-tanning) appears responsible for the development of SCC, [2,7,10,11] and mixed effects of cumulative and intermittent sun exposure seem to account for the development of BCC.[2,8,9,11]

Cumulative and intermittent sun damage is thought to significantly decrease the ability of the skin's immune system to repair chromosomal damage and detect and destroy potential cancerous cells. [12,13,14]

The Cancer Council of Queensland currently endorses six strategies to reduce cumulative and intermittent sun damage including: minimising time spent in the sun between 10am and 3pm; seeking shade; wearing suitable clothing that provides good sun protection; choosing a broad brim, legionnaire-style or bucket-style hat that protects the face, neck and ears; wearing sunglasses; and applying SPF 30+ broad spectrum, water-resistant sunscreen 20 minutes before going out into the sun.[15]

This North Queensland (NQ) study sought to identify whether personal experience of skin cancer is associated with the sun protective behaviours and cumulative and intermittent skin damage (suntan level and sunburn) of people who regularly participate in recreational boating.

2.7.3 Methodology

2.7.3.1 Participants: The study had a cross-sectional design with a 24-hour follow up. Data were collected first by a researcher-administered questionnaire, then by telephone 24 hours later. The survey was conducted in the city of Townsville, NQ (latitude 19°S, population 127,000) on three separate warm (above 30°C) and sunny Sundays between February and March 2003. The study population was adults (aged 18 years or older) who regularly participated in recreational boating activities (go boating at least once every two months).

Participants were approached after docking their boat at either the Townsville Sailing Club, or boat ramps at the Townsville Breakwater, South Townsville National Park, Bohle or Giru. Recruitment occurred between the hours 11am to 5pm, so participants could potentially have spent at least one hour in the sun between 9am to 3pm – the extreme period for UVR during a North Queensland summer.[16] On a typical Townsville summer day, UV-B peaks around midday, but levels are at least 1 Standard Erythemal Dose (SED) between the hours of 9am to 3pm.[16] The SED is the proposed 'measure' for erythemally-effective UVR exposure (equivalent to 100 J m^{-2} of erythemally-weighted irradiance), and is a standard measure that can be used for all individuals, regardless of skin type.[17] An exposure of approximately 1.5 SED will just redden the skin of a sun-sensitive person who never tans (Fitzpatrick skin type I).[17]

Of 134 boat users approached, 124 consented to participate. While all adults in a boat were invited to participate, in most instances (83%) it was only possible to obtain data from one member of the boating party, as the others were involved in attending to the docking of the boat. The data from 5 participants were excluded from the analyses because they either did not fulfil the study criteria of boating at least once every two months (1 participant) or spending any time boating between the hours 9am to 3pm (4 participants). The final sample population was 119 participants (response rate 92%).

Approval for the study was obtained from the James Cook University Ethics Committee, number H1334 (see Appendix 3 for a copy of the approval letter).

2.7.3.2 Questionnaire: Demographic questions included age, gender, and total number of years spent in NQ. Participants self-assessed their skin type according to Fitzpatrick's classification: an index of sun-sensitivity representing the propensity to sunburn, scale I to IV from most sun sensitive to least sun sensitive Caucasian skin.[18] Respondents assigned the current suntan level on their face to one of five categories: very light, light, moderate, dark or very dark.

Each participant was asked about their personal history of skin cancer; this data was then dichotomised into the dependent variable: "have/have not experienced a skin cancer". Participants were also asked if they were currently employed and, if so, how many hours they work in the sun on a typical workday. Specific questions asked whether or not participants used a canopy or covered area on the boat; and whether or not they used the following sun protective measures on the trip: sunscreen; wide-brimmed hat; narrow-brimmed hat; cap; long-sleeved shirt; sunglasses; long pants or "other" (open-ended so respondents can report use of less common measures such as legionnaire-style hats or sun-gloves). At analysis, those people who reported having one or more personal barriers and those people who reported having no personal barriers were dichotomised into a 'yes' or 'no' category for the variable "I had reasons why I did not use sun protection".

A time scale was used to obtain data on sun exposure during the boat trip, which allowed the investigation of both the total time in the sun, and time during peak UVR hours between 9am and 3pm. Recent sun exposure was assessed by asking frequency of boat trips and hours of sun exposure on a typical workday in the previous week. Participant's beliefs about sun exposure and sun damage were assessed by ‘yes’ or ‘no’ answers to the following questions: enjoyment of exposing their skin to the sun; if an occasional sunburn was an acceptable risk; if a boat canopy provided adequate sun protection; and if sun reflection off the water was a “big problem”.

Sunburn arising directly from the boat trip (defined as “at least skin redness or tenderness after 24 hours”) was determined by self-report after 24 to 48 hours via telephone follow-up, as all participants were asked to provide a first name and contact telephone number. All 119 eligible participants were able to be followed up by telephone to provide the required sunburn information.

While the questionnaire was not validated for the present study, a very similar questionnaire was piloted with 81 recreational boat users as part of a small undergraduate student project investigating sunburn incidence in 2002. Further, many of the measures relating to sun protection, sun exposure, sun damage and demographics used in the present questionnaire were adapted from a previous skin cancer survey administered by the authors to NQ men with a histologically-confirmed epithelial skin cancer.[19] Validation of that survey included interviewing five men from the target population to ensure the phrasing and terminology of each question was well understood and questions were answered as intended, with analysis of the pilot study involving 30 participants showing at least moderate agreement for most items.

2.7.3.3 Statistical Analysis Data were coded numerically and entered into SPSS release 14 for Windows. Table 2.7.1 shows a complete list of the variables as they were considered for statistical analysis. Numerical variables were described as mean values and standard deviations (SD). The bivariate associations between variables describing demographics, sun exposure, and sun protective beliefs and behaviours, and the respondent’s personal history of skin cancer, were assessed with Chi-squared tests and T-tests, as appropriate. A statistical test was considered significant when the *P* value was below 0.05.

2.7.4 Results

A total of 119 (response rate 92%) NQ adults involved in regular recreational boating participated in the study. The mean age of the participants was 36.0 years (SD $\pm$ 11.1), most (78.9%) were male, almost half (49.1%) experienced sunburn as a result of the boat trip, and almost twenty percent (18.4%) of participants reported having a dark or very dark tan. Overall, 84.2% reported that they used sunscreen while boating, 50.9% wore a wide-brimmed hat, 33.3% wore a long-sleeved shirt, 85.1% wore sunglasses, 12.3% wore long pants, and 56.4% reported they spent more than one hour in the sun on a typical workday.

Of the 39 participants who reported a barrier to why they did not use personal sun protection on the day, 41% stated that "it was too hot", 21% commented that they "forgot", 21% said they did not own a long-sleeved shirt or wide-brimmed hat, and 15% stated that a wide-brimmed hat "blows off too easily".

Twenty-four percent of participants reported a personal experience of skin cancer. In comparison to people with no experience of skin cancer, people reporting a personal experience of skin cancer were more likely to: (1) report spending fewer hours on the boat between 9 am and 3pm (p=0.010); (2) report using a canopy during the boat trip (p=0.038); (3) report wearing sunglasses (p=0.013); and (4) spend more than one hour in the sun on a typical workday (p=0.059). People reporting previous skin cancer were no more likely to use personal sun protection or have a lighter tan, eand no less likely to xperience sunburn from the boat trip, than people without previous skin cancer (Table 2.7.1).

Statistical analysis found no significant age-related differences in sun exposure or sun protective behaviours. However, stratification of the data found indoor workers with previous skin cancer, compared to outdoor workers with previous skin cancer, were more likely to use a canopy (88% versus 50%) and report personal barriers to using sun protection (85% versus 63%), respectively.

Table 2.7.1: Bivariate relationships between self-reported previous experience of skin cancer and sun exposure, sunburn and current sun protective behaviours during a recreational boat trip. Results are based on 119 regular recreational boat users resident in North Queensland.

	No history of skin cancer (n = 91)	History of skin cancer (n = 28)	*P*-value
Demographics			
My age in years (mean ± SD*)	35.3 ± 10.7	39.9 ± 12.6	0.064
My gender is male	78%	86%	0.775
I have skin type I or II (Fitzpatrick classification)	32%	34%	0.851
I have a “dark” or “very dark” suntan level	18%	29%	0.205
I work more than 1 hour in the sun on a typical workday	51%	71%	**0.059**
Years spent living in tropics (mean ± SD*)	18.7 (13.7)	20.3 (17.4)	0.611
Sun exposure			
Hours spent in the sun on this boat trip between 9am to 3pm (mean ± SD*)	4.4 ± 1.5	3.5 ± 1.4	**0.010**
I experienced sunburn as a result of the boat trip	52%	48%	0.718
Sun protective beliefs			
“Sun reflection off the water is a big problem”	97%	100%	0.330
“A canopy alone is not adequate sun protection”	72%	79%	0.519
“I do not enjoy exposing my skin to the sun”	65%	68%	0.769
“An occasional sunburn is not an acceptable risk”	52%	64%	0.240
Sun protective behaviours on the boat trip			
I wore a wide brimmed hat today	47%	57%	0.360
I wore a long sleeved shirt today	34%	39%	0.613
I applied sunscreen today	85%	79%	0.465
I wore sunglasses today	81%	100%	**0.013**
I wore long pants today	11%	18%	0.338
The boat I was on used a canopy today	39%	61%	**0.038**
I had reasons why I did not use sun protection	35%	21%	0.173

*SD = Standard deviation

2.7.5 Limitations to the study

It must be noted, however, that the present study has several limitations. The prior experience of skin cancer, suntan level, skin type and working status of the individuals who participated in the study were self-reported, and as a consequence, misclassification bias is possible with respect to these variables. Notwithstanding this limitation, selection bias for both sailing-boat and motor-boat users was unlikely; only one sailing club operates in Townsville and most members participated, and data were collected from all four major motor-boat ramps within 50 kilometres of Townsville city.

Furthermore, recall bias would likely be minimal, as sun protection and sun behaviour information was obtained as participants returned from the boat trip. As almost half the respondents reported using less than optimal sun protection and about half reported experiencing sunburn as a result of the boat trip, misinformation bias from participants providing more "acceptable" responses about their sun protection practices and sun damage is likely to be minimal.

2.7.6 Discussion

This study shows that participants with a history of skin cancer were more likely to use a boat canopy and sunglasses and decrease the length of time they spent out on the water during peak UVR hours. However, they were no more likely to use other sun protective behaviours, or to limit their tan or experience of sunburn as a result of the boat trip. Almost 50% of people with previous skin cancer experienced sunburn from the boat trip, with almost one-third reporting a dark or very dark suntan level (a higher percentage than people without previous skin cancer). Furthermore, almost three-quarters were in an occupation involving significant time working in the sun. These factors have all previously been associated with a higher risk of developing BCC and SCC. [2,4,11,20,21]

People with previously treated epithelial skin cancers have increased susceptibility to developing further skin cancer.[22-25] Raasch and Buettner found a similar scenario in NQ; of 6708 patients with epithelial skin cancer, 39% developed another within a 3-year follow up period.[26] These findings suggest it is possible that the high rate of multiple skin cancers in the NQ population is at least partly the result of chronic and intermittent UVR-induced skin damage experienced during recreational and occupational activities by people who have already developed skin cancer.

In this study, people with personal experience of skin cancer were more likely to rely on shade structures (a boat canopy) and reducing time spent in the sun during peak hours for UVR, than using recommended personal protective measures of long-sleeved shirts, wide-brimmed hats and sunscreen. However, a boat canopy is unlikely to provide adequate protection from reflected UVR off seawater earlier or later in the day, when up to 60% of UVR is reflected.[27] UVR studies in a tropical setting showed that shade structures alone do not provide sufficient protection against solar radiation even on dry land.[28]

Relying predominantly on shade during high-UVR exposure activities may partly explain the high proportion of people with previous skin cancer who continue to experience episodes of sunburn. Reliance on shade rather than personal protection may be related to factors associated with boating and the tropical environment: brimmed hats tend to blow off the head more easily in a breeze than caps, and there is a common perception in NQ that long-sleeved shirts are too hot and uncomfortable to wear during the warmer months of the year.[29]

Indoor workers with previous skin cancer, compared to outdoor workers with previous skin cancer, were more likely to use a canopy and report personal barriers to using sun protection. This suggests that at least in this tropical population, those who typically spend less time in the sun tend to use shade as their primary sun protection strategy and have more personal barriers to using recommended sun protection practices. These personal barriers and preference for shade in indoor workers may help explain the less than adequate use of personal sun protection strategies (long-sleeved shirt, brimmed hat and long pants) in the overall sample of people with a previous skin cancer. Further investigation is needed to explore the barriers that indoor workers have in using personal sun protection, and their preference for shade as sun protection.

In conclusion, people with personal experience of skin cancer who participated in recreational boating were as likely to become sunburnt during the activity as people without previous skin cancer. Many people with previous skin cancer who participate in recreational boating, particularly those who work indoors, rely on shade or reducing time spent in the sun during peak UVR hours to prevent sunburn, rather than using recommended sun protective practices.

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2.8 Conclusions to Chapter 2

The different analyses of the two cross-sectional studies showed NQ outdoor working men were more likely to report previous skin cancer or skin lesions than other men. In a group of NQ men with previous skin cancer, outdoor workers with sun-sensitive skin were significantly more likely to report more previous skin lesions than indoor working men. In a group of (predominantly) men and women who regularly participated in recreational boating, those reporting a previous history of skin cancer were more likely to be those who typically worked outdoors. As well as several studies mentioned in the literature review, a recent northern European study using population-based cancer registry data has also shown outdoor workers have a significantly increased risk of BCC and SCC compared to indoor workers (Radespiel-Tröger et al., 2009).

The reason outdoor workers are at high risk of epithelial skin cancer appears to be related to their high level of sun exposure and, paradoxically, their inadequate use of personal sun protection. In the group of men with previous skin cancer, outdoor working men spent significantly more time in the sun on both work days and days off than indoor workers; however, their use of recommended sun-protective behaviours (wide-brimmed hat, long-sleeved shirt, and sunscreen) were often no better than indoor workers.

In the group of men and women who regularly participated in recreational boating, a high-UVR activity, people reporting a previous history of skin cancer experienced no less sun-induced skin damage (dark suntan level and recent sunburn) and used no more recommended sun-protective behaviours (wide-brimmed hat, long-sleeved shirt, and sunscreen) than people reporting no previous skin cancer.

Across both studies, factors associated with experiencing sunburn included: younger age; beliefs that epithelial skin cancer is caused by childhood sun exposure, and that using sun protection will not help prevent further epithelial skin cancer; wearing of casual clothes; use of shade as a person's main sun protection strategy; spending longer time outdoors between 10am – 2pm; not wearing a wide-brimmed hat; not working outdoors; and, only intermittently participating in recreational boating.

The analyses also found factors associated with men using sunscreen to be: younger age; working indoors; and, having lived most of their life in the tropics, while factors associated with men wearing a long-sleeved shirt and a wide-brimmed hat were: age over 50; the perceived sun protection practices of the peer group majority; 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; and having the beliefs that the benefits of a suntan do not outweigh the risks, and that skin cancers cannot be easily treated.

Thus, this work shows that a major group of men in NQ at high risk of developing future epithelial skin cancer is outdoor workers. It is likely that NQ outdoor workers are a high risk group because they do not always use recommended sun protection practices of a wide-brimmed hat, long-sleeved shirt and sunscreen, particularly during the peak UVR period of 10am to 2pm, which results in many men regularly experiencing at least skin redness after 24 hours and/or having a dark tan. This work also shows that many outdoor working men in NQ are also experiencing significant chronic, sun-induced skin damage from recreational activities for the same reason - not using recommended sun protective practices during the peak UVR periods.

Furthermore, whether or not these men decide to use recommended sun protective practices at work or during recreational sun activities is significantly influenced by their age, level of experience with skin lesions (epithelial skin cancer or pre-cancerous lesions), level of experience (likely painful) with the tropical sun, personal barriers, the influence of peer groups, and personal beliefs related to the causes and prevention of epithelial skin cancer. These factors are investigated in greater depth amongst NQ men, and contrasted with those of NQ women, in the following chapter.

