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**PAPER**

## An investigation into the awareness and understanding of the ultraviolet index forecasts in the South West of England

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Despite large sun protection behaviour intervention campaigns there has not been a marked reduction in the incidence of skin cancer. This study explored the awareness and understanding of global solar UV index (UVI) information presented to the public in weather forecasts and whether individuals changed their sun exposure/protection behaviour as a result of receiving such information. A cross-sectional, face-to-face survey was undertaken in Devon and Cornwall in the South West of England between 20 August and 7 September 2008. 466 interviews were completed; 53% at beach locations and 38% in town centres. The specified targets for the interviews were achieved: males ( $n = 232$ ), females ( $n = 234$ ); resident ( $n = 251$ ), tourist ( $n = 215$ ); aged 16–34 ( $n = 156$ ), 35–54 ( $n = 158$ ), and 55 years plus ( $n = 152$ ). Sixty-seven percent of participants had heard of the UVI (the predominant source being television broadcasts). Only 40% were able to state correctly that a value of 7 would be considered to be ‘high’. Sixty percent indicated that knowing the UVI value did not influence their sun protection behaviour. Awareness of UVI in the UK appears to have altered little in the past decade and although some improvements in understanding have been observed, it is concerning that this information is not influencing most individual’s sun protection behaviour.

### Introduction

Although skin cancer is a largely preventable health problem, it is clear that, despite relatively costly, large-scale, multi-faceted sun protection behaviour intervention campaigns, risk taking behaviour continues, the desire to get a tan remains and there has not been a marked reduction in the incidence of skin cancer in the UK at least.<sup>1</sup> There is evidence in Australia however, where sun protection programmes have run for over twenty years, that in younger age groups there has been a reduction in basal cell carcinoma.<sup>2</sup> A systematic review of a wide range of interventions designed to increase sun protection behaviours revealed mixed results<sup>3</sup> but examination of survey data in Australia<sup>4</sup> on the effect of SunSmart television advertising campaigns indicated a pattern of improvement in sun protection behaviours and incidence of sunburn but with some levelling in recent years as TV advertising has reduced. Arguably sunscreen is the most common sun protection behaviour used but due to inappropriate use the actual sun protection factor received may be only 30–50% of that required.<sup>5</sup>

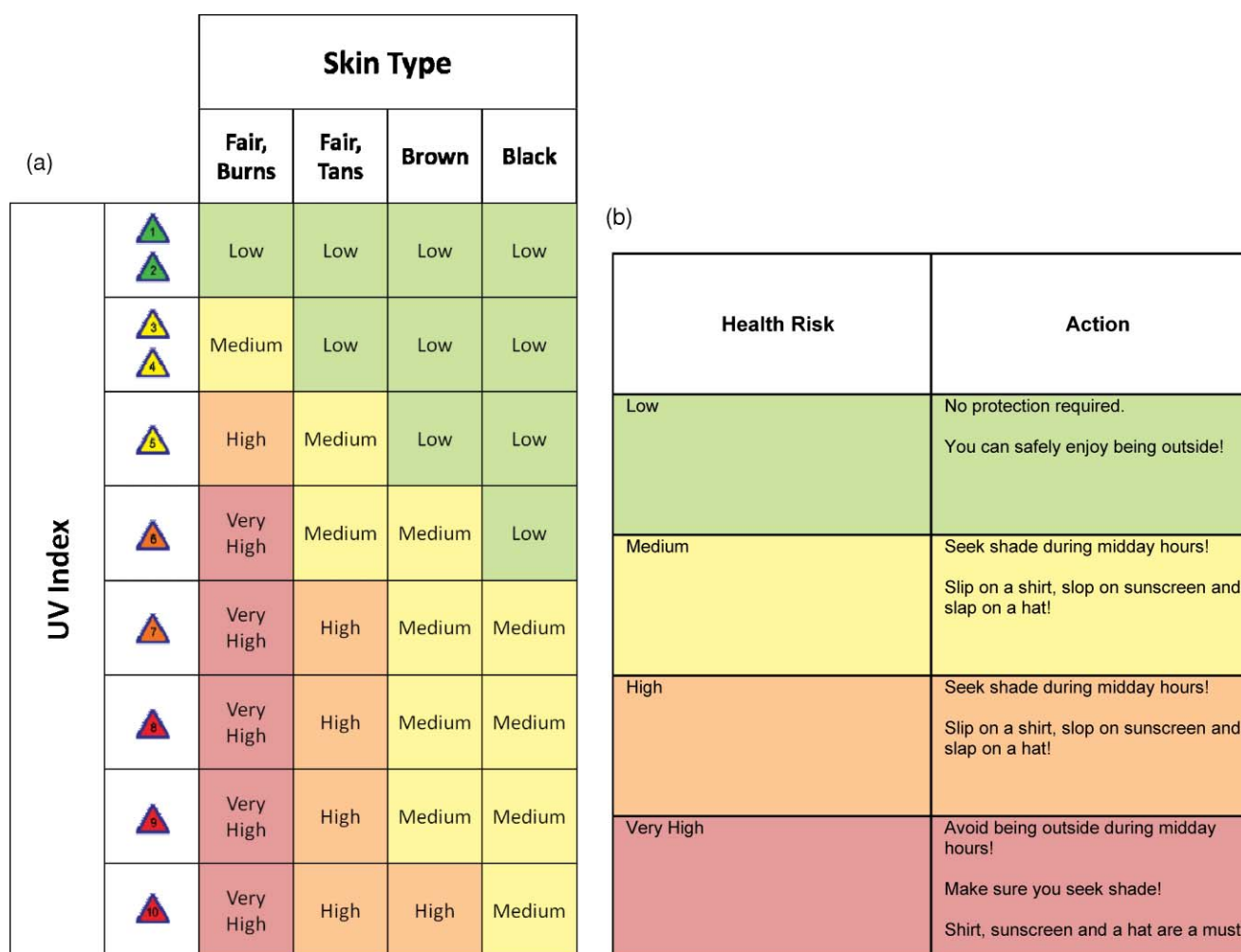
Furthermore, there is potential conflict in the messages given to the general public to avoid the sun to reduce their risk of skin

