

# The Influence of Age and Gender in Knowledge, Behaviors and Attitudes Towards Sun Protection: A Cross-Sectional Survey of Australian Outpatient Clinic Attendees

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## Abstract

**Objective** The aim of this study was to evaluate the differences in knowledge, attitudes, and behaviors regarding sun protection in different age groups and between men and women.

**Method** A multicenter cross-sectional study using a population-based survey of 416 individuals over the age of 18 years was undertaken during 2014.

**Results** Of individuals aged 18–30 years, 94 % had experienced at least one episode of sunburn in the previous year. The likelihood of self-examining increased as age increased ( $p < 0.001$ ). Only 15 % of participants used the recommended amount (40 ml) of sunscreen. Women were twice as likely to put on sunscreen as men. Women had better knowledge about sun protection and sunscreen use, and were twice as likely to know that sunscreen was denatured by heat and had an expiry date ( $p = 0.01$ ). Women were more than twice as likely to put on sunscreen every day compared with men ( $p = 0.002$ ). Reported barriers to sunscreen use included greasiness and forgetfulness and this was more commonly reported as age decreased ( $p = 0.002$ ;  $p = 0.004$ ). The younger population was less likely to use more than one modality of sun protection ( $p = 0.05$ ).

**Conclusion** This study highlights a number of gender- and age-specific findings with regards to sun protection.

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There are knowledge, attitude, and behavior deficiencies within each demographic group that need to be specifically targeted through educational and public health efforts in order to improve general sun protection measures and decrease the incidence of skin cancers.

## Key Points

Gender and age influence sun-protective behavior.

Educational and public health campaigns need to be tailored to specific target population groups.

A number of significant deficiencies exist in sun-protection knowledge, behavior, and attitudes in the general community.

## 1 Introduction

Australia has one of the highest incidence rates of skin cancer in the world. It remains a large and important public health concern. Melanoma is the fourth most common cancer in Australia with 11,405 new cases of melanoma diagnosed in 2010 [1, 2]. Rates of non-melanoma skin cancer (NMSC) continue to rise across all age groups in Australia. The incidence of NMSC is not captured in national cancer statistics; however, costs to Medicare for treating NMSC continue to rise and the cost to Medicare is expected to reach 1 billion dollars annually in the not too distant future. NMSC is the most costly cancer in the Australian health system, making its control more relevant than ever [3, 4].

In the past, the high incidence of skin cancer has been addressed by public campaigns, both short- and long-term, plus public health policies. The SunSmart campaign when actively promoted was very effective in raising awareness of the need for Australians to protect their skin from the sun, with some suggestion from a recent study that there may be a decline in skin cancer incidence in those aged under 45 years [5]. However, with the overall continued rise in the incidence of skin cancer, there has been a general decline in the awareness of protective measures and active measures to implement them [6].

This study sought to evaluate whether there were differences in knowledge and actions in implementation of sun protection measures in different age groups and between men and women.

## 2 Materials and Methods

A multi-center, cross-sectional survey was performed in the dermatology outpatient clinic of two separate private consulting rooms in Gosford and Mona Vale, New South Wales, Australia, in addition to the general outpatient clinics of Royal North Shore Hospital, New South Wales, Australia from February 2014 to June 2014. English-speaking patients and accompanying friends and family over the age of 18 were eligible to participate in the study. Those attending for any reason to the private dermatology clinics were invited to complete the questionnaire. Patients and family members in the waiting room at the general outpatient clinics of Royal North Shore Hospital were approached on a random basis to participate in the survey. The survey consisted of questions that evaluated behavior, knowledge, and attitudes regarding sun protection. This study was approved by the by Northern Sydney Local Health District Human Research and Ethics Committee.

### 2.1 Questionnaire (Electronic Supplementary Material 1)

The questionnaire collected the following data:

1. Demographic (age, gender)
2. Knowledge (understanding of SPF, UVA/UVB, Vitamin D, denaturing of sunscreen)
3. Sun exposure and protective behavior (skin cancers, self-examining for cancers, frequency of exposure to sun, solarium use, tanning behaviors, use of sunscreen, long-sleeved shirts, hats, avoidance of sun at peak times), barriers to sun-protective behaviors (greasiness, burning of eyes, acne, forgetfulness, nanoparticle concerns)

4. Behaviors (giving up sunbathing, willing to use sunscreen, hats and long-sleeved clothing, seeking shade)
5. Application of sunscreen (SPF used, seasonal application of sunscreen, frequency of application and reapplication, amount used, proper storage of sunscreen, checking for expiry of sunscreen). The recommended amount of sunscreen used (35–40 ml) in our survey was derived from the amount of sunscreen required to cover the average body surface area of an adult (1.8 m<sup>2</sup>) at the recommended thickness of 2 mg/cm<sup>2</sup>, from which SPF of sunscreens are tested [7, 8].