Chapter 3

Deeper understandings of the high rates of epithelial skin cancer in North Queensland

3.1 Introduction to Chapter 3

This chapter covers an in-depth exploration of sun exposure and sun protective practices in the NQ population. This will not only provide deeper understanding of the factors associated with whether or not men choose to use sun protective measures, but will also determine the most appropriate strategy to reduce chronic, sun-induced skin damage in men who work outdoors. Reducing outdoor men's chronic sun-induced skin damage and improving their sun-protective behaviours should, over time, reduce their risk of epithelial skin cancer and, in turn, reduce the rates of skin cancer and actinic keratoses in the North Queensland population.

To determine how best to achieve these goals, a better understanding is needed of gender differences in attitudes to using sun protection. Men are known to experience significantly more sun-induced skin damage (sunburn, a chronic suntan, skin cancer) and use significantly less sun protection than women in Caucasian populations, suggesting that women have more negative attitudes to experiencing sun-induced skin damage, and more positive attitudes and fewer barriers to using sun protection.

The quantitative evidence described in Chapter 2 demonstrates that North Queensland men's attitudes and behaviours relating to the use of sun protection were influenced by a number of factors: aging; experience of sun-induced skin damage; peer groups; personal beliefs related to the causes and prevention of epithelial skin cancer; and personal barriers.

Investigating the influence of these factors on male sun protective behaviour is best achieved using a qualitative research methodology. Qualitative research methodologies are the most appropriate strategy to document and interpret the different ways in which people make sense of and respond to their experiences of health and disease, and to understand the complexity of social, psychological and environmental factors which influence health and disease. In addition, a mixed methods approach combining both quantitative and qualitative data allows researchers to both describe and understand more deeply the factors associated with a health issue and the undertaking of preventive behaviours, and also to provide appropriate solutions.

Currently, only one qualitative research study in the field of skin cancer epidemiology has been published (Gerbert et al., 1996), and while this Californian study showed the importance of psycho-social factors in whether or not people choose to undertake sun-protective behaviours, the findings are not directly applicable to the North Queensland context. Therefore, group and one-on-one interviews with northern Australian men and women were undertaken to obtain greater understanding of the social, psychological and environmental factors which influence their practice of sun-protective behaviours.

Copies of the pre-formulated questions to direct the interviews are provided in Appendix 5, while letters of support from the Main Roads Department and Q-Build are provided in Appendix 6. Participant consent forms and information sheets for this study are provided in Appendices 7 and 8, respectively.

A summary of the main results of the qualitative study are described in the "Conclusions to Chapter 3" section (page 201).

3.2 Comparing the sun-related beliefs and behaviours of men and women across age groups: A qualitative study in a tropical region

Submitted as: "Woolley TS, Buettner P. Comparing the sun-related beliefs and behaviours of men and women across age groups: A qualitative study in a tropical region" for review by the Journal of Men's Health, July 2009.

3.2.1 Abstract

Issue addressed: Gender and age differences in knowledge, beliefs, attitudes and behaviours with respect to sun exposure and sun protection.

Methods: This North Queensland (NQ) study used a qualitative, grounded approach to collate information from 42 men and 22 women in one-on-one interviews and focus groups.

Results and Discussion: Women tended to have more accurate knowledge about the causes and prevention of skin cancer than men. Women had fewer barriers to using sun protection, were more likely to habitually use sun protection, and avoided going out in the midday sun. With age, women reported more positive improvements than men. Women's main motivators for sun protective behaviour were children and vanity. Men's behaviour was formed by their social environment and peer pressure.

Conclusions: Significant differences in knowledge, attitudes and behaviours towards skin cancer prevention were found between the sexes. These differences help explain why NQ men are experiencing much higher skin cancer rates than women. Men need skin cancer messages that are factual and less emotive. NQ workplaces may potentially be important sites for promoting these messages. Workplaces also need to portray a much more serious commitment to skin cancer prevention for employees who work outdoors.

Recommendations: The findings provide the basis for developing future health promotion interventions to address this gender imbalance.

3.2.2 Introduction

Sun exposure is regarded as the major environmental risk factor for cutaneous melanoma, basal cell carcinoma (BCC) and squamous cell carcinoma (SCC).[1-4] Cumulative sun damage is considered responsible for the development of SCC,[1,2] and mixed effects of cumulative and intermittent sun damage seem to account for the development of BCC and melanoma.[1,3-6] Incidence rates of skin cancer are high in Australia as a whole and extremely high in North Queensland (NQ),[7,8] which is a likely consequence of the population consisting of predominantly white individuals susceptible to skin cancer, and a tropical location with high, year round levels of ambient ultra-violet radiation (UVR).[9]

Between 1997 and 2002, age-standardised incidence rates of BCC and SCC together rose in NQ men from 3,134 to 3,385 per 100,000, while falling in NQ women from 1,713 to 1,688 per 100,000.[7,8] NQ men have more than two times the risk of developing skin cancer than women, and are three times more likely to develop multiple skin cancer.[7] Similar trends of men having higher rates of epithelial skin cancer than women are found in all Caucasian populations.[10-14] As both gender experience the same ambient level of sunshine, gender differences in both sun exposure and sun protection practices must occur. Indeed, studies have found that men spend more time in the sun at work and during recreational activities, experience more sun-induced skin damage, and use less sun protection.[15,16] Age is a second major factor that influences sun exposure and sun protection practices. Previous studies have shown that younger persons reported more at-risk sun behaviours[17,18] and demonstrated an increased likelihood to intentionally tan.[19]

This study aimed to explore gender and age differences with respect to sun exposure and sun protection in the NQ population. Identifying gender and age related barriers and motivators will increase the potential to develop appropriately targeted sun protection messages and interventions.

3.2.3 Methods

3.2.3.1 Design: This study utilised a qualitative, grounded approach ("Grounded Theory") which allows researchers to apply theoretical understandings to the respondent's own words and thoughts.[20] Components of the Health Belief Model [21-23] (HBM), a model for predicting sun protective behaviours, were used to frame questions given to participants. Ethical approval was obtained from the James Cook University Ethics Committee, number H1014 (see Appendix 3 for a copy of the approval letter).

3.2.3.2 Recruitment: A variety of strategies were utilised for recruiting participants; in particular, for younger men who were harder to attract. A total of 18 participants agreed to be interviewed face-to-face by the researcher during a project involving workplace skin examinations,[24] Twelve consented to be involved in further focus group research when replying to a cross-sectional skin cancer survey,[25] 14 responded to weekly advertisements in the local newspaper, and 20 James Cook University students were recruited for focus groups using the University's employment service.

3.2.3.3 Sample: All study participants were currently residing in Townsville (latitude 19.16^{o}S; population 143,328), a regional coastal city located in the dry tropics of northern Australia which averages more than 170 days of at least 8 hours of sunshine each year. Participants were either: known outdoor workers; men known to have a previously excised skin cancer; or, respondents to advertisements seeking people who spend time out in the tropical sun and/or have personal experience with skin cancer. Therefore, all participants were considered to be information-rich cases to allow the research questions to be adequately explored.[26]

Overall, 42 men and 22 women participated in the study. Of the men, 25 were aged between 18 to 30 years; of the women, 14 were aged 18 to 30 years. Thirteen of the men but none of the women worked outdoors. The other participants classed themselves as indoor workers (31) or students (20).

3.2.3.4 Data collection: One-on-one interviews and focus groups were conducted between September 2000 and May 2003. All focus group participants were sent a cover letter or e-mail describing the project, the topics to be covered, and an informed consent form. Focus group participants received a small honorarium to help offset transportation costs or provide compensation for their time. Food was provided at the focus group sessions.

Participants in one-on-one telephone interviews were verbally provided information about the study and gave verbal consent to participate; while those having face-to-face interviews were provided with written information and a consent form. Interviewees were not given compensation for their time. Overall, four one-on-one interviews were conducted face-to-face and eight were conducted over the telephone; the strategy chosen was at the convenience of the respondent. These interviews lasted approximately 20 minutes, and were transcribed in note fashion by the first author.

Focus group data were obtained from six face-to-face group discussions and seven chat-group discussions on the Internet. The 13 focus groups included: five groups of younger (18 – 30 years) men, four groups of younger women, two groups of older (>30 years) outdoor working men, one group of older indoor working men, and one group of older women. Five of the seven younger people’s focus groups were run over the Internet using the James Cook University “WebBoard” chat-room software. Chat-groups were used predominantly for younger persons as it was thought that the associated anonymity would result in more frank and open discussion of psycho-social factors such as peer pressure and masculinity. Each focus group session lasted approximately one hour. Numbers of participants in the male focus groups varied between three and four, and numbers in the female groups varied between three and six. Focus groups were designed to be as homogenous as possible to facilitate free and open discussions. Homogeneity was based on the respondent's age and gender and, when possible, whether they worked indoors or outdoors; this information was collected when consent was obtained, and used later to designate participants to focus groups.

For face-to-face focus groups, the facilitator (TW) and an assistant were present during each session. The facilitator led the group discussions, while the assistant transcribed detailed notes. Only the facilitator was involved in taking notes and asking questions for the telephone interviews and Internet focus groups. Face-to-face focus groups were audio-taped and fully transcribed with the participant's permission, while an electronic recording was made of all transcripts of the Internet focus groups.

The focus group and individual interviewing format included brainstorming opportunities combined with a limited set of predefined, open-ended questions functioning as prompts to provoke discussion. The three main areas of questioning undertaken during the research were knowledge of the causes and prevention of skin cancer, attitudes to sun exposure and sun damage, and use of recommended sun protective behaviours.

3.2.3.5 Data analysis: Focus groups and one-on-one interviews were conducted sequentially and analysed after each group to build an inductive understanding of the participant's responses, so that data from earlier groups or individuals were shared and expanded with subsequent participants. To ensure consistency, the facilitator and assistant debriefed after each focus group to cross-check notes about the main themes and findings. Every discussion or interview was transcribed to an electronic format.

Initial analysis involved reading through the electronic transcripts repeatedly, using immersion to develop a high level of familiarity with the data, manually coding the data into separate summary concepts or key words, and categorising and linking these into recurrent themes. In this way, all transcripts were organised around emerging themes. After data were grouped thematically, emerging themes were checked with further groups, and all negative cases explored in-depth. From group to group, the facilitator modified, deleted, and/or added questions as necessary to pursue all topics until no additional information could be elicited. Some quotes were included directly into the results if they illustrated themes and if the concepts they involved were held by the majority of participants.

3.2.3.6 Reliability and rigor: The level of focus group participation was high, and all participants were enthusiastic about sharing their views and experiences. Consistency was enhanced by having the same facilitator involved in all focus group discussions and interviews. Only the facilitator was involved in analysis. Themes were explicitly tested by trying out alternative explanations with a significant number of participants, by exploring in some depth any response which did not follow the general pattern, and by directly asking participants in the later focus groups and interviews if they agreed with the major themes that emerged in previous discussions.

The larger sample size allowed a “theory-saturation point” to be reached, where new discussions no longer produced new information.[27] In addition, the mix of focus group and interview participants across age, gender and indoor/outdoor working status allowed data source triangulation, while the mix of qualitative methodologies involving both face-to-face and internet focus groups *and* face-to-face and phone interviews allowed methodological triangulation.

3.2.4 Results and Discussion

The present study found that female respondents tended to have more accurate knowledge about the causes and prevention of skin cancer than men, had more frequent and pronounced perceptions of susceptibility to skin cancer and the seriousness of skin cancer, had fewer barriers that prevented them from using sun protection, were more likely to habitually use sun protection, and avoided going out in the sun around the midday hours. Irrespective of age, men in this study had fewer motivators to using sun protection than women, were more susceptible to negative peer influences, were more likely to report barriers to using sun protection at work and during recreational activities, and had a more risk-taking attitude to their health. These findings are consistent with previous studies which showed that women engaged in more sun protective behaviours[28-29] and had fewer barriers to sun protection.[30-31]

These findings fit into three main themes for what influences men and women to use sun protection: (1) perceived threat of developing skin cancer and other skin damage based on beliefs of personal susceptibility to skin cancer and seriousness of skin cancer; (2) factors that motivate individuals to use sun protection, and (3) perceived barriers to using sun protection. Tables 3.1 to 3.3 summarise the predominant responses for each of the three main themes stratified by gender and age (18-30 years; older than 30 years).

The three main themes identified in the present study closely correspond with those anticipated by the HBM. The HBM predicts health-related behaviours based on people's perceptions of the threat posed by the disease and their susceptibility to the disease, cues to action (motivators), and barriers to using the appropriate preventive actions.[21] Overall, perceived barriers to the practice of the health behaviour appear to be the most powerful component influencing whether or not people actually practice particular health behaviours, with perceived susceptibility to a disease also being a strong contributor. [21]

3.2.4.1 Perceived threat of developing skin cancer: Perceptions of susceptibility to skin cancer and seriousness of skin cancer in women seemed to be based on women's superior knowledge of the links between sun exposure, sun damage and skin cancer, and their concerns about the consequences of skin cancer. On the other hand, men voiced little concerns about the risks of sun exposure, irrespective of age.

Women also tended to further improve their sun exposure practices and sun protection knowledge, beliefs, attitudes and behaviours with age; in particular, reporting to reducing their exposure of unprotected skin to the sun almost completely. While men aged 30 or older showed some improvements in attitude to using sun protection, their knowledge rarely improved. There was little change in how serious older men perceived skin cancer as a health issue. They still reported high levels of sun exposure and sun damage, which might significantly increase their risk of developing skin cancer.

The present study suggests that men have poorer beliefs and attitudes towards skin cancer prevention. Men tended to believe skin cancers were not that dangerous, were easily treated, and were also less concerned, especially when younger, about preventing themselves from developing sun-damaged skin. This study suggests it is likely that men's lack of concern about skin cancer is at least partly a result of having a paucity of factual information on skin cancer. In contrast, women acquired skin cancer information from more factual and detailed sources and, as a consequence, had more accurate knowledge about skin cancer.

These findings are consistent with previous studies which showed that women were exposed to more skin cancer information and have a higher level of knowledge of skin cancer.[28,30,32] It seems vital that men receive more factual information about skin cancer to overcome their misconceptions, and increase their perceptions of personal susceptibility to the disease.

In addition, younger men in this study considered skin cancer to be a long-term health issue believing that people start to develop skin cancers only after 50 years of age. As individuals are known to under-value long-term risks,[33] younger men may under-value skin cancer as a health concern. The value placed on a health issue has been found to be even less when health protective actions to prevent illness need to be taken during an asymptomatic state[34] and for health problems occurring more than 15 years into the future.[35]

Table 3.1: Summary of responses to the theme "Threat of skin cancer – perceptions of susceptibility and seriousness" from participants grouped with regard to gender and age (18-30 years or older than 30 years)

Predominant beliefs of younger women (18–30 years)	Predominant beliefs of younger men (18 – 30 years)	Predominant beliefs of older women (> 30 years)	Predominant beliefs of older men (> 30 years)
• Belief that people usually start developing skin cancer in their 30s. All people in NQ are at risk of skin cancer because of tropical location, in particular, those with fair skin.	• Belief that people usually start developing skin cancer in their 50s. Living in NQ means skin cancer is an "acceptable" risk for young men: indoor workers believe "I will only get one or two at most"; outdoor workers with fair skin report they are at high risk, but outdoor workers with 'good genetics' do not ("Dad's spent all his life working in the sun and he only had two removed, so I reckon the most I'm going to get is two.").	• Belief that they are personally susceptible to developing skin cancer, though if they continue to use sun protection diligently, then their future susceptibility will be lower.	• Belief that they are personally susceptible to developing skin cancer, especially if they have fair skin and work outdoors.
• Belief that melanoma skin cancer is very dangerous because it kills or "results in a large amount of skin having to be taken out".	• Belief that melanoma skin cancer is only dangerous if detected late and has "spread deeply".	• Belief that melanoma skin cancer is very dangerous.	• Belief that skin cancer is more of an inconvenience than a serious danger.
• Belief that non-melanoma skin cancers can be easily treated by excision or being burnt off, though young women are very concerned about associated scarring.	• Belief that skin cancers can be easily treated by excision or being burnt off, and any scarring is not a problem unless on face, which can be fixed by plastic surgery.	• Belief that non-melanoma skin cancers can be easily treated, though older women are very concerned about associated scarring.	• Belief that skin cancer is easily treated ("just like going to the dentist"), with some men waiting so they can remove a number at one time; no concerns about scarring unless on the face.

