

The effect of behaviour and beliefs on the effective use of sunscreen

Authors

Barratt J A¹, Davies C J², Jenkins M³, Lewis Dr. I⁴, West Rh W⁵.

Correspondence : Julie Barratt, CIEH Pembroke House Ty Coch Lane Llantarnam Parkway
Cwmbran NP44 3AU

Telephone : 01633 865533 E mail j.barratt@cieh.org

¹ Chartered Institute of Environmental Health Wales Directorate

² Neath Port Talbot County Borough Council

³ Neath Port Talbot County Borough Council

⁴ Tenovus Institute, Cardiff

⁵ Blaenau Gwent County Borough Council

The effect of behaviour and beliefs in restricting the effective use of sunscreen

Abstract

Exposure to ultra violet radiation is the principal cause of skin cancer and much effort has been expended in educating the general public about ways in which they can protect themselves against over exposure to UV radiation including through use of sunscreen. Using a simple response questionnaire this research sought to ascertain whether the study group understood how sunscreen should be used and whether those who claimed to use sunscreen did so as in such a way as to afford them maximum protection. The study shows that there is a high level of understanding of the need for protection against over exposure to the sun but that the practice of protection is poor leading to strong optimistic bias in favour of adequacy of protection leading to over exposure. We recommend that health practitioners build on the recognition for the need for protection that is evidenced and devise and promulgate strong messages about the way in which protection should be managed to avoid over exposure and the consequent elevated risk of developing skin cancer.

Key Words: Sunscreen, skin cancer

Introduction

Skin cancer is the most common type of cancer in the UK. It is also one of the most preventable types of cancer. Malignant melanoma incidence rates in Britain have quadrupled since the 1970s, and over the last twenty-five years, rates of malignant melanoma in Britain have risen faster than any other common cancer. The reasons for the rise in incidents rates are several and include increasing accessibility of long and short haul foreign holiday taken in hot climates, increased use of Ultra Violet (UV) sun beds and increased amounts of leisure time spent in both active and passive outdoor activities with consequent exposure to the sun, in addition to promotion of tanned skin as being fashionable and desirable by the popular and niche press. It is well recognised that exposure to UV radiation is the principle cause of basal and squamous cell carcinomas of the skin and that protecting skin from UV radiation is one of the most effective ways of reducing rates of skin cancer.

Public health messages targeted at reducing rates of skin cancer have been based around campaigns designed to encourage individuals to keep out of the sun when it is at its strongest, between the hours of 11.00am – 3.00pm, to cover up in the sun protecting the body from direct exposure and to use sunscreen on exposed body parts when in the sun. Campaigns such

as the 'Slip, Slop, Slap' campaign are widely recognised and the messages are understood, however the effectiveness of the message relies on individuals both recognising the need to act and acting appropriately in the sun. The requirement to keep out of the sun when it is at its hottest and to cover exposed body parts are easy to understand and the necessary action easy to implement. Studies by *Thieden et al (2005)* suggest that there is great variation in sunscreen use with people tending to overestimate sunscreen use and to adopt risky behaviour such as staying out in the sun for longer when wearing sunscreen. There is further misunderstanding of the purpose of wearing sunscreen with a widely held belief that sunscreen is a tanning aid rather than protection from exposure to and damage from harmful UV rays.

Whilst public health messages promote the use of sunscreen there is evidence that people using sunscreen are under protected simply because they do not apply the sunscreen correctly to achieve the expected protection. The protection offered by a sun screen is indicated by its sun protection factor which is assessed after photo testing in vivo at an internationally agreed application thickness of 2 $\mu\text{l}/\text{cm}^2$. To achieve the rated protection over the whole body a typical adult of surface area 1.73 m^2 would therefore need to apply 35ml of sunscreen, being approximately one seventh of a typical 250ml bottle. Several studies (*McGregor et al 1993*, *Stenberg et al 1985*) show that individuals use much less than this, typically using an average of 0.5-1.3 $\mu\text{l}/\text{cm}^2$, with consequent reduction in protection, in some cases being closer to half the sun protection factor expected.