cancer, but to spend time in the sun to ensure adequate levels of vitamin D production,<sup>6</sup> and also to increase physical exercise and engage in more outdoor activities to reverse the effects associated with obesity-related diseases.<sup>7</sup>

A relatively recent medium for alerting the public to the strength of the sun’s ultraviolet (UV) radiation is the global solar UV index (UVI) developed by the World Health Organisation (WHO) and which was first used in the United Kingdom (UK) in 1999.<sup>8</sup> The UVI developed by the WHO<sup>9</sup> contains a range of values from 1 to 11 and above grouped into low, moderate, high, very high and extreme exposure categories with the guidance that sun protection measures are required above the level of moderate,<sup>10</sup> although it should be noted that level 11 and above as well as the extreme category (11+) are not employed when reporting the UVI in the UK (Fig. 1). The UVI is therefore designed to communicate to the public the level of solar UV radiation they are exposed to on a daily basis, indicating the potential for adverse health effects, so that they are able to protect themselves accordingly.

The UVI is a simple estimation of the UV radiation at a particular geographical location on the Earth’s surface, taking the position of the sun in the sky and the amount of cloud cover into consideration. Traditionally two methods can be employed to derive UVI. The simplest method converts the weighted erythral irradiance (recorded in  $\text{W m}^{-2}$  on a horizontal surface) into the index by multiplying by 40 and produces the numerical scale. The other method is intended for averaging over a possible burn-time period of 10–30 min and is considered to be more

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**Fig. 1** A visual summary of the UV index for information, illustrating the health risks implicated and preventative action advised. (A) Level of health risk indicated by specific UV index levels to individuals with different skin types; (B) sun protection action advised for different levels of health risk indicated by the UV index.

directly related to biological effects. Its calculation involves an accumulated time integration over different time periods centred around solar noon.<sup>8,9</sup> As levels of UV radiation vary throughout the day and peak around midday, the UVI is normally presented in forecasts as a single figure of the maximum expected at this time (these predictions are produced by a radiative transfer model which considers total ozone and aerosol optical properties), although some countries also report the actual ambient UVI levels recorded by local measurement stations. Individuals are required to interpret this information for themselves based on their skin type (four categories) and then take appropriate action depending on the level of risk (four categories) identified (Fig. 1). For the dissemination of the UVI to have any impact on sun protection behaviour, it is therefore clear that the message conveyed has to be understood.