Table 3.1: Continued

Predominant beliefs of younger women (18–30 years)	Predominant beliefs of younger men (18 – 30 years)	Predominant beliefs of older women (> 30 years)	Predominant beliefs of older men (> 30 years)
• Belief that skin cancer is caused by any excessive sun exposure (dark suntan, skin redness or peeling over a person's life, needing about 20 peeling sunburns before you have enough skin damage to develop skin cancer.	• Belief that the occasional peeling sunburn after about 20 years of age does not increase risk of skin cancer – nor do episodes of skin redness or having a suntan ("though it doesn't hurt to avoid the sun") - takes 50 - 60 peeling sunburns before people receive enough sun damage to develop skin cancer.	• Belief that skin cancer is caused by any excessive sun exposure throughout a person's life.	• Belief that peeling sunburns after about 20 years of age do not increase risk of skin cancer, nor do episodes of skin redness or having a suntan.
• Belief that light tans are safe if you are careful and use sunscreen, but peeling sunburns and dark tans are undesirable as they increase risk of skin cancer, and cause short- and long-term beauty problems (freckles, wrinkles, "leathery skin", "I don't want to peel on my face and get the motley look").	• Beliefs that the discomfort of peeling sunburn is the worst risk of sun exposure, while freckles and prematurely aged skin is not an issue – "a weather-beaten look is good for guys". A tan is safe as long as you don't peel to get one.	•Belief that any sun exposure is undesirable and will increase your risk of skin cancer.	• Belief that skin redness is "not a sunburn" and will not increase their risk of skin cancer; belief that suntan is not a risk factor for skin cancer. Many older men experience skin redness regularly and have a suntan, especially outdoor workers who have dark suntans.
• Young women try to avoid the midday sun because "It's the worst time to damage your skin".	• Young men do not avoid going out in the sun around midday.	• Older women rarely exposed their unprotected skin to the sun, and never around the midday hours.	• Older men still go out in the sun around the midday hours, but less than when younger.
• Most young women deliberately tan to "look better and feel better", while a significant number of young women do not as "it's not worth the risks".	• Few younger men deliberately tan, but all had a tan for other reasons – unprotected sun exposure, because they believed it reduced risk of skin cancer, made them feel more attractive, "created vitamins for good health".	• Older women did not deliberately tan, as having a suntan for vanity was no longer important to them since they had heard about, or experienced, skin cancer and sun damaged skin.	• Older men do not deliberately suntan, but all had a tan.

Table 3.2: Summary of responses to the theme "Factors that motivate the use of sun protection" from participants grouped with regard to gender and age (18-30 years or older than 30 years)

Predominant beliefs and actions of younger women (18–30 years)	Predominant beliefs and actions of younger men (18 – 30 years)	Predominant beliefs and actions of older women (> 30 years)	Predominant beliefs and actions of older men (> 30 years)
• Most young women habitually used sun protection because of influence from mothers very early in childhood (especially if skin cancer in the family) and from school; a few also had negative influences from family members: "I never had protection as a child. Nona always encouraged me to sun-bake or told me I looked unhealthy."	• Few young men habitually use sun protection; those who did were often influenced by their mother.	• Older women always habitually used sun protection.	• Some older men used sun protection more if they had experienced skin cancer.
• Motivated to use sun protection after experience with peeling sunburns in early/late teens, teaching them how easily you can get sunburn in the tropics, and how to use sun protection optimally.	• Young men who did not habitually use sun protection often experienced sunburn because they neglected to bring it along: "I was stuck in this boat in the middle of nowhere, slowly roasting", or did not use it until too late: "I only thought about protection when I started to get burnt."	• Encouraged to use sun protection after experience with sunburn, then later premature aging of their skin from sun damage, and then later still, from experiencing a skin cancer.	• Motivated to use sun protection if they were around their children, though their female partner was usually the one responsible for putting sun protection on the children and on the man.
• Encouraged to use sun protection from messages on the TV, which made them more aware of the risks of sun exposure and the danger of melanoma.	• Messages on the TV had little impact on improving their sun protection behaviours as these were emotive, low on facts and of little practical benefit: "scare tactics don't work for me", "More facts and less bullshit", "I don't know what to look for to identify a melanoma".	• Encouraged to use sun protection to set a good example for their children: "I want to protect my kids from anything harmful, so I was really keen to make them cover up and warn them about the sun."	• Older men usually only knowledgeable about skin cancer if they had a skin cancer previously excised.

Table 3.2: Continued

Predominant beliefs and actions of younger women (18– 30 years)	Predominant beliefs and actions of younger men (18 – 30 years)	Predominant beliefs and actions of older women (> 30 years)	Predominant beliefs and actions of older men (> 30 years)
• Encouraged to use sun protection after exposure to factual information in magazines (young women are well aware of the damaging effects of sun on their skin, and are knowledgeable about skin cancer in general).	• A few young men with fair skin were motivated to use sun protection habitually because of their susceptibility to sunburn. Encouraged to use sun protection in the short term after experiencing peeling sunburn, but became less motivated over time: "you get slacker the longer it has been". Encouragement to use sun protection in the long term usually came from observing others using sun protection. • Outdoor workers commented that workplaces rarely make a serious attempt at advertising the dangers of sun exposure: "Sunscreen use is recommended in the staff manual, but it isn't provided by my boss. I think it's just there in the manual to cover occupational health and safety.", "There's sunscreen there [at my workplace], so I guess we're supposed to use it, but they don't advocate it."	• Encouraged to use sun protection after exposure to factual information in magazines and from doctors if they had a skin cancer excised; very knowledgeable about skin cancer.	• Most are encouraged by their female partner to use sun protection, though this encouragement usually takes a significant period of time before being successful if children are not involved: "She gave up a long time ago.", "It took ten years, but finally she wore me down."

Table 3.3: Summary of responses to the theme "Barriers to using sun protection" from participants grouped with regard to gender and age (18-30 years or older than 30 years)

Predominant beliefs and actions of younger women (18–30 years)	Predominant beliefs and actions of younger men (18–30 years)	Predominant beliefs and actions of older women (> 30 years)	Predominant beliefs and actions of older men (> 30 years)
• All young women reported issues with using sun protection – "sunscreen is greasy on your skin", "sunscreen runs into your eyes if you sweat", "long sleeved shirts make you hot and sweaty", but most said these annoyances were not enough to stop them using it, as: "You can always wash it off your hands", and "maybe it makes the sand stick to you a bit more but I don't care about that". Some young women did not use protection on days which were cool or cloudy, even when they were going outdoors for long periods: "the day didn't feel hot enough to get burnt", "Don't usually wear it when it is cloudy…more a heat association"; instead, they usually wore a "skimpy dress style" during these times.	• All young men reported issues with using sunscreen – greasiness and running into your eyes when you sweat – these were the most important factors in why they often did not use it at work: "It [sunscreen] is sticky so the dirt and sawdust sticks and makes me sweat"; "My hands become slippery when holding tools like the nail gun, which is dangerous.", "You don't want to drop things on people's heads." Most young men reported issues with using long sleeved shirts (LSS) – "hot and uncomfortable in summer" was the most important factor why many did not use LSS. Two outdoor workers who worked for a company that enforced sun protective behaviours were more positive about wearing sunscreen and LSS: "they're a bit of a hassle, but I guess it will stop skin cancer"; "LSS are actually not that hot once you've sweated in them for a while."	• All older women reported some unpleasantness with using sun protection, but never enough to stop them from using it any time they went out in the sun.	• While they had more positive attitudes to using sun protection, many older men reported issues with its use; in particular, with using sunscreen, but also with using LSS to a lesser extent.

Table 3.3: Continued

Predominant beliefs and actions of younger women (18–30 years)	Predominant beliefs and actions of younger men (18–30 years)	Predominant beliefs and actions of older women (> 30 years)	Predominant beliefs and actions of older men (> 30 years)
• Belief that using the 'Slip, Slop, Slap!' strategy should be sufficient to avoid or reduce future skin cancer.	• Belief that they do not need to use sun protection when going out in the sun for periods of less than an hour because: "It's too short a time to get a sunburn". Belief that you would develop skin cancer "only if you used no sun protection at all for at least 10 years".	• All older women strongly believe, from their own personal experiences, that using 'Slip, Slop, Slap!' will avoid or reduce future skin cancers, and will reduce the visible signs of sun damaged skin.	• More positive attitudes to using sun protection than when they were younger.
	• Some young men alluded to peer pressure issues: "At work the guys don't use sun protection, so I'd be ridiculed if I used the work's sunscreen."		• Older men reported fewer barriers to using sun protection because they were now less risk-taking than when they were younger: "I no longer feel ten-foot tall and bullet-proof", "I've realized I'm not immortal".

3.2.4.2 Factors that motivate individuals to use sun protection: The present study suggests that women had two special motivators for using sun protection. Firstly, women improved their sun protection behaviour because they wanted to set a good example for their children. Secondly, women were far more motivated to avoid sun damage to their skin for vanity reasons: wanting to avoid scarring as a result of skin cancer excision, wanting to avoid short-term skin damage that affected appearance such as a peeling face, and wanting to avoid long-term skin damage such as wrinkles, freckles and “leathery skin”. Vanity concerns usually arose from women noticing prematurely aged sun damaged skin in older family members or their friends, from information contained in magazines, and, when they were older, from their own experiences with sun exposure and sun damage. In contrast, many of the men had few such vanity concerns, and there was a common attitude that wrinkles and a weather-beaten face contributed to a more masculine look.

In this study, the main motivator for men to use sun protection appeared to come from observing others using sun protection. Bandura suggests in his Social Cognitive Theory that individuals can acquire important information merely by observing other individuals;[36] therefore, social environments with family, friends and work colleagues will likely support or impede sun protective behaviour. While men in this study often reported they picked up sun protective skills from other family members, their partner and friends, the working environment was generally considered not supportive of sun protective behaviours for outdoor working men. Men commented that workplaces did not supply sunscreen and that few enforced the use of sun protective clothes. Younger male outdoor workers may, guided by peer influences, consider sun protection to be not masculine; this is supported by the results of this study and others that have investigated men’s attitudes and behaviours regarding the use of sun protection.[26]

3.2.4.3 Barriers to using sun protection: The present study found that men reported more perceived barriers to using sun protection than women. Men appeared to believe that sun protection is only necessary for long periods of sun exposure, and reported negative peer pressure. However, older men stated having a more positive attitude to using sun protection and fewer barriers than when they were younger. Younger men had more risk-taking attitudes towards health issues, as alluded to - in hindsight - by some of the older participants. It is likely that a significant number of men choose not to use sun protection based on negative peer influences and a risk-taking attitude. Neglecting sun protection seemingly provides to peers an appearance of bravado against a potentially fatal, though unlikely, scenario of developing melanoma later in life.

Significantly, two of the respondents in this study worked for a company which enforced the use of sun protection in outdoor workers; both of these individuals had positive attitudes to using sunscreen, perceived skin cancer to be a serious health issue, and did not think wearing a long-sleeved shirt was too much of a barrier in hot and humid weather because the shirts cooled down once they became wet with sweat. Workplace managements should either adopt a workplace policy of mandatory sun protection and/or develop a culture of being serious about skin cancer prevention. This would encourage outdoor workers to overcome negative peer influences and to use sun protection. Supporting this strategy, a recent study has shown that employees from workplaces that have adopted a mandatory workplace sun protection policy have lighter suntan levels, lower numbers of solar keratoses on hands and arms, and fewer previously excised self-reported skin cancers and recent sunburn than employees working under a voluntary sun protection policy.[25]

3.2.5 Limitations of the study

As the three main themes identified in the present study closely correspond with those anticipated by the HBM, generalisation from the present study should be possible.[37] In addition, the relatively large sample size for this study further supports the generalisability of findings.[27] However, a limitation of this study which may affect generalisability was the predominant use of university students in the younger age groups, given that demographic characteristics of this group, such as level of education and other socio-economic characteristics, have been found to influence knowledge, beliefs, attitudes and behaviours toward skin cancer prevention.[38] Further, participants were not specifically asked how often and how long they went out in the sun during a typical week, or how long they have lived in the tropics; therefore, it is unclear how representative the sample is regarding exposure to the tropical sun. However, all participants gave extensive insights into their outdoor activities, their sun-related attitudes, beliefs and behaviours, and their experienced sun-induced skin damage.

3.2.6 Conclusions

Women typically believed that the risks of sun exposure outweigh the benefits, mostly because of beauty concerns, and this became even more pronounced with age, with having a tan being viewed less and less desirably. In contrast, men seemed less likely than women to adopt regular sun protection habits over their lifetime, despite exposure to factors that should have motivated them to do so – their mother's or partner's influence, personal experience of sun damage, and information about skin cancer in the media or the workplace. The present study suggests that these motivating factors for using sun protection are less salient for men than for women, and men also have stronger perceived barriers to using sun protection.

These gender differences might provide an explanation for why NQ men experience more sun-induced skin damage and, in turn, more skin cancer. The findings support a multi-strategy approach to improve men's sun protective practices. Men need skin cancer messages that are more factual and less emotive. NQ workplaces also need to portray a much more serious commitment to skin cancer prevention.

3.2.7 References

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3.5 Conclusions to Chapter 3

Women appear to have more positive attitudes and behaviours toward using sun protection than men across three major themes: women have greater perceptions of the threat posed by epithelial skin cancer and their susceptibility to the disease; women are more strongly motivated by 'cues to action'; and women have fewer personal barriers to using sun-protective behaviours. Individual factors for both men and women are summarised in Table 3.5.1.

These findings suggest that from an early age, North Queensland women tend to have: more concerns about developing skin cancer; better knowledge about the causes of skin cancer; better sun-protective behaviours; a variety of strong motivators; and few significant personal barriers to using sun protection, than the men. In contrast, many North Queensland men often have significant barriers to using sun protection (e.g., social norms include using sun protection in front of other men is not masculine, sunscreen is too slippery in the workplace, long-sleeved shirts are too hot and uncomfortable in the tropics), and often are not motivated by the same 'cues to action' as women. The main motivator for more regular use of sun protective behaviours is significant negative experience with skin cancer and other UVR-induced skin damage; however, by the time this occurs, many men have already received so much UVR damage that further epithelial skin cancer is virtually unavoidable.

Table 3.5.1: Factors contributing to gender differences in sun protection attitudes and behaviour

Theme	Men	Women
Perceptions of the threat posed by the epithelial skin cancer and perceptions of susceptibility to the disease	• Paucity of factual knowledge of the causes of epithelial skin cancer - believe mild sunburn (skin redness without peeling) is not a sunburn and is not a risk factor for skin cancer; believe a chronic suntan or peeling sunburns in adulthood are not risk factors for skin cancer; believe skin cancers are not that dangerous, are easily treated, and do not develop until late in life • Few concerns about risks of sun exposure and skin cancer (risk-taking personality) • Show little improvement in knowledge, concerns, beliefs and sun protective behaviours across age groups; older men still experience skin redness, have a suntan and do not avoid exposing their skin to the midday sun	• More accurate knowledge of the causes of epithelial skin cancer – few erroneous beliefs about the causes of skin cancer • Very concerned about the risks of sun exposure and skin cancer • Show improvements in sun exposure practices, knowledge, beliefs and protective behaviours across age groups; older women do not experience skin redness or have a suntan, and do not expose their skin to the midday sun
Motivators or cues to action	• Some motivation to use sun protection in front of children (though primarily from female partner) • Encouragement from mother, and later their partner, to use sun protection; however, this rarely influences protective habits, or else this influence takes many years • Media advertisements on the dangers of sun exposure have little influence • Encouragement to use sun protection usually comes from observing others using sun protection, or positive peer influences (i.e., supportive environment)	• Vanity concerns in late 20s after noticing signs of sun-related aging on skin • Strong influence from mother to use regularly sun protection • Do not want to experience peeling sunburn • Want to set a good example in front of children for sun protection • Media advertisements on the dangers of sun exposure have strong influence
Personal barriers to using the appropriate sun-protective behaviours	• Peer pressure issues with younger men during outdoor activities – using sun protection is not thought of as 'manly' • Perceptions of serious issues involved with using sun protection, especially during work; therefore, men often do not regularly use sun protection • Not using sun protection often becomes habitual in younger men; older men who regularly use sun protection have often experienced many skin cancers or pre-cancerous lesions	• Perceptions of serious issues involved with using sun protection, but use it regardless • Using sun protection has usually become a long term habit for women once they are past their teenage years

If the findings from this chapter are entered into the corresponding components of the HBM and the TRA, both models predict that NQ women are more likely to regularly practice sun protective behaviours than NQ men. The HBM proposes that using preventive health behaviours is associated with an individual's perceptions of the threat posed by a disease, their perceived susceptibility to a disease, cues to action (motivators), and a lack of barriers to using the appropriate preventive actions. In contrast, the TRA proposes that whether or not an individual performs particular health behaviours is influenced by attitudes towards the action, with these attitudes being influenced in turn by the individual's knowledge/beliefs about a disease, and social norms about the appropriateness of the preventative action.