### 2.2 Statistical Analysis

Survey responses were analyzed using descriptive frequencies and binary logistic regression analysis using SPSS<sup>®</sup> 22.0 (SPSS Inc., Chicago, IL, USA).

## 3 Results

### 3.1 Demographic Data

A total of 416 participants completed the questionnaire. 174 (42 %) identified as male. 242 (58 %) identified as female. 10 % were aged between 18 and 30 years, 20 % between 31 and 45 years, 29 % between 46 and 60 years and 41 % over 60 years of age.

### 3.2 Sun Exposure and Protective Behavior (Tables 1, 2)

Thirty-five percent of all participants reported having had skin cancer. As expected, the reported history of having had a skin cancer increased with age ( $p < 0.001$ ). The reported history of a previous skin cancer was twice as likely in men as it was in women ( $p = 0.002$ ).

Forty-seven percent reported at least one episode of sunburn in the previous year and, significantly, 94 % of the 18–30-year-old group had experienced at least one episode of sunburn in the past year. The likelihood of experiencing sunburn decreased as age increased ( $p = 0.02$ ). The odds ratio for the likelihood of individuals over the age of 60 years to self examine for skin cancers was 3.3 (95 % CI 1.6–6.7) compared with those in the 18–30 age group.

Seventy-one percent of participants spent the majority of their day indoors, with only 5 % spending the majority of their time outdoors. Men were three times as likely as women to spend most of their time outdoors (odds ratio [OR] 3.40; 95 % CI 1.37–8.45).

**Table 1** Sun exposure and protective behavior and gender

	Gender		OR	95 % CI	p value
	Males 41.9 % (n = 174) n (%)	Females 58.1 % (n = 242) n (%)			
Skin cancer incidence	75 (43)	70 (29)	1.86	<b>1.24–2.80</b>	<b>0.002</b>
Incidence of sunburn					
1–5	75 (43)	92 (38)	1.24	0.83–1.84	0.30
6–10	5 (3)	7 (3)	0.99	0.31–3.18	0.99
10+	5 (3)	12 (5)	0.57	0.20–1.64	0.30
Self examination for skin cancers	111 (64)	169 (70)	0.76	0.50–1.15	0.20
Most time of day spent					
Indoors	106 (61)	186 (77)	0.47	<b>0.31–0.72</b>	<b>&lt;0.001</b>
Outdoors	16 (9)	7 (3)	<b>3.40</b>	<b>1.37–8.45</b>	<b>0.01</b>
Previous solarium use	5 (3)	44 (18)	<b>0.13</b>	<b>0.05–0.34</b>	<b>&lt;0.001</b>
Application of sunscreen before sunbathing	113 (65)	177 (73)	0.68	0.45–1.04	0.07
Reapplication after					
Swimming	111 (64)	169 (70)	0.76	0.50–1.15	0.20
Sweating	19 (11)	10 (4)	2.84	1.29–6.28	<b>0.01</b>
Both	45 (26)	63 (26)	0.99	0.64–1.55	0.97
Use of sunscreen	132 (76)	211 (87)	0.46	0.28–0.77	<b>0.003</b>
Use of SPF30 + sunscreen	111 (64)	143 (59)	1.22	0.82–1.82	0.33
Use of long-sleeved shirts	85 (49)	82 (34)	1.86	1.25–2.78	<b>0.002</b>
Use of hats	143 (82)	169 (70)	1.99	1.24–3.21	<b>0.005</b>
Avoidance of sun at peak times	113 (65)	174 (72)	0.72	0.48–1.10	0.13