In a survey of television weather forecasters ( $n = 185$ ) and the general public ( $n = 700$ ) in the US, 64% had heard of the UVI of whom >90% accurately described the index; but only 38% changed their sun protection behaviours as a result of the UVI information. More than 50% of the weather forecasters agreed inclusion of the index provided important sun protection information, but 15% noted that it took time out of relatively brief broadcasts.<sup>11</sup> The

latter finding was also reported in a study undertaken in New Zealand.<sup>12</sup>

In an evaluation ( $n = 1865$ ) of the impact of the UVI launched in the UK in May 1999, 64% had heard of the UVI, but only 7% knew the level of risk from an index value of 6 (high).<sup>8</sup> The awareness in the UK was higher than that reported in a Swedish study ( $n = 1094$ ) where only 27% had heard of the daily UVI forecasts and only 24% changed their sun behaviour habits as a consequence.<sup>13</sup>

Given the climate and high rates of skin cancer in Australia and New Zealand, it might be expected that awareness and understanding of the UVI (forecasting began in 1996) would be high. One survey undertaken in Queensland showed that whilst ~90% ( $n = 977$ , 30–70 years, 78% response rate) had seen or heard the UV forecast, only around 35% said the forecast influenced their behaviour.<sup>14</sup> A survey in Perth ( $n = 50$ , 44% response rate) suggested a high awareness of the term UVI (>90%) although only 5% ( $n = 24$ ) had noticed the UVI on the day of the interview. Knowledge of the UVI was poor with only 44% knowing that the index was related to the level or intensity of the sun's rays and only 12% were able to identify that a value of 7 was very high (20% could not answer this question). Furthermore 83% of the 24 individuals who knew the UVI value on the day of the survey stated that

**Table 1** Characteristics of respondents according to awareness of the UV index (UVI) (%)

	Heard of UVI ( <i>n</i> = 314)	Possibly/not sure heard of UVI ( <i>n</i> = 45)	Not heard of UVI ( <i>n</i> = 107)	Knew UVI forecast on day of survey ( <i>n</i> = 28)
<b>Gender</b>				
Females	143 (61)	32 (14)	59 (25)	12 (43)
Males	171 (74)	13 (6)	48 (21)	16 (57)
<b>Age group</b>				
16–24	40 (54)	9 (12)	25 (34)	3 (11)
25–34	47 (57)	11 (13)	24 (29)	4 (14)
35–54	125 (79)	11 (7)	22 (14)	8 (29)
55+	102 (67)	14 (9)	36 (24)	13 (46)
<b>Resident</b>	170 (68)	27 (11)	54 (21)	17 (61)
<b>Tourist</b>	144 (67)	18 (8)	53 (25)	11 (39)
<b>Perception of ease of burning in sun</b>				
Never	30 (70)	1 (2)	12 (28)	4 (14)
Not easily at all	59 (71)	7 (8)	17 (21)	6 (21)
Not very easily	86 (67)	14 (11)	29 (22)	7 (25)
Somewhat easily	73 (66)	16 (14.5)	21 (19)	5 (18)
Very easily	66 (65)	7 (7)	28 (28)	6 (21)

the knowledge did not influence their behaviour.<sup>15</sup> A subsequent survey undertaken in Perth also revealed a lack of knowledge and understanding around the meaning of the UVI.<sup>16</sup> Results from a telephone survey undertaken in New Zealand (*n* = 396, response rate 52.5%) revealed a surprisingly low awareness of the UVI (43%) with only 49% believing it to be useful in determining appropriate sun protection.<sup>17</sup>

Efforts to change the look of the UVI have been made in parts of Australia<sup>18,19</sup> but despite the public preferring the bell-curve format employed, only 9% (*n* = 419) knew the UV forecast on the day of the survey, and 50% could not recall ever seeing a UV alert, although when showed the graphic 48% were able to say that the alert indicated when UV levels were high.<sup>19</sup>

From the above, it can be seen that internationally there is a mixed picture in terms of awareness and knowledge around the UVI information presented in the media. Whilst levels of awareness have often been relatively high, understanding has been low. The UVI continues to be broadcast as part of weather forecast information in the UK, and it was felt appropriate to test further the awareness and knowledge first reported by the Department of Health in 2000,<sup>20</sup> which employed an Omnibus Postal Survey of 3000 adults randomly selected from private households in Great Britain in September 1999 (with a 69% response rate). Furthermore, a recent marketing strategy highlighted the need to benchmark measures of existing sun protection awareness in the South West region.<sup>21</sup> The aim of this study was to explore awareness and understanding of the UVI information presented in weather forecasts; and to determine whether individuals change their sun exposure/protection behaviour as a result of receiving such information.