This work found NQ women often had positive perceptions of threat and susceptibility to skin cancer and significant motivators and few barriers to using sun protection. Therefore, the HBM predicts NQ women are likely to regularly practice sun protective behaviours. Similarly, the TRA also predicts that many NQ women will regularly use sun-protective behaviours, as this work found women often have good knowledge about the causes of skin cancer, positive attitudes toward using sun protection, and are aware of positive social norms supporting the use of sun protection. As a result of regular use of sun protective behaviours, many NQ women's sun-protective behaviours develop into a 'sun protective habit'. In contrast, it appears that not using recommended sun protection tends to be the habit of many NQ men. Unfortunately, long-term habits and lifestyle are hard to break; habits are established over a long period and often performed automatically, thus, are highly resistant to change. In addition, many people are not adequately prepared or even ready to change their behaviours; a recent study by Kristjansson et al. (2004) found less than half their study sample were ready to improve sun protective behaviours. McCool et al. (2009) and Hammond et al. (2008) also found socio-demographic, personal and workplace factors reduced use of sun protection by outdoor workers.

While formation of a sun protective habit has been described as the most important goal for any sun protection program in regions receiving high levels of UVR (van der Pols et al., 2006), these recent findings, and the results described in this chapter, suggest that forming “new” sun protective habits in NQ outdoor working men will be very difficult. Many NQ men appear not to be overly concerned about epithelial skin cancer, have few motivators for improving their sun protective behaviours, and have significant personal and workplace barriers. The literaure also shows that trying to improve men’s sun protection habits using interventions based on fear-appeals, knowledge-change or attitude-change have resulted in only minor or short-term increases in sun protective practices. It appears that for many NQ men, only when they develop many skin cancers and sun damage is perhaps irreversible, are they sufficiently motivated to more consistently use recommended sun-protective practices.

Therefore, the author of this work decided that an environmental intervention (also called ‘social engineering’; for example, interventions to prevent smoking in restaurants) would likely be the most successful intervention strategy, rather than any attempt to improve behaviour via knowledge-change or attitude-change. For improving the sun-protective practices of the high risk group of NQ men for developing epithelial skin cancer – outdoor workers – the logical social engineering approach is making it mandatory for outdoors workers to use recommended sun protection practices of long-sleeved shirts, wide-brimmed hats, long pants and sunscreen.

Chapter 4 describes a study evaluating a mandatory workplace sun protection policy for its effectiveness in reducing sun-induced skin damage (suntan level, recent sunburn, solar keratoses and epithelial skin cancer) of NQ outdoor working employees, compared to employees working under a voluntary workplace sun protection policy.

Chapter 4

Reducing sun-induced skin damage in northern Australian outdoor workers

4.1 Introduction to Chapter 4

Workplace policies to enforce sun protection among outdoor working employees may be the key element to sustaining sun protective behaviour in outdoor working men – a high-risk group for epithelial skin cancer in North Queensland. At present, Australian occupational health and safety policies strongly recommend that sun protection strategies are used in the workplace; however, there is much evidence that the use of sun protective measures by outdoor working employees is inadequate when policies are only recommendations. However, in 2003, only two workplaces in North Queensland made it mandatory for outdoor working employees to use long-sleeved shirts, wide-brimmed hats and sunscreen and enforce this policy – the Department of Main Roads and the SunMetals zinc refinery.

This chapter investigates whether a mandatory workplace sun protection policy for outdoor workers in the tropics is associated with reduced sun-related skin damage (lighter suntan levels, and fewer self-reported sunburns, solar keratoses and skin cancers) compared to a voluntary workplace sun protection policy for outdoor workers. It describes the results of a non-directional study comparing results from two cross-sections of outdoor workers in Townsville, North Queensland – outdoor workers from an organisation with a mandatory sun protection policy (Department of Main Roads, has had a mandatory sun protection policy for all employees for more than 10 years including wearing long-sleeved shirts, wide-brimmed hats and sunscreen while outdoors), and outdoor workers from an organisation in which employees are (voluntarily) responsible for whether or not they use sun protective measures (Q-Build).

A prospective trial would be a better way to examine whether mandatory use of sun protection directly results in reduced suntan levels, self-reported sunburns, and incidence of actinic keratoses and skin cancers, compared to a voluntary sun protection policy. However, during the data collection period for this PhD (2001-2005), it was difficult to gain support from organisations in North Queensland to implement a mandatory workplace sun protection policy for their outdoor working employees. Larger organisations with longer term employees were concerned that an employee who had not used sun-protective practices and had skin cancer identified in the course of the study might sue the company for negligence. In addition, smaller organisations with more short-term contract employees were concerned that introducing a mandatory sun protection policy may be an unpopular policy which would result in their employees choosing to work for another organisation without a mandatory sun protection policy (in the construction industry environment in NQ between 2000-2006, employers found it difficult to recruit and retain employees).

Therefore, given the reluctance of NQ companies to implement a mandatory workplace sun protection policy for outdoor workers, and the time constraints associated with doctoral studies, a non-directional study design was chosen as the most feasible design for this final investigation.

A copy of the questionnaire used in this study is provided in Appendix 4, while letters of support from the Main Roads Department and Q-Build are provided in Appendix 6. Participant consent forms and information sheets for this study are provided in Appendices 7 and 8, respectively. A summary of the main results of the qualitative study are described in the “Conclusions to Chapter 4” section (page 224). This study has also been published; a copy of the following publication is presented in Appendix 14: Woolley T, Buettner PG, Raasch B, Glasby M, Lowe J. Workplace sun protection policies and employees' sun-related skin damage. *American Journal of Health Behaviour* 2008; 32:201-8.

4.2 Comparing workplace sun protection policies and employees' sun-induced skin damage

Published as:

Woolley T, Buettner PG, Raasch B, Glasby M, Lowe J. Workplace sun protection policies and employees' sun-related skin damage. American Journal of Health Behaviour 2008; 32:201-8.

4.2.1 Abstract

Objectives: Investigate whether mandatory sun protection for outdoor workers in tropical regions is associated with reduced sun damage.

Methods: In 2003 survey of 26 employees working under mandatory sun protection policy was compared to survey of 21 employees working under voluntary sun protection policy.

Results: Voluntary sun protection associated with employees having more solar keratoses on dorsum of right hand (P = 0.006), and more previously excised self-reported skin cancers (P=0.008).

Conclusions: Employees working under mandatory sun protection policy had reduced sun damage; a likely consequence of less sun exposure.

4.2.2 Introduction

Exposure to ultra-violet radiation (UVR) is regarded as the key environmental risk factor for solar keratoses (SK; a precursor lesion of squamous cell carcinoma), melanoma, basal cell carcinoma (BCC) and squamous cell carcinoma (SCC); with both sunburn and accumulated sun damage consistently identified as contributing factors.[1] Studies suggest chronic sun damage accrued over many years to be responsible for the development of SK and SCC,[1,2] while mixed effects of intermittent sunburn and accumulated sun damage seem to account for the development of BCC and melanoma.[3,4]

North Queensland (NQ), Australia, has one of the highest reported age-standardised incidence rates for melanoma and non-melanoma skin cancers (NMSC) in the world.[5] These high rates are a likely consequence of many NQ communities having both proportionally large Caucasian populations genetically susceptible to skin cancer, and a tropical environment with year-round high levels of ambient UVR.[6]

A previous study conducted in NQ found that incidence rates of NMSC were almost double in males compared to females[5] and that men were more likely to develop multiple NMSC.[7] NQ outdoor workers seem to bear the burden of skin cancer; a 2002 study of men with a previously excised NMSC found outdoor workers with sun sensitive skin types developed significantly more skin lesions, and earlier, compared to indoor workers.[8]

These results were consistent with previous studies conducted in Australia and England which found outdoor workers to be at particularly high risk to develop BCC,[4,9] SCC[4,9,10] and SK.[10] Previous studies from the United States and Australia have shown that males spend more time out in the sun at work and recreation than females,[11] while not protecting themselves sufficiently when doing so.[11-12] Outdoor workers are predominantly male, and the higher rates of NMSC in NQ men are a likely result of inadequate sun protection practices over a number of years.[13] Supporting this, a recent study in the Queensland construction industry found the use of sun protection is low in outdoor workers; with approximately 40% using wide-brimmed hats, 30% using sunscreen, and 20% long-sleeved shirts.[14] Habits and lifestyle evolve over many years, and attempts to voluntarily change these habits are likely to be very difficult.

Even NQ men known to have had at least one previously excised NMSC generally only improved their sun protection behaviours after repeated negative experience with skin cancer. [15]

To overcome the reluctance to voluntarily using adequate sun protection, a workplace policy of mandatory use of sun protection seems to be a promising strategy and several organisations have implemented a mandatory sun protection policy for employees who work outdoors. The purpose of the present study was to determine whether the mandatory use of sun protection in outdoor workers was associated with a reduction in sun damage when compared with employees who were voluntarily responsible for their own sun protection. The six specific research questions investigated were whether reductions in the overall numbers of sunburn experienced during working hours, previous NMSC, suntan levels and SK on the forearms and dorsum of hands were observed when mandatory use of sun protection was compared with voluntary sun protection.

4.2.3 Methods

The present “natural experiment” compared results from two cross-sections of outdoor working men in NQ. The study was conducted in Townsville (latitude 19^{o}S, population 160,000) from March to May, 2003. Ethical approval for the study was obtained from the James Cook University Ethics Committee, number H1403 (see Appendix 3 for a copy of the approval letter).

4.2.3.1 Participants: Men were classified as outdoor working if they worked a minimum of 30 minutes out in the sun on a usual workday. The Main Roads Department (MRD) of Queensland was used as the organisation with the mandatory sun protection policy. MRD has had a mandatory policy of all employees wearing long-sleeved shirts, wide-brimmed hats and sunscreen while outdoors for over ten years. Supervisors observe outdoor working employees for compliance with sun protection practices on a regular basis, with compliance being ensured via a system of escalating disciplinary measures, including verbal warnings, written warnings, re-training and finally, potential dismissal. In addition, MRD usually has a yearly education session on skin cancer prevention to assist the mandatory sun protection policy in changing worker behaviour. Data were collected from MRD employees by completing first the questionnaire, then the measurement of suntan level, followed by the SK and skin cancer examination.

Q-Build was used as the organisation in which employees were responsible for their own sun protection. To obtain management support for data collection, Q-Build employees were offered a free ‘tool box’ talk on the dangers of heat stress for outdoor workers during the tropical summer. For logistical reasons, Q-Build employees were split into two groups after their tool box talk; one group had their SK and suntan levels recorded first while the other group filled out the questionnaire; then the groups were swapped over. The management of both organisations made it mandatory for employees to attend these sessions.

Sixty-nine employees were present at the tool box talk for Q-Build and the skin examination for MRD, and all consented to participate. However, 17 Q-Build employees left before completing either the self-administered questionnaire or the sun damage measurements because of work commitments. The data from these 17 Q-Build respondents were excluded from the analysis. A further five respondents were later excluded from the final analysis as they reported working less than 30 minutes in the sun on a usual work day. This gave a final sample population of 26 participants from MRD and 21 participants from Q-Build.

4.2.3.2 Data collection: Data collection was by self-administered questionnaire and by taking measurements of current sun damage (level of UVR-related darkness of skin and presence of SK) on participant's right forearm and dorsum of right hand. Demographic questions recorded included age, gender, skin type and self-reported family history of skin cancer. Skin type, an index of sun-sensitivity representing both the propensity to sunburn and the capacity to develop a tan, was self-assessed according to Fitzpatrick's classification (scale I to IV from most sun sensitive to least sun sensitive Caucasian skin).[16]

Sun exposure and sun damage was investigated by questions on total years lived in NQ (north of Rockhampton), total years spent working outdoors in NQ, self-reported number of previously excised, medically diagnosed skin cancers, hours spent in the sun on a usual work day and on days off, and number of mild and severe sunburns experienced as a result of work or recreational activities in the previous month. Mild sunburn was defined as "at least skin redness or tenderness after 24 hours", and severe sunburn as "skin peeling".

The questionnaire also determined employee's knowledge of the causes and prevention of skin cancer, and attitudes and beliefs towards skin cancer prevention and exposure to the sun. For knowledge questions, participants had a choice of four different answers for each question, and responses were marked as being correct or not. Questions on attitudes and beliefs, asked the participants to rate their response on a scale from 1 to 4, with 1 labelled as "not at all", 2 as "a little bit", 3 as "a fair bit" and 4 labelled as "very much".

Sun protective behaviours were self-assessed by asking questions about typical measures at work and on days off. A specific closed question asked what participants wore on a typical recreational day, with choices including a wide-brimmed hat, cap, sunscreen, long-sleeved shirt, and short-sleeved shirt.

The main part of the questionnaire was developed utilising the Theory of Reasoned Action and the Health Belief Model.[17,18] The questionnaire used is almost identical to the instrument developed by the authors for a previous study for which it was validated.[19] In the present study questions on the number of mild and severe sunburns experienced in the previous month as a result of work or recreational activities were not validated; however, definitions for 'mild' and 'severe' sunburn were given in the questionnaire to aid validity and reliability.

The level of suntan of each participant was determined by using an Evans Electroselenium Limited reflectance spectrophotometer (model 99; Diffusion Systems Ltd, London UK, 1990) to measure change in skin reflectance on the right forearm and dorsum of right hand due to sun exposure. Suntans have been linked to both SK[10] and NMSC.[20] To calculate the difference in skin darkness due to UVR exposure, we used the formulae "skin reflectance of forearm/dorsum of hand at 650nm – skin reflectance of inside of the upper arm at 650nm". Three repeated measurements of skin reflectance were taken on each right forearm, dorsum of right hand and inner-upper right arm. The inside of the upper arm has been shown to be the most accessible and consistent site to determine base pigmentation.[21]

The numbers of SK on the right forearm and dorsum of right hand were counted. SK are precursor lesions of SCC. The number of SK is considered a key risk marker for the development of NMSC, indicating that a person has constitutional susceptibility and/or sufficient lifetime UVR exposure.[2]

The researchers were previously trained and experienced in using an EEL spectrophotometer (TW) and in the clinical diagnosis of SK (MG). Spectrophotometer and SK data were always collected by the same assessor to avoid potential inter-rater reliability issues. The SK assessor was blinded to the study conditions, while the suntan level assessor was not; however, EEL spectrophotometers have precise digital readouts, making measurements objective. Reflectance readings with EEL spectrophotometers have been used in many studies of human skin colour,[22] and the spectrophotometer used in the present study is subject to yearly external calibration, is set to a zero baseline at the beginning of each data collection session, and is checked regularly throughout a session.

4.2.3.3 Statistical analysis: Data were entered into the statistical computer package for social sciences, SPSS Release 12 for Windows. Table 4.1 provides a complete list of the variables as they were considered for statistical analysis. Numerical variables were described as mean values and standard deviations (SD). The bivariate associations between the participant's workplace sun protection policy and variables describing demographics, sun damage, knowledge, attitudes and sun protective behaviours were assessed with Chi-squared tests and t-tests, as appropriate. The study investigated six specific research questions relating to the total number of sunburns experienced during working hours, the number of previously excised NMSC, suntan levels and number of SK on the forearms and dorsum of hands. Bonferroni adjustment for multiple comparisons was calculated and a p-value less than 0.0083 was assumed to indicate statistical significance (overall level of significance 0.05).

4.2.4 Results

4.2.4.1 Description: The mean age of the participants from the mandatory sun protection policy workplace was 42 years (SD ± 11). Most employees from this group (89%) were male, had skin type I or II (fair skin; 69%), did not have a family history of skin cancer (61%), had spent a mean of 20 years (SD ± 13) working outdoors in the tropics, and had lived in the tropics for a mean of 36 years (SD ± 14) (Table 4.1). The mean age of participants from the voluntary sun protection policy workplace was 44 years (SD ± 16). All of these outdoor working employees were male, and most (52%) had skin type I or II, had a family history of skin cancer (60%), had spent a mean of 24 years (SD ± 14) working outdoors in the tropics, and had lived in the tropics for a mean of 37 years (SD ± 16) (Table 4.1).