**Table 2** Sun exposure and protective behavior and age

	Age group (years)				p value
	18–30 (n = 40) n (%)	31–45 (n = 85) n (%)	46–60 (n = 119) n (%)	60+ (n = 172) n (%)	
Skin cancer incidence	0 (0)	9 (11)	38 (32)	100 (58)	<b>&lt;0.001</b>
Incidence of sunburn					
1–5	34 (86)	49 (58)	39 (33)	40 (23)	<b>&lt;0.001</b>
6–10	2 (5)	3 (4)	4 (3)	2 (1)	0.11
10+	1 (3)	4 (5)	8 (7)	3 (2)	0.40
Self examination for skin cancers	19 (47)	53 (62)	86 (72)	129 (75)	<b>&lt;0.001</b>
Most time of day spent					
Indoors	31 (77)	62 (73)	84 (70)	122 (71)	0.42
Outdoors	3 (7)	0 (0)	10 (8)	9 (5)	0.57
Previous solarium use	4 (11)	15 (18)	18 (15)	12 (7)	0.07
Application of sunscreen before sunbathing	6 (14)	14 (16)	35 (29)	77 (45)	<b>0.04</b>
Reapplication after					
Swimming	25 (62)	54 (63)	81 (68)	131 (76)	<b>0.02</b>
Sweating	4 (11)	7 (8)	5 (4)	14 (8)	0.77
Both	12 (29)	26 (30)	35 (29)	28 (16)	<b>0.006</b>
Use of sunscreen	36 (90)	79 (93)	102 (86)	127 (74)	<b>&lt;0.001</b>
Use of SPF30 + sunscreen	21 (53)	54 (63)	77 (65)	105 (61)	0.64
Use of long-sleeved shirts	10 (24)	26 (30)	40 (34)	93 (54)	<b>&lt;0.001</b>
Use of hats	23 (58)	62 (73)	94 (79)	132 (77)	<b>0.03</b>
Avoidance of sun at peak times	21 (53)	57 (67)	88 (74)	120 (70)	0.08

Nearly all participants (99 %) reported not currently using a solarium (a tanning unit for non-medical purposes), although 12 % stated that they had previously used one. Of those who had used a solarium in the past, the majority were women, who were six times as likely as men to have used one ( $p < 0.001$ ). Those aged 30–60 years were more likely to have used a solarium compared with those under 30 years and those over 60 years.

A large portion (30 %) reported not applying sunscreen before sunbathing. As age increased, people were more likely to use sunscreen before sunbathing ( $p < 0.001$ ). Eighty-three percent of participants used sunscreen, with females twice as likely to put on sunscreen as men. More than 85 % of those under 60 years of age reported using sunscreen compared with 74 % of those over 60 years of age.

Seventy-six percent of participants choose to use a sunscreen that is of SPF30 or above. There was no difference in this decision based on age or gender. Forty percent of participants used long-sleeved shirts as a sun protective measure and men were twice as likely as women to do so ( $p = 0.002$ ). The participants in the youngest group, 18–30 years of age, were least likely to do this with only 24 % of people in this group using this as a sun protective measure. This is in comparison with the group

over 60 years of age in which long-sleeved shirt use as a sun protective measure was at 54 %. Seventy-five percent of total participants reported the use of a hat as a sun-protective measure. However, the reported use of a hat was especially low in the 18- to 30-year-old group compared with each of the other three older categories (58 vs 73–79 %). Women were twice as likely to not wear a hat compared with men (OR 1.99, 95 % CI 1.24–3.21).

### 3.3 Knowledge of Sun Protection and Application of Sunscreen (Tables 3, 4)

Only 10 % of respondents were able to identify the meaning of SPF30 correctly. Furthermore, the likelihood of correctly knowing the meaning of SPF decreased with increasing age ( $p < 0.05$ ). Those in the 18- to 30-year-old group were three times as likely as those over 60 years to know the correct meaning of SPF. There was no difference with regards to gender or age in the correct understanding of UVA/UVB. Females were more likely to correctly understand the role of Vitamin D and skin cancer in addition to being almost twice as likely as men to have the correct understanding about sunscreen being denatured by heat and having a use-by date ( $p = 0.01$ ).