## Results and discussion

### Weather

Mean temperatures for the UK during summer 2008 were slightly above average but above average rainfall was also recorded. Summer sunshine levels were below average with only six sunny

days (five or more hours of recorded sunshine) occurring during the study period. Single day UV index data (30 minute average) indicated that the mean daily peak UVI observed during the study period was 4.0 (medium UVI level) but daily UVI maximums ranged from just 1.8 (low UVI level) to 6.3 (very high UVI level) on different days (data source: DEFRA).

### Respondent characteristics

A total of 466 interviews were completed of whom 247 (53%) were interviewed at beach locations, 177 (38%) in town centres and 40 at unspecified locations (information was missing about the location for two interviews). The specified targets (as indicated in the experimental description) for the interviews were achieved: males (*n* = 232), females (*n* = 234); resident (*n* = 251), tourist (*n* = 215); aged 16–34 (*n* = 156), 35–54 (*n* = 158), and 55 years plus (*n* = 152). There were 164 with school aged children. Twenty-two percent of respondents believed that they burned ‘very easily’ in strong sun, 24% felt they burned ‘somewhat easily’; and 67% (*n* = 312) had not been sunburnt in the UK in the year of the survey.

### Awareness and understanding of the UV index

Table 1 illustrates respondent characteristics according to awareness of the UVI. Sixty-seven percent (*n* = 314) had heard of the UVI but only 28 (8%) knew the UVI value on the day of the survey. More males than females had heard of the index (74% compared with 61%), although more females (14% compared with 6%) reported that they ‘possibly/not sure’ had heard of the index ( $\chi^2 = 11.64$ ,  $p < 0.003$ ). Of those who had not heard of the index (or were unsure if they had heard of the index), percentages were higher in the 16–24 and 25–34 age groups, with the highest numbers aware of the index in the 35–54 age group (79%;  $\chi^2 = 20.16$ ,  $p < 0.003$ ). There was no relationship between perception of ease of burning in strong sun and awareness of the UVI; nor between residents or tourists with around 67% in each of the latter two groups stating they had heard of the UVI.

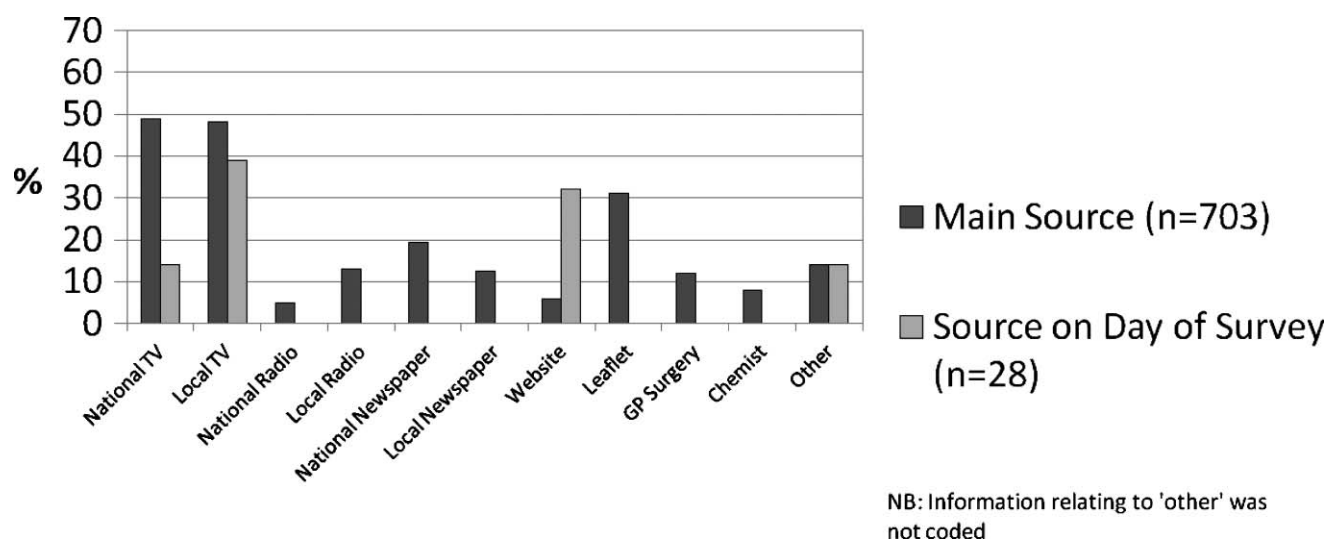


Fig. 2 Main sources of UV index information.