4.2.4.2 Workplace sun protection policy and sun damage (Table 4.1): Having a voluntary sun protection policy was associated with a darker tan level of the right forearm (p = 0.037) and dorsum of right hand (p=0.017), and a greater number of SK on the right forearm (p = 0.015). However, those results were non-significant after adjusting for multiple comparisons. The number of SK on the dorsum of the right hand (p=0.006) and the number of self-reported medically diagnosed skin cancers (p=0.008) were significantly higher in employees working under a voluntary sun protection policy.

4.2.4.3 Workplace sun protection policy and knowledge, attitudes, beliefs and behaviours towards sun protection (Table 4.1): Compared to workers with a mandatory policy, employees working under a voluntary sun protection policy were more likely to state that having tanned skin increases your risk of skin cancer (p=0.046), were more likely to believe that they were susceptible to developing skin cancer (p=0.019), and that long-sleeved shirts were more hot and uncomfortable than short-sleeved shirts (p=0.049). Employees working under a voluntary sun protection policy were less likely to state that UVR levels are extreme between 10 am to 2 pm during winter days in the tropics (p=0.049), and were less likely to usually wear a long-sleeved shirt while out in the sun at work (p<0.001). If findings were fully adjusted for multiple comparisons, only the result referring to the wearing of long-sleeved shirts was to remain significant.

Table 4.1: Associations between workplace sun protection policy and North Queensland outdoor workers' sun-induced skin damage and beliefs toward sun exposure and sun protection.

	Mandatory Policy (n = 26)	Voluntary Policy (n = 21)	P-value
Demographics			
Mean age in years (±SD*)	42 ±10	43 ± 16	0.616
% Male gender	89%	100%	0.108
% Skin type I or II (Fitzpatrick's classification)	69%	52%	0.237
% Having a family history of skin cancer	39%	60%	0.334
Sun exposure and sun damage			
Mean years spent working outdoors in the tropics (±SD)	20 ±13	24 ±14	0.290
Mean years lived in the tropics (± SD)	36 ±14	37 ±16	0.782
% Who usually work more than 3 hours a day in the sun	69%	76%	0.596
% Who usually spend more than 3 hours a day in the sun on days off	44%	43%	0.938
Mean number of mild sunburn experienced at work last month (±SD)	0.6 ± 0.9	1.1 ±1.4	0.135
Mean number of severe sunburn experienced at work last month (±SD)	0.1 ± 0.3	0.3 ±0.4	0.128
Mean number of total sunburns experienced at work last month (±SD)	0.7 ± 1.0	1.4 ±1.6	0.090
Mean number of sunburns experienced from days off last month (±SD)	0.3 ± 0.5	0.6 ±0.7	0.113
Mean tanning level on right forearm (± SD)	20.5 ± 7.8	25.4 ±5.1	0.037
Mean tanning level on right dorsum of hand (± SD)	20.2 ± 6.7	25.1 ±4.4	0.017
Mean number of solar keratoses on right forearm (± SD)	0.7 ± 1.6	8.1 ±11.4	0.015
Mean number of solar keratoses on right dorsum of hand (± SD)	0.3 ± 0.7	4.0 ±5.9	0.006
Mean number of previous medically diagnosed skin cancers (± SD)	0.5 ± 1.2	3.5 ±5.2	0.008
Knowledge of causes and prevention of skin cancer (% correct)			
"You cannot feel UVR hitting your skin"	27%	43%	0.252
"Having tanned skin increases your risk of skin cancer"	58%	85%	0.046
"Skin redness increases your risk of skin cancer"	42%	52%	0.491
"A cap does not provide adequate protection for the face"	89%	91%	0.824
"People with olive skin can still get multiple skin cancer"	42%	43%	0.970
"Sunscreen by itself is not adequate sun protection"	77%	86%	0.446
"Childhood sun damage is linked to getting skin cancer"	62%	76%	0.284
"Adulthood sun damage is linked to getting skin cancer"	23%	10%	0.219
"People with fairer skin have a higher risk of skin cancer"	89%	91%	0.824
"People with red hair have a higher risk of skin cancer"	73%	62%	0.414
"People with light coloured eyes have higher risk of SC"	23%	38%	0.263
"UVR is reflected mostly on hazy, partially cloudy days"	16%	21%	0.667
"UVR levels are extreme between 10am and 2pm during winter days in the tropics"	54%	25%	0.049
"Working outdoors for more than 5 years gives you a high risk of skin cancer"	38%	15%	0.095
"you should apply sunscreen 20 minutes before you go out in the sun"	39%	55%	0.264

Table 4.1: Continued

	Mandatory Policy (n = 26)	Voluntary Policy (n = 21)	P-value
Attitudes towards sun exposure and using sun protection (mean ± SD of ratings between 1 'not at all' and 4 'very much')			
"I enjoy being out in the sun"	2.9 ± 0.8	2.7 ± 1.1	0.634
"I look better with a suntan"	2.1 ± 0.9	1.8 ± 0.9	0.202
"I feel better with a suntan"	2.0 ± 0.9	1.7 ± 0.9	0.226
"I am susceptible to skin cancer"	2.6 ± 0.9	3.2 ± 0.8	0.019
"LSS** are more hot and uncomfortable than short sleeve"	2.0 ± 1.0	2.7 ± 1.2	0.049
"Using sun protection reduces your risk of skin cancer"	3.4 ± 0.7	3.1 ± 0.8	0.193
"A suntan is useful to prevent peeling"	2.3 ± 1.0	2.1 ± 0.9	0.447
"Regular sun exposure is an acceptable risk"	2.1 ± 1.1	1.9 ± 1.2	0.706
"Benefits of a suntan outweigh the risks"	1.8 ± 0.7	1.8 ± 0.8	0.865
"Benefits of wearing a LSS outweigh the inconveniences"	3.4 ± 1.1	3.3 ± 1.0	0.806
"Benefits of wearing a WBH*** outweigh the inconveniences"	3.4 ± 1.1	3.3 ± 1.1	0.726
"Benefits of a using sunscreen outweigh the inconveniences"	3.1 ± 1.1	3.4 ± 0.9	0.422
"My employer is serious about skin cancer prevention"	3.7 ± 0.6	3.3 ± 0.8	0.067
"I hear a lot about skin cancer from my employer"	3.2 ± 0.9	2.6 ± 0.9	0.013
Sun protective behaviours			
"I usually wear a LSS when out in the sun at work"	81%	29%	<0.001
"I usually wear a WBH when out in the sun at work"	69%	62%	0.598
"I usually wear sunscreen when out in the sun at work"	35%	38%	0.805
When out in the sun for a significant time on my days off:			
I usually wear a long-sleeved shirt;	19%	32%	0.341
I usually wear a wide brimmed hat;	54%	53%	0.936
I usually use sunscreen.	27%	26%	0.964

*SD = Standard deviation; **LSS = long-sleeved shirt; ***WBH = Wide-brimmed hat. The six main research questions were printed in italics and respective significant results were bolded.

4.2.5 Limitations of the study

The results of the present study need to be interpreted with some caution; in particular, as only two workplaces were involved. The Main Roads Department is one of only two employers in Townsville having an enforced, mandatory sun protection policy (the SunMetals zinc refinery being the other); and while the City Council has a mandatory policy, it is not enforced; that is, employees can work with sleeves rolled up and with no hat. Therefore, the Main Roads Department was the option of choice of a mandatory enforced sun protection workforce in Townsville. Q-Build is one of many workplaces in NQ with a voluntary sun protection policy; it has a safety officer employed to deliver regular 'tool box' occupational health and safety talks, and employees can choose long sleeved work clothing if they wish. Because of this approach, the results of the present study may give an under-estimation of sun damage in NQ outdoor workers under a voluntary workplace sun protection policy, as Q-Build employees were likely to have better knowledge and behaviours than other voluntary sites.

The present study had only a small sample size and therefore low power. In particular, the study did not have the power to detect statistically significant differences for the four research questions relating to the number of sunburns, the suntan level and the number of SK on the right forearm. The actual power of the study was as low as 16% for the question relating to the total number of sunburns, but ranged between 44% and 60% for the remaining questions.

However, the response rate was high because the management of both organisations encouraged employees to attend, and allowed the data collection to occur within work time. We attempted to minimise recall bias in relation to employee's self-reported experience of sunburn and typical sun protection by asking for recent behaviour. Self-reporting of recent sunburns is considered a good overall indicator for both individual sun exposure and cutaneous sun damage.[13] Other questions in the survey measured current knowledge and attitudes to skin cancer and sun protection trying to limit recall bias. No attempt has been made to cross check the self-reported number of previous skin cancers with medical records. SK and suntan level were measured directly, by the same researchers for both workplaces, limiting observer bias.

The participants' demographics, skin type, and their self-reported current level of occupational and recreational sun exposure did not differ significantly between the two workplaces. Multivariate linear regression analyses adjusted for confounding showed that sun protection policy remained a significant factor for the total number of sunburns ($p = 0.004$), suntan level on right forearm ($p = 0.002$), suntan level on dorsum of right hand ($p = 0.028$), number of SK on right forearm ($p = 0.004$), and number of previously excised NMSC ($p = 0.019$). Thus, differences in employees' sun damage found between the two workplaces in the present study were most likely due to their workplace sun protection policy rather than confounding.

While this research was conducted in the Australian tropics, results might also be relevant for subtropical regions. However, before mandatory policies are considered in cooler climates, similar studies are necessary in these regions to prove the effectiveness of sun protective clothing in preventing work-related skin damage.

4.2.6 Discussion

The present study suggests that a mandatory sun protection policy in a tropical region is associated with a reduction in outdoor workers' likelihood of developing NMSC and SK when compared to voluntary sun protection. This finding is the likely result of differences in UV exposure which these outdoor workers experience. Development of SK and NMSC has been linked to both suntans[20] and sunburns.[10,13] Sun exposure is thought to significantly decrease the ability of the skin's immune system to repair chromosomal damage and detect and destroy potential cancerous cells.[23] As extreme rates of UVR occur between 10am to 2pm throughout the year in tropical regions,[6] this chronic UV exposure in long time NQ outdoor workers is likely to contribute to the overwhelming of their skin's natural defences against NMSC.

On the other hand, the present study also suggests that a mandatory workplace sun protection policy is not necessarily associated with any significant improvement in employees' knowledge and beliefs regarding the causes and prevention of skin cancer. Nor does a mandatory sun protection policy appear to be associated with a significant improvement in the employees' attitudes toward sun exposure, using sun protection, or having a suntan. A mandatory workplace sun protection policy does not necessarily lead to an improvement in sun behaviours; that is, the use of long-sleeved shirts, wide-brimmed hats or sunscreen when out in the sun on days off.

Although these non-significant results have to be interpreted with caution because of the limited power of the present study, they suggest that employees who worked under a mandatory sun protection policy used similar levels of sun protection and experienced similar rates of sunburn on days off to the employees who were responsible for their use of sun protection. Therefore, the differences in the objective findings of sun damage between the two groups were more likely due to the difference in work-related sun protection practices.

Because of the extreme UV exposure in NQ, optimal sun protection must include a combination of practices: wide-brimmed hat, long-sleeved shirt, long pants and applying (and re-applying) sunscreen regularly to the remaining sun exposed areas on the face, hands and legs. However, social norms do not support these non volitional behaviours in the general community. Sun protection policies need to be enforced for NQ outdoor workers, and for workers in tropical areas of other countries, as this study suggests that employees who are not made to wear sun protection generally do not use it as recommended.

A likely personal barrier to using sun protection in the voluntary sun protection group is the perception that long-sleeved shirts are too hot and uncomfortable to wear during the warmer months of the year.[15] NQ lies within the tropics, where hot and humid conditions prevail for the majority of the year. However, anecdotal evidence from outdoor workers who use long-sleeved shirts over the warmer months suggests that after an initial period when sweating occurs, the wet sleeves then confer a cooling property to the arms and body. Indeed, the present study showed that employees who were made to wear long-sleeved shirts while working outdoors were less likely to state that long sleeved-shirts are more hot and uncomfortable than short sleeved-shirts.

Even with a mandatory sun protection policy, compliance with using wide-brimmed hats and long-sleeved shirts was less than 100%, as low as 69% for wide-brimmed hats, and sunscreen use was low, suggesting that strategies are needed to ensure compliance. The present study suggests that it is not sufficient in tropical areas to merely provide sunscreen in the workplace or to give outdoor workers a choice to use sun protective clothing. This study recommends that use of appropriate sun protective clothing and sunscreen should be made mandatory for all those who work outdoors, and that this policy should preferably be policed for compliance. Such a mandatory workplace policy has the potential to reduce the rates of skin cancer in NQ.

In conclusion, NQ employees made to wear long-sleeved shirts while working outdoors had significantly reduced sun damage on forearms and hands; a likely consequence of less UVR exposure over several years. Therefore, skin damage from work-related sun exposure would appear to be a key contributor to the development of SK and NMSC in white-skinned people from tropical regions. Mandatory sun protection policies, whereby employees have to be adequately protected whenever they are out in the sun, would reduce this skin damage. Mandatory sun protection policies seem necessary as many people do not engage in adequate sun protective behaviours even after developing multiple skin cancers and skin lesions. A mandatory sun protection policy would also need to be well policed, as this study suggests that even employees made to wear sun protection while working outdoors generally still do not use it as recommended.

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4.5 Conclusions to Chapter 4

A mandatory policy of sun protection for outdoor workers (wearing a long-sleeved shirt with wide-brimmed hat) was associated with outdoor working employees having lighter suntan levels, fewer actinic keratoses on their right forearm and dorsum of right hand, and fewer self-reported recent sunburns and previous skin cancers. These findings suggest that employees who were forced to wear sun protective clothing when working outdoors had significantly reduced sun damage on their forearms and hands; a likely consequence of less harmful UVR exposure over time.

A recent review of previously implemented strategies for reducing exposure to UVR among outdoor workers found insufficient evidence to suggest that any current workplace sun safety program has been effective (Glanz et al., 2007). Therefore, it is recommended here that the most effective strategy to reduce sun-induced skin damage and future epithelial skin cancer in North Queensland outdoor working men is to make the use of a wide-brimmed hat and a long-sleeved shirt mandatory for all who work outdoors in high sun-exposure occupations. This strategy should, over time, also help reduce the extreme rates of epithelial skin cancer currently experienced in the North Queensland region.

Chapter 5

Discussion and final recommendations

This work has exposed a number of misconceptions held by North Queensland men about the causation and prevention of epithelial skin cancer. It may be that many northern Australian men do not have access to factual information about epithelial skin cancer and are therefore unaware of their increased risk of BCC and SCC as a result of having a chronic, dark suntan or from regularly experiencing skin redness without peeling.

It is suggested that these misconceptions could be easily targeted by health promotion messages aimed specifically at men. Medical professionals should advise male patients with a history of skin cancer that having a dark suntan over an extended period and accumulated episodes of skin redness are significantly adding to their risk of developing further skin cancers. In addition, it should be recommended to men that they use a combination of sun protective measures when out in the sun, but with greater reliance on sun protective clothing than artificial shade structures and sunscreen.

In addition, health promotion messages delivered through the media in northern Australia should emphasise the importance of sun protection throughout life; messages that solely target sun exposure during childhood and adolescence might have encouraged the prevailing belief that it is almost pointless to reduce sun exposure during adulthood. Health promotion messages should also emphasise the importance of habitually using sun protection – particularly for outdoor workers or people participating in high-UVR exposure recreational activities to prevent them constantly experiencing sun-related skin damage – and provide factual information explaining the relevance of these messages.

Information should also be provided on ways men can avoid skin damage when participating in occupational or recreational sun activities, and the importance of avoiding skin damage in reducing the risk of developing epithelial skin cancer. Future research could centre around making this information particularly effective for men by including sun protection messages that are more factual and less emotive, and adapting the messages to target peer and family social networks, such as using identified peer leaders to model recommended sun protective practices. This education strategy would make a very significant further study for the North Queensland region with respect to improving the sun protection practices of men participating in more social, high-UVR exposure recreational sun activities.

However, given the many factors that act to reduce the effectiveness of education in improving health-related behaviours, it is recommended that a social engineering strategy is the most appropriate intervention to improve sun protection practices in the workplace. The variety and strength of the barriers of North Queensland men towards using sun protection and the lack of motivators they have against improving their sun protective behaviours means that it is no longer sufficient to merely provide sunscreen in workplaces situated in tropical regions, or to give workers in the tropics the option of using sun protective clothing when outdoors for significant periods. Workplaces in tropical regions need to adopt a more serious commitment to skin cancer prevention, including a mandatory workplace sun protection policy for outdoor workers.