**Table 3** Knowledge of sun protection, application of sunscreen and gender

	Gender		OR	95 % CI	<i>p</i> value
	Males 41.9 % ( <i>n</i> = 174) <i>n</i> (%)	Females 58.1 % ( <i>n</i> = 242) <i>n</i> (%)			
Correct understanding of SPF	12 (7)	27 (11)	0.58	0.29–1.20	0.15
Correct understanding UVA/UVB	137 (79)	208 (86)	0.61	0.36–1.01	0.06
Correct understanding of Vitamin D and skin cancer	120 (69)	189 (78)	0.62	0.40–0.97	<b>0.04</b>
Correct understanding of denaturing and expiry of sunscreen	49 (28)	99 (41)	0.57	0.38–0.87	<b>0.01</b>
Seasonal application of sunscreen					
Summer	171 (98)	240 (99)	0.48	0.08–2.88	0.42
Winter	26 (15)	73 (30)	0.41	0.25–0.67	<b>&lt;0.001</b>
Autumn	44 (25)	99 (41)	0.49	0.32–0.75	<b>&lt;0.001</b>
Spring	71 (41)	131 (54)	0.58	0.39–0.87	<b>0.008</b>
Frequency of application and reapplication					
Every day	19 (11)	56 (23)	0.41	0.23–0.71	<b>0.002</b>
Only when outside	155 (89)	186 (77)	2.46	1.40–4.31	<b>0.002</b>
Correct amount (40 ml) used	24 (14)	39 (16)	0.83	0.48–1.44	0.52
Storage					
Cupboard	125 (72)	186 (77)	0.77	0.49–1.20	0.25
Car	14 (8)	7 (3)	2.94	1.16–7.44	<b>0.02</b>
Checking for expiry of sunscreen					
Some, most or all	94 (54)	172 (71)	0.48	0.32–0.72	<b>&lt;0.001</b>
Rarely or never	80 (46)	70 (29)	2.09	1.39–3.14	<b>&lt;0.001</b>
Buying a new sunscreen every year	80 (46)	126 (52)	0.78	0.53–1.16	0.22

**Table 4** Knowledge of sun protection, application of sunscreen and age

	Age group (years)				<i>p</i> value
	18–30 ( <i>n</i> = 40) <i>n</i> (%)	31–45 ( <i>n</i> = 85) <i>n</i> (%)	46–60 ( <i>n</i> = 119) <i>n</i> (%)	60+ ( <i>n</i> = 172) <i>n</i> (%)	
Correct understanding of SPF	6 (15)	11 (13)	13 (11)	9 (5)	<b>0.01</b>
Correct understanding UVA/UVB	32 (79)	77 (90)	105 (88)	132 (77)	0.05
Correct understanding of Vitamin D and skin cancer	10 (24)	25 (29)	20 (17)	52 (30)	0.56
Correct understanding of denaturing and expiry of sunscreen	14 (36)	26 (31)	50 (42)	57 (33)	0.96
Seasonal application of sunscreen					
Summer	40 (100)	84 (99)	119 (100)	169 (98)	0.33
Winter	10 (24)	20 (24)	33 (28)	38 (22)	0.67
Autumn	11 (27)	40 (47)	40 (34)	55 (32)	0.33
Spring	18 (46)	52 (61)	56 (47)	76 (44)	0.13
Frequency of application and reapplication					
Every day	8 (20)	18 (21)	20 (17)	29 (17)	0.43
Only when outside	31 (77)	65 (76)	95 (80)	143 (83)	0.20
Both	1 (3)	3 (3)	4 (3)	0 (0)	0.07
Correct amount (40 ml) used	14 (35)	23 (27)	15 (13)	7 (4)	<b>&lt;0.001</b>
Storage					
Cupboard	28 (71)	62 (73)	84 (71)	138 (80)	0.10
Car	2 (5)	6 (7)	8 (7)	3 (2)	0.09
Checking for expiry of sunscreen					
Some, most or all	16 (39)	52 (61)	81 (68)	122 (71)	<b>&lt;0.001</b>
Rarely or never	25 (62)	33 (39)	38 (32)	50 (29)	<b>&lt;0.001</b>
Buying a new sunscreen every year	22 (54)	48 (57)	65 (55)	69 (40)	<b>0.01</b>

Nearly all participants reported utilizing sunscreen in summer. The frequency of application was much lower for all the other seasons, in the following order—spring, autumn, winter. Compared with reported sunscreen usage rates of 99 % in summer, the use in non-summer seasons was between 24 and 49 %. In each of the non-summer seasons, application rates for sunscreen were almost twice that in women compared with men ( $p < 0.01$ ). Females were 2.5 times as likely as males to apply sunscreen every day as opposed to only when outside ( $p = 0.002$ ). Only 15 % of participants used the recommended amount of 40 ml of sunscreen per application. As age increased, the likelihood of reporting use of the correct amount decreased ( $p < 0.001$ ). The large majority correctly stored their sunscreen in a cupboard. Males were three times more likely than females to store sunscreen in the car ( $p = 0.02$ ). Females were more likely than males to check the expiry date of sunscreen ( $p < 0.001$ ). As age increased, individuals were more likely to check the expiry date on sunscreens ( $p < 0.001$ ).