Fig. 2 illustrates the main sources of information about the UVI, from which it can be seen that the two main sources were national and local television (49% and 48% respectively); only 22 (6%) used the Met Office website. The only notable differences in terms of demographic information was that there was a linear association with increasing age group in terms of the numbers of people who obtained the information from national newspapers with for example 7% of those in the 16–24 year group using this as a source of information compared with 46% in the 55+ age group ( $\chi^2 = 10.64$ ,  $df = 3$ ,  $p < 0.01$ ). Of those 28 who obtained UVI information on the day of the survey, the two main sources were local television (39%) and the Met Office website (32%).

Despite the relatively high level of awareness only 46 (13%) knew that the maximum value was 10 or 11 (in the UK the maximum value is 10); with 228 (63.5%) indicating that the maximum value was 17. However, it should be noted that these data were not further analysed to determine the responses of the tourists separately and we do not know which countries or what UVI levels they normally resided in, however awareness of the UVI between tourists and residents was not observed to be dissimilar. Only 40% ( $n = 144$ ) of participants were able to state correctly that a value of 7 would be considered 'high'. Regarding knowledge, of the 359 who had heard (or 'possibly/not sure' had heard) of the UVI, 60% ( $n = 215$ ) correctly stated that the UVI was influenced by the position of the sun in the sky compared with 35% ( $n = 37$ ) of those who had not heard of the UVI ( $n = 107$ ); 55% ( $n = 198$ ) correctly stated that UVI was influenced by cloud cover compared with 21% ( $n = 22$ ) of those who had not heard of the UVI; and 54% ( $n = 193$ ) that the UVI was influenced by the amount of ozone compared with 35% ( $n = 38$ ) of those who had not heard of the UVI (Fig. 3). Only 22 respondents of those who had heard of the UVI got all three (and only those three) influencing factors correct.

Overall, 60% ( $n = 214$ ) of participants who had heard/possible heard of the UVI indicated that knowing the UVI value did not influence their sun protection behaviour. There were significant differences between gender with more males stating such information would not influence their behaviour (70% compared with 49% females;  $\chi^2 = 15.54$ ,  $p < 0.0001$ ); and perception of burn in strong

sun with more in the categories suggesting they did not burn easily in strong sun stating UVI information would not influence their sun protection behaviour (72% 'not very easily', 64% 'not easily at all', 61% 'never';  $\chi^2 = 18.12$ ,  $df = 8$ ,  $p < 0.05$ ). This finding is noteworthy when considered with the information provided about what the term UVI meant to respondents with 46% ( $n = 165$ ) indicating it meant skin damage by UV, 36% the risk of skin cancer, 35% the likelihood that the skin will get damaged and 28% the degree of sun protection required. Examination of this data by age group, resident status and gender revealed that significantly more respondents in the 55+ age group (46%) believed the term UVI meant risk of skin cancer compared with those in the younger age groups (10% in the 16–24 group and 9% in the 25–34 group;  $\chi^2 = 19.78$ ,  $df = 3$ ,  $p < 0.0001$ ).

The aim of this cross-sectional survey was to explore awareness and understanding of the UVI used by the UK Met Office in a sample of the population from the South West of England. The findings showed that general awareness of the UVI was high (67%) and was similar to the findings reported in the US (64%<sup>11</sup>) and also with the results from a similar survey undertaken in England in 1999 (64%<sup>8</sup>). This value is much lower than that achieved in Australia however (90%<sup>14,15</sup>), but is higher than that observed in Sweden (27%<sup>13</sup>) and New Zealand (43%<sup>17</sup>).

It was also evident, that understanding around the meaning of the UVI was generally poor with relatively few respondents knowing the scale values (13%) and their meaning (40%) as well as a substantial number not understanding the factors that influenced the UVI (only 22/359 who had heard of UVI answered this section correctly). It is worth noting however, that the number of individuals who could correctly identify that a UVI value of 6/7 was high, had increased substantially over the past decade from only 7% in 1999<sup>20</sup> to 40% in 2008.