While a prospective, controlled study design is needed to show conclusively that a mandatory workplace sun protection policy will reduce employees' suntan level, episodes of sunburn and numbers of new actinic keratoses and epithelial skin cancer, the evidence gathered in this work is sufficiently strong to support the view that the time has come for workplaces in northern Australia to introduce workplace policies making it mandatory for their outdoor working employees to always wear a long-sleeved shirt and a wide-brimmed hat when out in the sun.

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APPENDIX 1

SURVEY 1

(Chapter 2.2 – 2.4)

Skin Cancer Group

This first section will ask you a few personal details. The other sections will ask about your thoughts and behaviours regarding sun exposure and skin cancer. Please answer ALL questions if possible. Tick or write the answer that is most appropriate for you. There is no right or wrong answer to any question. Tick only ONE box unless otherwise stated.

Examples of how the questions should be answered are shown below:

Do you go to the movies more than once per month? ☐ Yes ☐ No

Do you enjoy Townsville's climate?

					/	

never — half the time — always

What is your date of birth? Day............/Month............/Year............/

What is your current marital status?

Never married or single.	☐	Divorced or separated.	☐
Married or defacto.	☐	Widowed.	☐

In your home, do you live with?

A partner.	☐
Your child/children.	☐
A partner and your children as a family.	☐
Another person/s such as a good friend or relative.	☐
Another person/s to share living costs.	☐
By yourself.	☐

How many years in total have you lived in the tropics (north of Rockhampton)**?** ☐ years

How many years of your childhood (age less than 20 years) **did you live in the tropics?** ☐ years

What AGE were you when your first skin cancer or skin lesion was diagnosed? ☐ years

How many skin cancers or skin lesions have you had removed? ☐

Skin Cancer Group

If you went outside tomorrow and exposed your untanned skin to the sun for about 1 hour between 10 am and 2 pm, what would happen? Please tick the **MOST** appropriate box.

Skin always tans, never burns.	☐
Skin tans easily, burns rarely.	☐
Skin tans with difficulty, burns easily.	☐
Skin never tans, always burns.	☐

This section will ask what you think about the sun and skin cancer. This will give us an insight into the attitudes and beliefs of Townsville men towards sun exposure and skin cancer.

Do you think you will get more skin cancers if you keep on getting sunburnt? ☐ Yes ☐ No

Do you like the sun? Please tick the **MOST** appropriate box.

Yes, I like the sun and I go out and get tanned as often as I want.	☐
Yes, I like the sun, and I get tanned occasionally.	☐
No, I avoid the sun as I have a reaction to it; or because I dislike being in the sun.	☐
No, I avoid the sun because I think it is dangerous to my skin.	☐

Do you think that having a suntan is risky? ☐ Yes ☐ No ☐ Not Sure

Do you think that the benefits of a suntan outweigh the risks? ☐ Yes ☐ No ☐ Not Sure

Do you think you can prevent yourself getting another skin cancer? ☐ Yes ☐ No ☐ Not Sure

Do you think having a suntan prevents you getting more skin cancer? ☐Yes ☐ No ☐ Not Sure

Do you want to change the way you protect yourself from the sun? ☐ Yes ☐ No

Do you feel better when you have a suntan?

no — neutral — very much

Do you look better when you have a suntan?

no — neutral — very much

I think getting a skin cancer depends mainly on a person's skin type.

strongly disagree — not sure — strongly agree

Skin Cancer Group

I think I use sufficient sun protection when I go out in the sun for 1 hour or more.

strongly disagree			not sure			strongly agree

I do not worry about protecting myself from further sun damage because I did so much damage to my skin when I was younger.

strongly disagree			not sure			strongly agree

I think skin cancer is an easily treatable disease.

strongly disagree			not sure			strongly agree

I have already had one or more skin cancers, so it is too late to stop them now.

strongly disagree			not sure			strongly agree

Finding out that I could get skin cancer was traumatic.

strongly disagree			not sure			strongly agree

I think skin cancer is a serious risk to my health.

strongly disagree			not sure			strongly agree

I think my risk of getting another skin cancer is low.

strongly disagree			not sure			strongly agree

How often do you think about sun protection?

never						always

Do you think using sun protection will help prevent another skin cancer?

strongly disagree			not sure			strongly agree

Exactly how many minutes do you think an average, fair-skinned person in Townsville

could stay out in the sun without burning between 10 am and 2 pm in September?

Does sunscreen lose effectiveness after you sweat? ☐ Yes ☐ No

The last time you protected yourself with sunscreen, when did you apply it?

I do not use sunscreen.	☐
I applied sunscreen 20 to 30 minutes before I went out in the sun.	☐
I applied sunscreen just before I went out in the sun.	☐
I applied sunscreen after I was in the sun for a while.	☐

Is this typical of when you apply sunscreen? ☐ Yes ☐ No

What helped cause your skin cancer? Tick "**Yes**", "**No**" or "**Not Sure**" for **EACH** question.

Age.	☐ Yes	☐ No	☐ Not Sure
Injury.	☐ Yes	☐ No	☐ Not Sure
Skin type.	☐ Yes	☐ No	☐ Not Sure
Sun exposure in the last few years.	☐ Yes	☐ No	☐ Not Sure
Poor diet.	☐ Yes	☐ No	☐ Not Sure
Smoking.	☐ Yes	☐ No	☐ Not Sure
Sun exposure in childhood and adolescence.	☐ Yes	☐ No	☐ Not Sure
Stress.	☐ Yes	☐ No	☐ Not Sure
Other? (please describe)			

The following section will quiz you on your sun behaviours. This will tell us how Townsville men protect themselves from the sun, and how much they are exposed to the sun.

The LAST time you spent 20 minutes or more in the sun between 10 am and 2 pm, did you wear a shirt? ☐ Yes ☐ No

If you did wear a shirt, what type of shirt was it? Please tick **ONE** box.

Long-sleeved shirt.	☐
Short-sleeved shirt.	☐
Singlet.	☐
Other? (please describe)	

Do you usually wear this type of shirt when out in the sun for a significant time? ☐ Yes ☐ No

Skin Cancer Group

The LAST time you spent 20 minutes or more in the sun between 10 am and 2 pm, did you wear a <u>hat</u>? ☐ Yes ☐ No

If you did wear a hat, what <u>type</u> of hat was it? Please tick **ONE** box.

Wide-brim hat.	☐
Narrow-brim hat.	☐
Cap.	☐

Do you <u>usually</u> wear this type of hat when out in the sun for a significant time? ☐ Yes ☐ No

The LAST time you spent 20 minutes or more in the sun between 10 am and 2 pm, did you use <u>sunscreen</u>? ☐ Yes ☐ No

If you did use sunscreen, <u>where</u> did you apply it (such as face, hands, etc.)?

....

Do you <u>usually</u> put on sunscreen when out in the sun for a significant time? ☐Yes ☐ No

If you <u>do not</u> always wear protective clothing or sunscreen while out in the sun for 1 hour or more between 10 am and 2 pm, <u>why not</u>? Please tick as **MANY** boxes as applicable.

Because I have olive skin, I probably will not ever develop another skin cancer.	☐
I often do not have the time to worry about sun protection.	☐
I often forget to bring them along.	☐
Inconvenient to use them.	☐
I often do not get around to putting them on.	☐
Hats and long-sleeved shirts are hot and uncomfortable in the tropics.	☐
Hats, long-sleeved shirts and sunscreen are expensive.	☐
Other? (please describe)	

During the LAST week or so, what <u>activities</u> (fishing, exercise, gardening, watching sport, etc.) **did you do that involved being out in the sun for 1 hour or more between 10 am and 2 pm?**

....

Is this <u>typical</u> of the activities that you do during a week? ☐ Yes ☐ No

When you do activities in the sun, do you try to <u>avoid</u> going out between the hours of 10 am to 2 pm? ☐Yes ☐ No

Skin Cancer Group

How do you <u>most prefer</u> to protect yourself from the sun?

....

LAST week, how often did you wear <u>casual clothes</u> (singlet, T-shirt, swimwear, etc.) **in the sun between 10 am and 2 pm?**

never | half the time | always

Is this <u>typical</u> of how regularly you wear casual clothes in the sun at this time? ☐ Yes ☐ No

The next 7 questions are related to your work and recreation. If you are NOT currently working, please make your responses to your LAST permanent job.

LAST week, how much time on an average <u>workday</u> and <u>weekend or day off</u> were you out in the sun? Please tick **ONE** box for workdays, and **ONE** box for days off.

Average Working Day		**Average Weekend Day, or Day Off**	
Less than 15 minutes in the sun.	☐	Less than 15 minutes in the sun.	☐
Between 15 and 30 minutes.	☐	Between 15 and 30 minutes.	☐
Between 30 minutes and 1 hour.	☐	Between 30 minutes and 1 hour.	☐
Between 1 and 2 hours.	☐	Between 1 and 2 hours.	☐
Between 2 to 3 hours.	☐	Between 2 to 3 hours.	☐
Between 3 to 6 hours.	☐	Between 3 to 6 hours.	☐
More than 6 hours.	☐	More than 6 hours.	☐

Is this <u>typical</u> for a work day? ☐ Yes ☐ No **Is this <u>typical</u> for a day off?** ☐ Yes ☐ No

Are you mostly an <u>indoor</u> or <u>outdoor</u> working person?

Indoor.	☐
Outdoor.	☐
About half indoor and half outdoor.	☐

Do your <u>co-workers</u> generally use protection if working in the sun? ☐ Yes ☐ No ☐ N/A

Does your workplace <u>require</u> you use protection if working in the sun? ☐ Yes ☐ No ☐ N/A

Thinking back to your <u>last longer holiday</u> of one or more weeks, what were your major activities? Please tick as **MANY** boxes as applicable.

Fishing.	☐

Skin Cancer Group

Boating.	☐
Working around house or yard.	☐
Travelling.	☐
Hunting or bushwalking.	☐
Indoor activities.	☐
Beach or island activities.	☐
Do not have holidays.	☐
Other? (please describe)	

Do you wear less or more sun protection during the cooler months than in summer?

much less — same — much more

For work or recreation, do you go out in the sun less or more during the cooler months than in summer?

much less — same — much more

On average, how many daylight hours would you spend fishing or boating in a month? ☐

The LAST time you went boating or fishing, how did you protect yourself from the sun (such as long-sleeved shirt, hat, boat canopy, did not worry about protection, sunscreen, etc.)?

....

Is this typical of the sun protection you use when you are boating or fishing? ☐ Yes ☐ No

How often do you go boating or fishing between 10 am and 2 pm?

never — half the time — always

If you have a suntan, why do you? Please tick **ONE** box.

I do not have a suntan.	☐
I work on getting a suntan because I prefer to have a tan.	☐
I have a suntan because with my job it is unavoidable.	☐
I have a suntan because I spend time outdoors on my days off.	☐

How many times did you have severe sunburn (blistering or peeling) **up to your first diagnosed skin cancer?**

never many

What <u>number</u> do you describe as "many" (such as 5, 10, 50, 100, etc)? ☐

How many times have you had <u>severe</u> sunburn (blistering or peeling) **since your <u>last</u> diagnosed skin cancer ?** ☐

How many times have you had <u>mild</u> sunburn (some redness or tenderness) **since your <u>last</u> diagnosed skin cancer?** ☐

Is there <u>someone</u> you occasionally talk with in <u>some depth</u> about skin cancer? ☐ Yes ☐ No

If you do talk with someone, then <u>who</u> is this person?

Spouse	☐
Family or relative	☐
Friend	☐
Medical staff	☐
Other (please describe) …………………………………………………………………	

This last section will ask you a few personal demographics. We will use this information as group data only. These questions will discover if there are particular groups of men that are at greater risk of getting skin cancer. Please do not answer any question that you feel is intrusive.

What has been your <u>usual occupation</u> over your working life (such as teacher, fisherman, etc.)?

……………………………………………………………………………………

How many <u>years</u> have you, or did you, work in your usual <u>occupation</u>? ☐ years

What is your usual work activity <u>now</u>?

Employed or self-employed.	☐	Household duties.	☐
Retired.	☐	Sickness allowance.	☐
Age, disability or support pensioner.	☐	Unemployed.	☐

If currently <u>employed</u> or <u>self-employed</u>, what is your job? ……………………………

If currently working, how many <u>hours</u> per week do you usually work? ☐ hours

Skin Cancer Group

How much is your <u>total yearly household income before tax</u> (including partner's income if living together)? This will be used as group data only, and not connected with you or your partner.

Less than $5,000.	☐	$35,001 to $50,000.	☐
$5000 to $15,000.	☐	$50,001 to $70,000.	☐
$15,001 to $25,000.	☐	More than $70,000.	☐
$25,001 to $35,000.	☐		

What is the highest <u>level of education</u> you have completed? Please tick **ONE** box.

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.	☐
University degree.	☐

Would you like to add <u>anything</u> about your thoughts on your skin cancer that you feel is <u>significant</u>, and has not been covered by this questionnaire?

....

....

....

....

....

Thank you very much for your participation. If you have any queries or problems with the survey, please contact Torres Woolley at the School of Public Health and Tropical Medicine, on 47225761.

APPENDIX 2

SURVEY 2

(Chapter 2.5 – 2.7)

Boat number: ___________
Participant Number: _________

<u>Section 1: Personal Details-:</u> This section will ask some basic demographic information.

1. Sex M / F
2. How old are you? ______ years
3. How many years have you lived in NQLD (north of Rockhampton)? [ ] yrs
4. About how often do you go out in a boat each month? (times/month?)___________.
5. Are you currently employed?

   No
   Yes (How many hours did you spend in the sun on a typical workday last week? ___hr)

6. How dark, would you estimate, is the tan level on your face at the moment?

   Very light ______Light_______Moderate_______Dark________Very dark _________

7. Have you ever had a skin cancer diagnosed by a doctor? Yes (how many_____) / No

(This question will try to determine what skin type you are)

8. If you exposed your untanned skin (inside upper arm) to the sun for a significant period, what do you think would happen to that skin?

   [ ] Skin always tans, never burns
   [ ] Skin tans easily, burns rarely
   [ ] Skin tans with difficulty, burns easily
   [ ] Skin never tans, always burns

Section 2: This next section relates to your sun exposure and your use of sun protection.

9. Approximately, between what hours did you go out in the boat today?

l______l______l______l______l______l______l______l______l______l
7am 8am 9am 10am 11am 12am 1pm 2pm 3pm 4pm

10. What types of sun protection did you wear while out on the boat today?

[ ] long-sleeved shirt	[ ] wide-brimmed hat
[ ] narrow brimmed hat	[ ] sunglasses
[ ] long pants	[ ] cap
[ ] sunscreen	[ ] other (___________________________)

11. How well did you think the other people on the boat protected themselves today?

Persons 1-5 (1 tick per person)

Poor	OK	Good	Very good

12. If you used sunscreen today, when did you apply it?

[ ] 20 minutes before going out in the sun
[ ] Just before going out in the sun
[ ] After being out in the sun a while
[ ] When you realized you were getting a bit red

13. If you used sunscreen today, how many times did you apply it? ________________.

14. What type of sun protection if ANY, do you leave on the boat for next time?

____

15. Did you use a canopy, or covered area, when you went out on the boat today? Yes/ No

Section 3. Attitudes: This section focuses on your attitudes toward using sun protection.

16. Can you think of any reasons that you did not use any of sunscreen, a wide brimmed hat or a long-sleeved shirt today?

____

____

The next 4 questions will be yes or no. Would you say Yes or No that …….?

17. You enjoy exposing your skin to the sun? Yes/ No

18. Do you think getting the occasional sunburn is an acceptable risk? Yes/ No

19. Do you think that a boat canopy is adequate sun protection when boating? Yes/ No

20. Do you think that sun reflection off the water is a big problem? Yes/ No

<u>Section 4. Evaluation of sunburn:</u> ASKED ON THE DAY – sun damage previous to trip

21. About how many months ago did you experience your last serious sunburn? ________

22. Do you have any areas of skin that are still a bit red or tender from going out in the sun previous to today's fishing trip? Yes/ No

ASKED THE NEXT DAY – sunburn prevalence from boating trip

23. Do you have any skin areas still a bit red or tender from going out on the boat yesterday?

    Yes/ No

24. If you are still a bit red, where on your body are you red?

THANKS VERY MUCH FOR YOUR HELP!