Forty-nine percent of people reported buying a new sunscreen every year. Those that were younger were more likely to buy a new sunscreen every year ( $p = 0.01$ ). There

was no significant difference for gender (52 % females, 46 % males).

#### 3.4 Barriers to Sun-Protective Behaviors and Attitudes (Tables 5, 6)

Twenty percent of participants cited forgetfulness as a reason for not applying sunscreen. This was seen across all age groups and both sexes. The greasiness of the sunscreen was a deterrent to its use in 17 % of individuals. Both of these factors were more frequently reported in the younger age group ( $p < 0.01$ ). The belief that sunscreen may cause vitamin D deficiency as a barrier was reported in 3 % of participants and this was more likely as age increased ( $p = 0.04$ ).

The majority of surveyed participants were willing to change their current sun protective behavior in one or more ways. Gender was not found to influence this willingness to change sun-protective behavior (Table 5). Those over the age of 30 years were 2–4 times more likely to be willing to give up sunbathing than those in the 18- to 30-year-old age group. Those that were younger were more willing to use sunscreen ( $p = 0.007$ ). Those that were older were more

**Table 5** Barriers and attitudes to sun-protective behaviors and gender

	Gender		OR	95 % CI	<i>p</i> value
	Males 41.9 % ( <i>n</i> = 174) <i>n</i> (%)	Females 58.1 % ( <i>n</i> = 242) <i>n</i> (%)			
Greasiness	30 (17)	41 (17)	1.02	0.61–1.71	0.94
Burning of eyes	7 (4)	17 (7)	0.55	0.22–1.37	0.20
Acne	5 (3)	7 (3)	0.99	0.31–3.18	0.99
Forgetfulness	37 (21)	46 (19)	0.99	0.71–1.87	0.57
Application time consuming	14 (8)	15 (6)	1.32	0.62–2.82	0.47
Vitamin D deficiency	3 (2)	10 (4)	0.41	0.11–1.50	0.18
Nanoparticle concerns	2 (1)	12 (5)	0.22	0.04–1.01	0.05
Willing to give up sunbathing	134 (77)	194 (80)	0.83	0.52–1.33	0.44
Willing to use sunscreen	160 (92)	230 (95)	0.60	0.27–1.32	0.20
Willing to use covered clothing	153 (88)	203 (84)	1.40	0.79–2.48	0.25
Willing to go into shade	151 (87)	208 (86)	1.07	0.61–1.90	0.81

**Table 6** Barriers and attitudes to sun-protective behaviors and age

	Age group (years)				<i>p</i> value
	18–30 ( <i>n</i> = 40) <i>n</i> (%)	31–45 ( <i>n</i> = 85) <i>n</i> (%)	46–60 ( <i>n</i> = 119) <i>n</i> (%)	60+ ( <i>n</i> = 172) <i>n</i> (%)	
Greasiness	11 (28)	20 (23)	23 (19)	19 (11)	<b>0.002</b>
Burning of eyes	5 (13)	4 (5)	7 (6)	9 (5)	0.26
Acne	3 (8)	5 (6)	0 (0)	3 (2)	<b>0.01</b>
Forgetfulness	12 (31)	26 (31)	18 (15)	28 (16)	<b>0.004</b>
Application time consuming	6 (15)	5 (6)	6 (5)	12 (7)	0.29
Vitamin D deficiency	0 (0)	1 (1)	4 (3)	9 (5)	<b>0.04</b>
Nanoparticles	0 (0)	7 (8)	4 (3)	3 (2)	0.25
Willing to give up sunbathing	23 (57)	72 (85)	92 (77)	144 (84)	<b>0.01</b>
Willing to use sunscreen	40 (100)	82 (97)	111 (93)	157 (91)	<b>0.02</b>
Willing to use covered clothing	31 (78)	71 (84)	99 (83)	153 (89)	<b>0.05</b>
Willing to go into shade	32 (81)	78 (92)	98 (82)	151 (88)	0.67

willing to use covered clothing as a method of sun protection ( $p = 0.05$ ).

#### 4 Discussion

Overall, the findings in our study evidenced that both age and gender contributed to differing attitudes and behaviors towards sun protection. Men knew less about the correct use of and storage of sunscreen. Women were more aware of sunscreen expiry periods (particularly evident among older women), and the need to reapply sunscreen more frequently. Additionally, women demonstrated better sunscreen use across a seasonal spectrum. While both men and women exhibited high rates of sunscreen use in the warmer

months, there were significantly lower usage rates in the cooler months. Women used more sunscreen than men in the cooler months. These findings are in line with previous studies, which have also shown that overall females are more likely to wear sunscreen than males [9–12]. While the reason is not entirely clear, it can be speculated that sunscreen is commonly included in skincare and beauty products, thereby being more accessible to women. This is also reflected in the results of our study, where women possessed a greater knowledge of and understanding of the importance of sun protection measures.