The general lack of knowledge and understanding observed was reflected in the finding that the majority of individuals who took part in this survey (60%) would not change their sun protection behaviour as a consequence of the UVI values. This is concerning and is considerably higher than other countries (38% US;<sup>11</sup> 24% Sweden;<sup>13</sup> 35% Australia;<sup>14</sup> 49% New Zealand.<sup>17</sup> Examination of



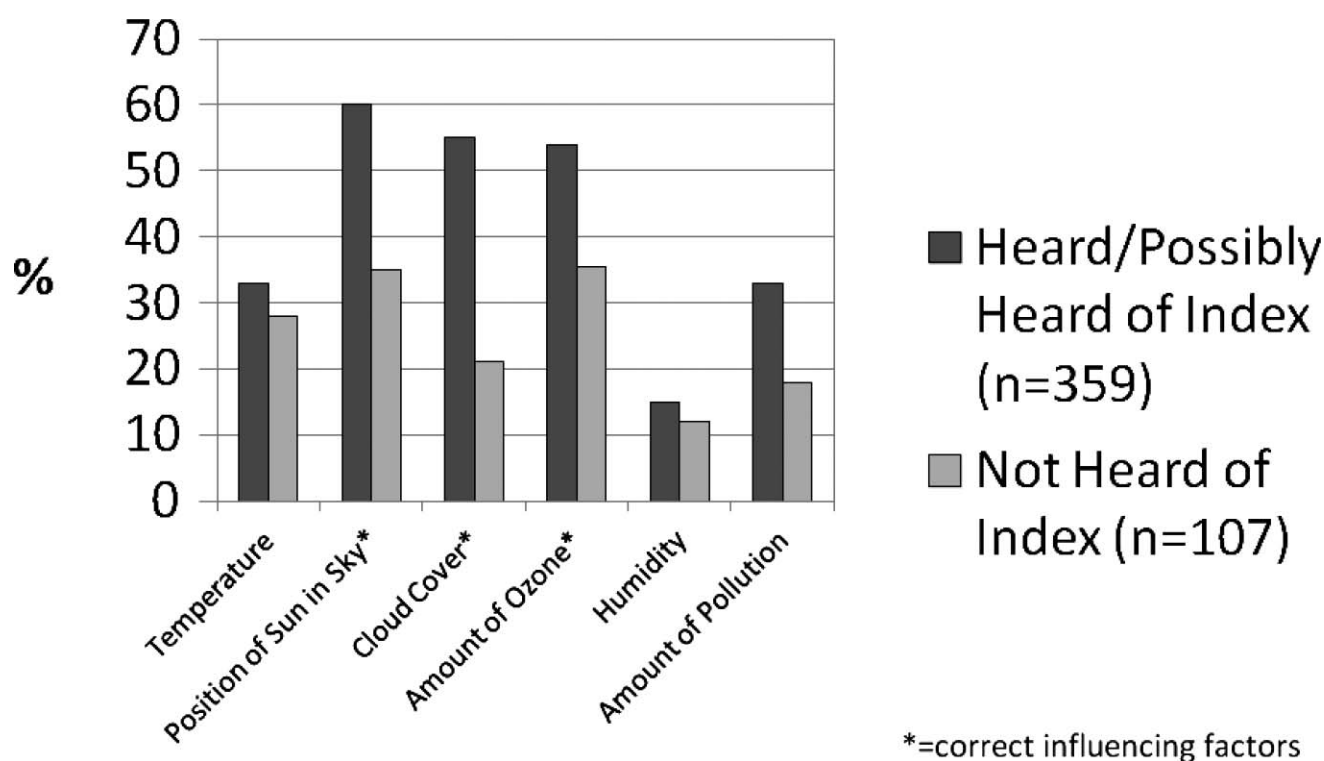


Fig. 3 Beliefs about factors that influenced the UV index.

demographic characteristics showed that those most aware of the UVI were males and those aged between 35 and 54 years. There was no relationship between awareness of the UVI and the extent to which respondents perceived themselves to be at risk of burning in strong sun.

#### Opinion of the UV index used by the UK Met Office

Respondents were shown the format for the presentation of the UVI on the UK Met Office website ([http://www.metoffice.gov.uk/weather/uk/uk\\_forecast\\_warnings.html](http://www.metoffice.gov.uk/weather/uk/uk_forecast_warnings.html)) and the format used by media websites and also television. Sixty-nine percent ( $n = 323$ ) 'liked'/'liked a lot' the format, and 85% ( $n = 395$ ) thought the information was 'easy'/'very easy' to read. Only 23 (5%) however, said that having regular access to the information would have 'a lot of influence' on their behaviour, with 22% ( $n = 102$ ) indicating it would have 'none' and a further 22% 'very little influence' on their behaviour. Differences between groups were not significant when analysed by age group, gender or perception of how easily respondents would burn in strong sun.