<u>Contact Details-:</u> To contact to find out if your skin got a bit red from today's trip……

First Name: ______________________________

Contact phone numbers: Mobile____________________________

APPENDIX 3

JCU Ethics Approvals

JAMES COOK UNIVERSITY

Townsville QLD 4811 AUSTRALIA

ETHICS REVIEW COMMITTEE

(Human Ethics Sub-Committee)

AMENDED

APPROVAL FOR RESEARCH OR TEACHING INVOLVING HUMAN SUBJECTS

PRINCIPAL INVESTIGATOR	*Mr Torres Woolley*
CO-INVESTIGATOR (1)	*Dr Bev Raasch*
CO-INVESTIGATOR (2)	
SCHOOL	*Public Health & Tropical Medicine*
PROJECT TITLE	*Sun damage and sun protection in NQ recreational boaters*

DATE	*1 December 2002 – 31 December 2003*	CATEGORY	*1*

This project has been allocated Ethics Approval Number **H1334**
with the following provisos and reservations:

1. All subsequent records and correspondence relating to this project must refer to this number.
2. The Principal Investigator is to advise the responsible Monitor appointed by the Ethics Review Committee:
   - periodically of the progress of the project;
   - when the project is completed or if suspended or prematurely terminated for any reason.
3. In compliance with the National Health and Medical Research Council (NHMRC) ***"National Statement on Ethical Conduct in Research Involving Humans"*** you are required to provide an annual report detailing security of records and compliance with conditions of approval. The report should very briefly summarise progress.

NAME OF RESPONSIBLE MONITOR	*Dr Kim Usher*
SCHOOL	*Nursing Sciences*
[forwarded by E-mail without signature] *Tina Langford* *Ethics Administrator* Ph: 4781 4342 Fax: 4781 5521 E-mail: Tina.Langford@jcu.edu.au	DATE *10 August 2002*

JAMES COOK UNIVERSITY
Townsville QLD 4811 AUSTRALIA

ETHICS REVIEW COMMITTEE

(Human Ethics Sub-Committee)
AMENDED
APPROVAL FOR RESEARCH OR TEACHING INVOLVING HUMAN SUBJECTS

PRINCIPAL INVESTIGATOR	*Mr Torres Woolley*
CO-INVESTIGATOR (1)	*Dr Petra Buettner*
CO-INVESTIGATOR (2)	
SCHOOL	*Public Health & Tropical Medicine*
PROJECT TITLE	***Exploring sun-related beliefs and behaviours in NQ men and women susceptible to NMSC***

DATE	*1 August 2000 – 31 December 2003*	CATEGORY	*1*

This project has been allocated Ethics Approval Number with the following provisos and reservations: **H1014**

1. All subsequent records and correspondence relating to this project must refer to this number.
2. The Principal Investigator is to advise the responsible Monitor appointed by the Ethics Review Committee:
   - periodically of the progress of the project;
   - when the project is completed or if suspended or prematurely terminated for any reason.
3. In compliance with the National Health and Medical Research Council (NHMRC) ***"National Statement on Ethical Conduct in Research Involving Humans"*** you are required to provide an annual report detailing security of records and compliance with conditions of approval. The report should very briefly summarise progress.

NAME OF RESPONSIBLE MONITOR	*Dr Kim Usher*
SCHOOL	*Nursing Sciences*
[forwarded by E-mail without signature] *Tina Langford* *Ethics Administrator* Ph: 4781 4342 Fax: 4781 5521 E-mail: Tina.Langford@jcu.edu.au	DATE *12 January 2001*

JAMES COOK UNIVERSITY
Townsville QLD 4811 AUSTRALIA

ETHICS REVIEW COMMITTEE

(Human Ethics Sub-Committee)
AMENDED
APPROVAL FOR RESEARCH OR TEACHING INVOLVING HUMAN SUBJECTS

PRINCIPAL INVESTIGATOR	*Mr Torres Woolley*
CO-INVESTIGATOR (1)	*Dr Petra Buettner*
CO-INVESTIGATOR (2)	*Dr Bev Raasch*
SCHOOL	*Public Health & Tropical Medicine*
PROJECT TITLE	***Reducing sun damage in outdoor workers by enforcing the use of protective clothing***

DATE	*1 December 2002 – 31 December 2003*	CATEGORY	*1*

This project has been allocated Ethics Approval Number with the following provisos and reservations: **H1403**

1. All subsequent records and correspondence relating to this project must refer to this number.
2. The Principal Investigator is to advise the responsible Monitor appointed by the Ethics Review Committee:
   - periodically of the progress of the project;
   - when the project is completed or if suspended or prematurely terminated for any reason.
3. In compliance with the National Health and Medical Research Council (NHMRC) ***"National Statement on Ethical Conduct in Research Involving Humans"*** you are required to provide an annual report detailing security of records and compliance with conditions of approval. The report should very briefly summarise progress.

NAME OF RESPONSIBLE MONITOR	*Dr Kim Usher*
SCHOOL	*Nursing Sciences*
[forwarded by E-mail without signature] *Tina Langford* *Ethics Administrator* Ph: 4781 4342 Fax: 4781 5521 E-mail: Tina.Langford@jcu.edu.au	DATE *12 August 2002*

JAMES COOK UNIVERSITY

TOWNSVILLE Queensland 4811 Australia Telephone: (07) 4781 4111

ETHICS REVIEW COMMITTEE

(Human Ethics Sub-committee)

APPROVAL FOR RESEARCH AND TEACHING INVOLVING HUMAN SUBJECTS

PRINCIPAL INVESTIGATOR	*Mr Torres Woolley*
SCHOOL	*Public Health & Tropical Medicine*
PROJECT TITLE	*Knowledge, attitudes & behaviours with respect to the sun in People with previously excised NMSC*

This project has been allocated Ethics Approval Number **H871**

with the following provisos and reservations:

1. All subsequent records and correspondence relating to this project must refer to this number.
2. The Principal Investigator is to advise the responsible Monitor appointed by the Ethics Review Committee:
   - periodically of the progress of the project;
   - when the project is completed or if suspended or prematurely terminated for any reason.

1. In compliance with the National Health and Medical Research Council "Statement on Human Experimentation (and Supplementary Notes)" you are required to provide an annual report detailing security of records and compliance with conditions of approval. The report should very briefly summarise progress.
2. **The project must comply with the provisions detailed in the attached memorandum.**

NAME OF RESPONSIBLE MONITOR	*Dr Peter Leggat*
SCHOOL	*Public Health & Tropical Medicine*
[forwarded by E-mail without signature] *Tanya Healy* *Administrative Officer - Ethics/Legal*	**DATE** *Wednesday, 10 February 1999*

cc. ***MONITOR: Dr Peter Leggat***
DIRECTOR (SCHOOL): Professor Ian Ring

APPENDIX 4

SURVEY 3

(Chapter 4.2)

This questionnaire asks about your thoughts and experiences with sun protection, sun exposure and skin cancer. Please answer ALL questions. Write or tick the answer that is most appropriate for you.

Q1. What are your initials? (e.g., John Edward Citizen) ___________

Q2. What is your date of birth (day/month/year)? ________/_______/______/

Q3. What is your gender? Male ☐ Female ☐

Q4. In total, how many years have you worked outdoors? _________

Q5. How many medically diagnosed skin cancers have you had excised? _________

Q6. Have any of your "blood relatives" had problems with skin cancer? (A blood relative is a brother, sister, parent, grandparent, aunt, uncle). (Yes) (No) (Not Sure)

Q7. At work, how often do you use sunscreen when in the sun? Please tick a box.

Never	Sometimes	Mostly	Always

Q8. At work, how often do you wear a long sleeved shirt when in the sun? Tick a box.

Never	Sometimes	Mostly	Always

Q9. At work, how often do you wear a brimmed hat (not a cap) when in the sun?

Never	Sometimes	Mostly	Always

Q10. Approximately, how many mild sunburns have you experienced in the last month from WORKING in the sun? (Mild sunburn is considered any exposure to the sun that results in skin redness or tenderness without peeling). Please tick ONE box.

☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ **5 or more (How many? _______)**

Q11. Approximately, how many severe sunburns have you experienced in the last month from WORKING in the sun? (Severe sunburn is considered any exposure to the sun that results in skin peeling or blistering). Please tick ONE box.

☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ **5 or more (How many? _______)**

Q12. Approximately, how many mild AND severe sunburns have you experienced in the last month while on your DAYS OFF? Please tick ONE box.

☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ **5 or more (How many? _______)**

Q13. Are you aware that your workplace has a policy on Sun Safety? Yes ☐ No ☐

Q14. Have you previously worked for a company that made it compulsory for employees to wear sun protection? Yes ☐ No ☐

Q15. How many years have you lived in the tropics (north of Rockhampton)? _______yrs

Q16. The LAST time you spent more than 1 hour in the sun on a day off, what clothing did you wear? Please tick as many boxes as applicable.

☐	T-shirt	☐	Long sleeve shirt
☐	Brimmed hat	☐	Cap
☐	Long pants	☐	Shorts
☐	Sunscreen	☐	Sunglasses
☐	Gloves	☐	Other?______________________

Was this typical for days off? Yes ☐ No ☐

If this was NOT typical, what do you usually wear? ____________________________

Q17. LAST week, how much time on an average workday AND day off were you out in the sun? Please tick ONE box for workdays, and ONE box for days off.

Average Working Day		Average Weekend Day, or Day Off	
Less than 15 minutes in the sun.	☐	Less than 15 minutes in the sun.	☐
Between 15 and 30 minutes.	☐	Between 15 and 30 minutes.	☐
Between 30 minutes and 1 hour.	☐	Between 30 minutes and 1 hour.	☐
Between 1 and 2 hours.	☐	Between 1 and 2 hours.	☐
Between 2 to 3 hours.	☐	Between 2 to 3 hours.	☐
Between 3 to 6 hours.	☐	Between 3 to 6 hours.	☐
More than 6 hours.	☐	More than 6 hours.	☐

Is this typical for a workday? ☐Yes ☐ No

Is this typical for a day off? ☐ Yes ☐ No

If this was NOT typical, what is?______hrs

If this was NOT typical, what is?______hrs

Q18. If you went outside tomorrow and exposed your untanned skin to the sun for about 1 hour between 10 am and 2 pm, what would happen? Please tick the **MOST** appropriate box.

My skin always tans, never burns.	☐
My skin tans easily, burns rarely.	☐
My skin tans with difficulty, burns easily.	☐
My skin never tans, always burns.	☐

This next section will ask you questions about the causes and prevention of skin cancer. Please tick either Yes (Y), No (N) or Not Sure (NS).

Q19.	You can <u>feel</u> ultra-violet radiation hitting your skin.	(Y)	(N)	(NS)
Q20.	Having <u>sun darkened</u> (tanned) skin reduces your risk of skin cancer	(Y)	(N)	(NS)
Q21.	<u>Skin redness without peeling</u> increases your risk of skin cancer.	(Y)	(N)	(NS)
Q22.	A cap provides <u>adequate</u> sun protection for your face.	(Y)	(N)	(NS)
Q23.	People with <u>"olive"</u> skin types can get multiple skin cancers.	(Y)	(N)	(NS)
Q24.	Using sunscreen <u>by itself</u> is adequate sun protection.	(Y)	(N)	(NS)
Q25.	Skin cancer is strongly linked to sun damage during <u>childhood.</u>	(Y)	(N)	(NS)
Q26.	Skin cancer has no link to sun damage in <u>adulthood</u>.	(Y)	(N)	(NS)
Q27.	People with <u>fair skin</u> have a higher risk of skin cancer.	(Y)	(N)	(NS)
Q28.	People with natural <u>red hair</u> have a lower risk of skin cancer.	(Y)	(N)	(NS)
Q29.	People with <u>light coloured eyes</u> have a higher risk of skin cancer.	(Y)	(N)	(NS)

Please tick **ONE** box to answer each of the next 6 questions

Q30. Ultra-violet radiation (UVR) gets reflected off all surfaces the <u>most</u> on ......?

☐ Clear days	☐ Overcast days
☐ Partially cloudy or hazy days	☐ Rainy days

Q31. How strong are UVR levels between 10am to 2pm during the <u>Townsville winter</u>?

☐ Low	☐ High
☐ Medium	☐ Extreme

Q32. To <u>adequately</u> protect yourself from the tropical sun, you should use or wear.....?

☐ Long sleeved shirt	☐ Sunscreen
☐ Wide brimmed hat	☐ All these methods in combination

Q33. Approximately, how many <u>years</u> of working outdoors in north Queensland does it take before your risk of skin cancer <u>rises significantly</u>?

☐ 1	☐ 15
☐ 5	☐ 25

Q34. <u>When</u> should you apply sunscreen?

☐	20 minutes before going out	☐	After you have been out a while
☐	Just before going out	☐	When you see your skin is a bit red

Q35. Over winter, daily UVR levels in North Queensland are approximately ....?

☐	The same as in Victoria	☐	Three times more than in Victoria
☐	Half as much as in Victoria	☐	Six times more than in Victoria

This last section asks about attitudes to the sun. Tick ONE box for each question.

Q36. Do you <u>enjoy</u> being out in the sun?

Not at all | Little bit | Fair bit | A lot

Q37. Do you <u>feel</u> better when you have <u>tanned</u> skin?

Not at all | Little bit | Fair bit | A lot

Q38. Do you <u>look</u> better when you have <u>tanned</u> skin?

Not at all | Little bit | Fair bit | A lot

Q39. How <u>susceptible</u> are you to getting skin cancer?

Not at all | Little bit | Fair bit | Very much

Q40. Do you think your employer genuinely considers skin cancer to be a <u>serious</u> workplace health and safety issue?

Not at all | Little bit | Fair bit | Very much

Q41. Do you hear <u>a lot</u> about skin cancer prevention from your employer?

Not at all | Little bit | Fair bit | Very much

Q42. Do you think it is important to use sun protection in the cooler months?

Not at all	Little bit	Fair bit	Very much

Q43. Do you think it is important to use sun protection on your days off?

Not at all	Little bit	Fair bit	Very much

Q44. How important to you is having a healthy diet?

Not at all	Little bit	Fair bit	Very much

Q45. How important to you is having a regular health check?

Not at all	Little bit	Fair bit	Very much

Q46. When working in the sun, are long sleeved shirts more hot and uncomfortable than short sleeved shirts?

Not at all	Little bit	Fair bit	Lot more

Q47. To prevent peeling sunburn, how useful is having sun-darkened (tanned) skin?

Not at all	Little bit	Fair bit	Very useful

Q48. When you work outdoors, is being cool and comfortable more important than being protected from the sun?

Not at all	Little bit	Fair bit	Very much

Q49. Do you think having sun-darkened skin increases your risk of skin cancer?

Not at all	Little bit	Fair bit	Very much

Q50. Do you think getting <u>skin redness</u> from sun increases your risk of skin cancer?

Not at all	Little bit	Fair bit	Very much

Q51. Do you think using sun protection will <u>reduce</u> your risk of getting skin cancer?

Not at all	Little bit	Fair bit	Very much

Q52. Do the <u>benefits</u> of having <u>tanned</u> skin outweigh the risks?

Not at all	Not really	A little	Very much

Q53. Do the <u>benefits</u> of using <u>sunscreen</u> outweigh the inconveniences?

Not at all	Not really	A little	Very much

Q54. Do the <u>benefits</u> of wearing a <u>hat</u> outweigh the inconveniences?

Not at all	Not really	A little	Very much

Q55. Do the <u>benefits</u> of wearing a <u>long sleeved shirt</u> outweigh the inconveniences?

Not at all	Not really	A little	Very much

Q56. Is regular sun exposure on unprotected areas of skin an <u>acceptable risk</u>?

Not at all	Not really	A little	Very much

Q57. How likely is it that you will have <u>5 or more</u> skin cancers by age 60?

Not at all	Unlikely	Possible	Very likely

THANK YOU FOR YOUR TIME

Skin examination data

Personal details

Initials of Name (e.g., **J**ohn **E**dward **S**mith): ……………………….