In our study, the incidence of skin cancer in males was twice that of women, consistent with previous reports [13]. However, both men and women were equally likely to have experienced sunburn in the past year, which is in contrast



to a previous study showing that men were twice as likely as women to have experienced sunburn in the previous year [14].

We found that multiple barrier methods of sun protection, such as hats and long-sleeved shirts, are not being utilized, especially in the younger population. This is despite knowledge that sunscreen alone is unable to protect an individual entirely from UV radiation exposure [15].

Cumulative sun exposure is one of the most important factors in the development of skin cancers, particularly squamous cell carcinomas. Our study showed, as expected, that skin cancer incidence increased with age [16]. The older respondents in our study were less likely to have accurate knowledge about SPF. Additionally, when sunscreen was used, the older population used less than the appropriate amount. This suggests that sun protection education should not only encourage using SPF 30+ sunscreens but also applying it liberally to ensure its adequacy and effectiveness.

Nearly all the participants in our 18- to 30-year-old group had experienced sunburn in the previous year, which is in line with previous reports that the younger population is at a much higher risk of experiencing sunburn events [14]. It is also well known that sunburning in the younger years is more commonly associated with an increased incidence of malignant melanoma [17]. This highlights that, despite widespread knowledge in the community about skin cancer and sun protection, it is not decreasing the rates of sunburn and that this remains a significant public health issue as also outlined in a previous Australian study [18]. The younger population were also less willing to forgo sunbathing than the older population and also less likely to use sunscreen. These findings are similar to an earlier study of almost 1,000 Australians [19]. This highlights a need to develop practical strategies to encourage this group to increase a broad range of sun protection measures and avoid sunburn. Sun-protection behavior generally improved in our study as people reached 45 years—this may be due to a varying range of factors such as personal experience with skin cancer, or having friends or family who have experienced skin cancer.

Reported past use of a solarium was highest in those aged between 30 and 60 years, and this was almost exclusively in women. However, the decreased prevalence of use in the younger population, and the fact that there were almost no active solarium users in our study, may suggest that current public health campaigns to discourage solarium use are having a positive effect.

Large portions of our study population reported not applying sunscreen before sunbathing. This was a question that was likely to have been poorly understood. Sunscreen application rates were generally high, with hat use and long sleeve use increasing with age. Despite this, low sunscreen

usage rates were reported in response to the question regarding application of sunscreen before sunbathing. This indicates there was confusion regarding this question, which could have been more appropriately worded as “sunscreen application prior to undertaking outdoor activities”. Regardless of this confusion, the overall results show that further sun-protection education is necessary.

The main limitation of our study was the sample size and overall smaller numbers in the 18–30 years age group. Had we conducted this survey at sporting clubs and had overall larger groups, we would have obtained more information about the 18–30 years age group. This probably occurred as participants were selected from an outpatient clinic setting, where the average age of participants was generally likely to be older. In addition, the results of our study could have been affected by a degree of selection bias from a higher portion being dermatology patients. However, it could be reasoned that, being dermatology patients, their general knowledge and behavior might be in fact better than the general population as a whole, and yet, despite this, significant deficiencies were identified in our study.

Nonetheless, we believe that our results reflect the knowledge, attitudes, and behaviors of the broader Australian population and highlights that we need to actively continue our educational and public health efforts. This is especially in light of the significant rising cost burden of treating skin cancers in Australia [3, 4]. Public health messages and educational programs need to be segmented into specific target populations that have negative habits as identified in our study. This would then provide an improved chance of rectifying incorrect health practices and beliefs with regards to sun protection, as also outlined in the NSW Skin Cancer Prevention Strategy of 2012–2015 [20].

## 5 Conclusion

Our study identifies a number of gender- and age-specific findings with regards to sun protection. There are knowledge, attitude, and behavior deficiencies within each group. These deficiencies have the potential to be specifically targeted through educational and public health efforts in order to improve general sun protection measures and decrease the incidence of skin cancers. Future research is also needed into reasons why these differences exist between the different age groups and genders, in addition to reasons why a large portion of participants are continuing to sunbathe.

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