Further work is needed on communicating information about and the implications of UVI values. The main sources of UVI information were television broadcasts but these were used by less than half the participants. Relatively few accessed the Met Office website and even fewer heard the information on national and/or local radio. In an innovative study,<sup>22</sup> Dixon *et al.* communicated information about the UVI using email and although this was to a specific group working in organisations, it does highlight how different methods can be employed. It should be noted, however, that this intervention was not observed to change the sun protection behaviours of the particular cohort being investigated.

Given the need to target young people who are most likely to engage in outdoor activities and not use appropriate sun protection measures, consideration should be given to communicating information to them *via* the media they use most often (*e.g.* mobile telephones/social network sites). This could be reinforced by appropriate signage in public places such as beaches patrolled by lifeguards who might then be able to take responsibility for placing signs and highlighting the UVI value for the particular day.

From the findings presented here it is difficult to speculate why communication of the UVI has not been more successful in promoting appropriate sun protection behaviour amongst the UK general public. It does appear however, that males and individuals who do not think that they burn easily are more unlikely to take action as a result of being aware of the UVI and although not investigated here members of the general public may incorrectly think that as long as they do not get badly burnt no skin damage occurs and they will not get skin cancer. They may alternatively, however, understand the risk to their health and simply be not prepared to change their lifestyle/sun exposure habits or give up their desire for a tan. It is definitely clear that understanding of the scale and meaning of the UVI in the sample questioned was poor and it is reasonable to suggest that better education of the public in these respects could be helpful as could more mention of the UVI in sun protection advice distributed in the UK. Further research might help to identify the key issues in the apparent limitations to this potentially useful information for guiding people to use sun protection behaviours when the UVI is above 3. There is a particular challenge in the UK however where the weather may be generally perceived to not produce the most pleasant climate incorrectly negating the need to take adequate sun protection.

It is also clear that any future investment in communicating information about the UVI needs to be considered in the context of wider community based sun protection campaigns. In England, this would mean working with organisations such as Cancer Research UK and the Public Health Observatories although it is of concern to note that the UK Department of Health reduced funding for the Cancer Research UK SunSmart campaign by 31% between 2006/7 and 2007/8.<sup>21</sup>

## Experimental

A cross sectional, face-to-face survey was undertaken in Devon and Cornwall in the South West of England between 20 August and 7 September 2008. A power calculation ( $p = 0.05$ ; population proportion = 0.5) indicated that a sample of 400 was required. A market research company was employed to undertake the interviews and to use quota sampling to recruit as follows: 50% male, 50% who lived in Devon or Cornwall and 50% on holiday from outside Devon and Cornwall; and 33% in each of the following age bands: 16–34, 35–54 and 55 years plus. Additionally 33% of the sample was required to have school age children in the household. Ten locations were selected throughout Devon and Cornwall to represent five towns (three urban and two coastal) and five beach areas. A wide sampling strategy was therefore employed although it was not designed to produce a representative cross-section of the population of Devon and Cornwall.

A questionnaire was designed for the project based on those used in other surveys.<sup>15,16</sup> The questionnaire consisted of 21 questions which included three about the participants' incidence of sunburn and use of sun protection behaviours; 13 about awareness and knowledge of the UVI; two about sun seeking behaviour; and three that related specifically to the UVI displayed by the UK Met Office. Each interview took approximately 12 min. Advice from the Chair of the University Ethics Committee indicated that formal ethical committee approval for this study of anonymous volunteers was not required. The company who undertook the interviews were bound by the Market Research Society Code of Conduct.

Data were analysed using SPSS version 16 for windows. The main focus of the analysis was on differences in awareness and knowledge of the UVI by gender and age.

## Conclusion

Skin cancer remains the most common neoplasm in the UK,<sup>23</sup> with incidence rates anticipated to continue to rise with the predicted effects of climate change. Awareness of UVI in the UK appears to have altered little in the past decade and although

some improvements in understanding have been observed, this information is not influencing sun protection behaviour despite some understanding of the consequences of excessive sun exposure being evident.

## Acknowledgements

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