Date of Birth (Day/Month/Year): ………../………../…………/

Skin measurements

1. Skin reflectance on upper right arm:

   Reading 1: ____________________

   Reading 2: ____________________

   Reading 3: ____________________

2. Skin reflectance on right forearm:

   Reading 1: ____________________

   Reading 2: ____________________

   Reading 3: ____________________

3. Skin reflectance on back of right hand:

   Reading 1: ____________________

   Reading 2: ____________________

   Reading 3: ____________________

4. Number of solar keratoses on forearms ____________

   Number of solar keratoses on dorsum of hands ____________

APPENDIX 5

QUALITATIVE INTERVIEW QUESTIONS

(Chapter 3.2)

Focus group questions – men and women

Well, let's start. I'd like to ask a general question about what you do for sun protection

Q1. Everyone briefly describe what is your general sun protection strategy when you know you'll be out in the sun for a length of time. If you don't have one, just say that.

Q2. Does anyone bother with sun protection if you are not going out for a reasonable length of time?

Q3. OK, tell us how well your overall sun protection strategy actually works to avoid getting a bit burnt (good, OK, bad, etc)?

Q4. How many sunburns would you get a year, then, you'd estimate?

"These next 3 questions are mainly for those who reckon their sun protection strategy works at least OK".

Q5. Tell me about which part of your sun protection strategy you believe works the best for preventing sunburn.

Q6. Did anyone tell or show you how to do this, or did you read about it somewhere?

Q7. Does anyone hassle you about using sun protection (further questions - what did they say, how did you feel being harassed)?

"These next 4 questions are mainly for those whose sun protection strategies do not always work".

Q8. How often would you remember to use sun protection when you go out in the sun? (how come you use protection in some situations, and not others).

Q9. Do you think your NOT using sun protection in sometimes is more because of habit, or more because of a conscious decision?

Q10. OK now, what do you reckon is the main cause behind you sometimes getting sunburnt?

Q11. Anything in particular you could do that would stop you getting sunburnt in the future? (e.g., what is stopping you from doing this now?).

" To finish off the sun protection section, I'll ask everyone 3 more questions".

Q12. Describe to me what you dislike the most about sun protection.

Q13. Do you come across information about using sun protection or skin cancer anywhere? What does the info say?

Q14. Finally, if you used sun protection every time you spent more than half an hour in the sun, would it stop you getting skin cancer when you're older?

"Anyone have anything to say about using sun protection that they feel is important before we move on?"

"The last part of our discussion will be to talk a bit about suntans and sunburns."

Q15. OK everyone, are there any good things associated with having a suntan? (look better to the women/yourself/look healthier). (do men without a tan look normal, or unhealthy). (do men without a tan look normal, or a bit wimpy?)(do women look better with a tan?)

Q16. Are there any bad things you associate with a suntan?

Q17. How concerned would you be about getting skin cancer in the future if you had a suntan?

Q18. How concerned about getting future skin cancer would you be if you had a mild sunburn (skin redness or tenderness)?

Q19. How concerned about getting future skin cancer would you be if you had severe sunburn (blistering or peeling)?

Q20. Estimate how many sunburns would it take before you had enough to get a skin cancer (1-5, 5-10, 10-20,30-50, 50-100,100-200, etc)?

Q21. If you got a skin cancer, what age do you reckon you would most likely get it?

Q22. At this moment in your life, just how serious a health issue is skin cancer to you?

Q23. Do you worry about any other health issues? (how come - more serious health issues to worry about, or you think your chances of getting skin cancer are not high enough to worry about).

Questions for outdoor workers

A. Skin cancer/sun protection as a health issue

1. Do you think your employer pushes the theme that skin cancer prevention is an important health and safety issue at work?

2. As people who work in the sun, do you feel the same way about skin cancer prev'n?

3. What health issues, if any, concern you at the moment? What's more important to you – a long and healthy life, or looking good and healthy now? (suntan dangerous?)

4. And skin cancer as a health issue, how important/serious is that?
   How often you think about skin cancer prevention?

5. Who works outdoors? At the moment, who here wears a long sleeve shirt and hat in the sun at work? What is main reason you do - risk-taking personality??- value health)
   Do you still use a long sleeve shirt and hat in the cooler months?
   (Look for lighter skin, ask about family history)

   Why not? (look for skin type – ask lighter skin guys about susceptibility. If hot, ask them if they ever used long S shirts, and how many skin cancers expect to get – age)

   Some older guys said it was partly a bravado thing not to use sun protection – a melanoma skin cancer could kill you if you got it and didn't notice it until too late – but there was every chance that you wouldn't get one. Do you think this 'living dangerously, bravado attitude is still an attitude young guys have to sun protection?

Sun protection on days off

Who here mostly puts on some sun protection when out in the sun on weekends?

> What is your main reason you do? (what activities…look for lighter skin, ask about family history)

If people who only go out in the sun on weekends – is not wearing sun protection sort of an acceptable risk – what age???

Attitude to suntans

What level of skin colour, or tan, do you prefer?

> How come? / (How dark before it is unsafe?)
>
> Do you think having a tan from the sun leads to your skin looking a bit rougher? (….is this good, bad, or OK if your tan is not too dark)

Attitude to sunburns

> Experience skin redness from time to time?

Thinking about nasty sunburns, when it hurts quite a bit, how long it is usually between the next nasty burn? (any ideas why you get a nasty sunburns from time to time – forget about how painful they are, stay out too long, forget to bring along sun protection??)

Skin cancer messages

Information about skin cancer – where, if anywhere, do you see or read about messagesabout skin cancer?

What do these messages tell you about skin cancer?

Lastly, what if you were made to use a long sleeve shirt and wide brim hat at work?

“OK, before we finish, does anyone have any burning issues that they’d like to bring up?”

APPENDIX 6

LETTERS OF SUPPORT

Main Roads Department

Q-Build

JAMES COOK UNIVERSITY
Townsville campus
Townsville QLD 4811 AUSTRALIA
Telephone: (07) 4781 4111 Web: www.jcu.edu.au

Mr. Torres Woolley
Skin Cancer Group
James Cook University
Townsville NQLD 4811

30th May, 2002

Mr. Brett Thompson
Safety Officer,
Main Roads Department,
Townsville NQLD 4810.

Dear Brett,

I am writing in relation to our recent discussion about the possibility of Main Roads Department (North Queensland) participating in a study to be carried out by James Cook University.

As I explained, the aim of the study is to determine whether employees of companies enforcing a Sun Protection policy show differences in both attitudes to the seriousness of skin cancer and their sun protection behaviours on days off, compared with employees from companies not enforcing a sun protection policy.

The study will involve employees who spend at least an hour a day working out of doors. Employee inclusion in the study will be on a voluntary basis, and only after they have given their informed consent in writing.

At the start of the study, employees will be asked to complete a questionnaire and undergo an examination of the skin on their forearms for sunspots and tan level. The examination will be carried out by an experienced General Practitioner. All employees who participate in the study will be offered the opportunity of having a full body examination for skin cancer. Participants will be immediately informed if a suspicious lesion is identified, but will be still included in the study.

Data collected during the study will be stored in a password-protected computer and in a locked cabinet of the office of the principal investigator. Only summary data of the study will be published, and no personal data will be released. Your company will be provided with a copy of the report of the study outcomes. It is expected that the study will commence approximately at the end of June this year, and will continue until the end of June, 2003.

If you are agreeable to your company participating in the study, could you please indicate your consent by co-signing the enclosed copy of this letter, and returning it to me.

Yours sincerely,

Date 31·5·02

Torres Woolley,
PhD Student, James Cook University

Date 31/5/02.

Brett Thompson
Safety Officer, Main Roads Department

JAMES COOK UNIVERSITY
Townsville campus
Townsville QLD 4811 AUSTRALIA
Telephone: (07) 4781 4111 Web: www.jcu.edu.au

4th December, 2002

Mr. Don Matthews,
North Queensland Manager,
Q-Build,
Townsville NQLD 4810

Dear Mr. Matthews,

I am writing in relation to our recent discussion about the possibility of Q-Build (North Queensland) participating in several studies to be carried out by James Cook University. The studies have the overall aim of reducing the risk for employees of Q-Build in North Queensland, of heat illness over the summer months and in enclosed spaces, and future sun damage and skin cancer. It is intended that the results of these studies be implemented in regional and metropolitan Q-Build units throughout Queensland.

The studies will involve employees who spend at least an hour a day working outdoors. Employee participation in the studies will be on a voluntary basis, and only after they have given their informed consent in writing. Any data collected during the study will be stored in a password-protected computer in a locked cabinet in the office of the JCU researcher. Only summary data of the study will be published, and no personal data will be released. Your company will be provided with a report of the outcome of each study. It is expected that the studies will commence in December this year, and will continue until the end of June, 2003.

If you are agreeable to your company participating in the study, could you please indicate your consent by co-signing the enclosed copy of this letter, and returning it to me.

Yours sincerely,

Torres Woolley Date 5·12·02

Torres Woolley,
PhD Student, JCU.

Don Matthews Date 5/12/02

Don Matthews ,
Q-Build Manager (NQLD).

APPENDIX 7

PARTICIPANT CONSENT FORMS

INFORMED CONSENT FORM

School: School of Public Health & Tropical Medicine, James Cook University.

Chief Investigator: Mr. Torres Woolley, School of Public Health & Tropical Medicine.

Contact Details: Phone Torres Woolley, on 47225761.

Description of Project: Participants will be placed into groups of 4 to 5 men of similar age. Participants will choose a convenient method of discussion, time and place (if required). Group discussions are expected to take not more than 45 minutes. A UV-protective long-sleeved shirt will be given to all participants, plus nibblies and drinks if required. Groups will discuss beliefs and behaviours toward sun exposure and sun protection relevant to their age group and the north Queensland lifestyle. The aim of the groups is to explore beliefs and behaviours with regards to sun protection, sunburns and skin cancer. Discussions will involve recorded transcripts.

CONSENT

The aims of this study have been clearly explained to me and I understand what is needed of me. I know that taking part in this project is voluntary, and I am aware that I can stop taking part in it at any time.

I understand that any information I give will be kept strictly confidential and that no names will be used to identify me with this study without my approval.

Name: *(printed)*

Signature: **Date**:

Contact Telephone Number:

Preferred days: **Preferred hours:**

INFORMED CONSENT FORM

Faculty: Health, Life & Molecular Science, James Cook University.

Chief Investigator: Mr. Torres Woolley, School of Public Health & Tropical Medicine.

Contact Details:	Telephone	Ms. Carmen Nicholson	47745854
		Mr. Torres Woolley	47225761

Description of Project: Participants will be placed into Internet chat groups of 4 to 5. Participants will choose a convenient time and place. Group discussions are expected to take not more than 45 minutes. Groups will discuss the risk taking behaviours of first and second year OT students. The aim of the groups is to explore the factors that influence their participation in risk taking behaviours. Discussions will involve recorded transcripts, though no names will be identified and an alias used when entering the chatroom.

CONSENT

The aims of this study have been clearly explained to me and I understand what is needed of me. I know that taking part in this project is voluntary, and I am aware that I can stop taking part in it at any time.

I understand that any information I give will be kept strictly confidential and that no names will be used to identify me with this study without my approval.

Name: *(printed)*

Signature: **Date**:

Contact Telephone Number:

Preferred days: **Preferred hours:**

APPENDIX 8

PARTICIPANT INFORMATION SHEET

JAMES COOK UNIVERSITY
Townsville campus
Townsville QLD 4811 AUSTRALIA
Telephone: (07) 4781 4111 Web: **www.jcu.edu.au**

Skin Cancer Research Group
JCU House
57 Mitchell Street
North Ward QLD 4810

17th December, 1999

Dear Sir,

I would like to ask you for your assistance. I am a researcher from the Skin Cancer Research Group, School of Public Health and Tropical Medicine, James Cook University. I have begun a study to reduce skin cancer in North Queensland men. A recent skin cancer incidence survey run by the Research Group has identified that the Townsville region has the highest recorded rates of skin cancer in the world, and that these rates are especially high in men. The Research Group needs to obtain more information about why so many men get such large numbers of skin cancers.

Your information will be of great value in trying to reduce skin cancer in the Queensland tropics. I have approached your GP, who has given permission to send you this letter.

To participate in the study, you are asked to complete the enclosed questionnaire. There are no right or wrong answers. However, the accuracy and reliability of each answer is very important. Your participation is completely voluntary, and will not affect any future medical treatment. You will be identified only by a code number, so strict confidentiality will be maintained at all times. The information will help to design programs to reduce the incidence of skin cancer in the tropics.

Please send back the questionnaire in the envelope provided, with your feedback if possible. The questionnaires will be processed in 2 weeks time, so your response is needed soon. I hope you can assist us with this important health problem.

Yours sincerely,

Mr. Torres Woolley
PhD Student.

If you have any queries about the survey questionnaire, please phone Mr. Torres Woolley at the School of Public Health and Tropical Medicine, on 47225761, or your personal GP.

JAMES COOK UNIVERSITY
Townsville campus
Townsville QLD 4811 AUSTRALIA
Telephone: (07) 4781 4111 Web: **www.jcu.edu.au**

Dear Mr -

Thank you very much for supporting my skin cancer questionnaire last year. Because of your contribution, and the contribution of others like yourself, I was able to uncover new information on men's sun protection and sun exposure beliefs and behaviours which may be contributing to Townsville's skin cancer problem.

However, I once again need your help. I would like to invite you to participate in one of several discussion groups of Townsville men with an interest in skin cancer. These groups are solely for the purpose of research. Using these discussion groups, I hope to discover the human factors lying behind the questionnaire findings. These discussions may uncover valuable information that would be impossible to obtain by other means.

Using group discussions to uncover information is not new, but such groups have not previously been used in the field of skin cancer. Perhaps as a consequence, there has never been a successful education program to improve sun beliefs and behaviours anywhere in the world. We must fully investigate all at-risk sun-related beliefs and behaviours if we are to design a program to reduce our high rates of skin cancer.

The group sessions will be organized to take between 40 to 45 minutes. The groups will involve myself and an assistant, and from 5 to 7 interested men of similar age. Groups will discuss questions on sunburn, sun protection and skin cancer. While this is solely for research, it does not mean the groups will be formal. In fact, the best information arises from relaxed and enjoyable discussions amongst the participants themselves. To this end, a selection of nibblies and free drinks will be available during and after the discussion. Also, a free SunSmart hat will be given to all participants on arrival.

I would like to hold these group sessions at a time and place convenient for you, so please put down a time and place on the consent form provided. My suggestions are Seagulls Holiday Resort, in North Ward, and Brothers Leagues Club, in Kirwan.

Please sign the consent form and post it back in the return envelope if you wish to participate. Your participation is completely voluntary. I will then contact you regarding possible times and venue for the discussion groups.

Yours sincerely,

Torres Woolley,
PhD Student, Skin Cancer Group.

If you have any questions about the discussion groups, please phone Mr. Torres Woolley, at the School of Public Health and Tropical Medicine, on 47225761.

INFORMATION SHEET

SUN PROTECTION in OUTDOOR WORKERS Study

Skin Cancer Research Group

Aims of the study

Skin cancer is a major health problem in North Queensland, causing significant ill health, disfigurement and death. North Queensland has the highest reported rates of skin cancer in the world. Using adequate sun protection when working in the sun should reduce your risk.

Your work place is participating in a research project in association with the Skin Cancer Research Group, James Cook University. The project is designed to assess how workplace sun protection policies influence their employee's attitudes towards using sun protection and their level of sun exposure on days off. A questionnaire will investigate attitudes towards using sun protection and recent sun exposure. Level of sun exposure will be determined by investigating the level of suntan and presence of solar keratoses on the back of your hands and forearms. Your co-operation in this study will be a very valuable part of collecting information on sun exposure and attitudes to sun protection in North Queensland.

Your Part in the Study

We are asking for your consent to have a local GP examine the back of your hands and forearms for level of suntan and the presence of solar keratoses. We are also asking you to fill out a questionnaire, which will take 5 to 10 minutes of your time. This questionnaire shall ask about your attitudes towards sun protection and your recent sun exposure.

You are under no obligation to take part in the study.
If you choose not to participate there will be no detriment to your career.
You may withdrawal from the study at any time with no detriment to your career.

Risks of the study

The researchers are not aware of any potential risk arising with your participation in this study. Please do not hesitate to contact us on the number below with any concerns.

"Skin Cancer Research Group" – Mr. Torres Woolley/ Dr. Bev Raasch/ Dr. Petra Buettner
School of Public Health and Tropical Medicine, James Cook University
Phone: 47 961721/ Fax: 47 961767

APPENDIX 9

PUBLISHED ARTICLE

ARISING FROM THIS THESIS

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TO COPYRIGHT RESTRICTIONS

APPENDIX 10

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