According to the European Commission the estimated retail value of the sunscreen products industry in Europe was approximately £1.35bn in 2005, represent a 4 per cent increase on sales in the previous year and the market is recognised as growing. There is wide customer choice within the market, the market being segmented into products for children and babies, products that are waterproof and products with Sun Protection Factor (SPF) ranging from SFP3 to SPF 50. Autier (2000) suggests that there is considerable consumer confusion regarding the meaning of SPF and particular confusion about the increasing benefits to be obtained from using increasingly high SPFs. There is a general belief that safe exposure time can be calculated by using the SPF as a simple multiplier against normal burning time, and a failure to understand that increasing SPF does not equate to increasing 'strength' of the sunscreen used.

The market also includes After Sun products that are designed to compliment the sunscreen range the purpose of which products are advertised as to cool and sooth skin that has been burned after exposure to sun. The existence of these products is a tacit acceptance by the industry that sunscreen has not been used at all or is not used effectively and evidence suggests that there is confusion amongst consumers about the purpose of after- sun lotions, with a commonly held belief being that use of sunscreen and after-sun are complimentary and that sunscreens work better when used with an after-sun lotion (*Fleming et al 1996*) .

The aim of this study was to analyse the beliefs held by individuals about the purpose of sunscreen and that way in which sunscreen should be used. It particularly considered knowledge relating to the dose required for effective protection and necessity for

reapplication. In addition it sought to identify beliefs held by individuals about natural sun tans when compared to sun tans obtained by using UV sun beds.

Methodology.

The study was undertaken in south Wales in May 2009. A sample of 202 randomly selected adults attending an outdoor activity were asked to take part in an interview asking them about their use of sunscreen and the beliefs that they held about the way in which sunscreen should be used. The survey also asked them to consider whether a sun tan achieved through exposure to the sun was healthier than one achieved through use of UV sunbeds.

Study population

The subjects chosen for interview were adults who were at the time of the interview at an outdoor location. They were self selecting in that they were asked if they would like to take part in a short survey. No inducement was offered to the participants. The study group consisted of only adults as adults are able to make their own decisions as to whether to use sunscreen and as to how much should be applied. Children were not part of the study group since decisions about whether to use sunscreen how much to apply and how often are more usually made for them by an adult than the decision being that of the child (*Bennetts et al 1991*), and further the dosage questions asked related specifically to adult body doses. The study group was taken from 3 locations, being a town centre, a beach and a golf course.

A beach location was selected as individuals going to the beach were considered likely to be engaging in activities which would result in their being exposed to the sun for a considerable period of time and further considered likely to be involved in water based activities. A study in New Zealand showed that beach or water based activities to be associated with the highest number of reported episodes of burning in a population whose sun exposure, sunburn and sun protection activities were studied (*McGee et al 1995*) therefore this group was considered to be at risk of sunburn if not properly protected, and further advice relating to effective use of sunscreen advised that it should be applied at intervals of 1 ½ to 2 hours and after water based activities such as swimming (*Cancer Research UK – Sunsmart.*). For individuals in this group to be adequately protected their level of knowledge in respect of the effective use of sunscreen needed to be high.

The golf course was selected as another location where adults would be exposed to the sun for a considerable period of time, commonly in excess of 4 hours where a round of 18 holes of golf was being played. Research in Tasmania (*Herlihey et al 1994*) suggests that individuals commonly underestimate the duration of personal exposure in recreational settings such as golf courses and that they fail to adequately protect themselves from the sun in consequence of this.

The town centre location was selected as being a 'non-recreational' and 'non occupational' setting, adults visiting were often doing so in the course of what was perceived as neither business or recreation. Research suggests that where activity is not considered to fall into either of these categories even individuals who consider themselves to have good level of awareness in respect of the need to use sun protection fail to take adequate steps to protect themselves from exposure to the sun (*McGee et al*).

Information requested during interview

Respondents were asked why they were at the location, in order to distinguish between those who were at the site in the course of employment and those who were taking part in a recreational activity. This was in order to determine whether there was a difference in levels of awareness between those occupationally exposed and those recreationally exposed individuals within the sample population.

Sun Protection used

Interviewees were asked if they protected themselves from the sun, and those who responded positively were asked which protection methods they employed.

Dosage

Interviewees who mentioned use of sunscreen were then shown 5 identical bottles each containing a measured amount of sunscreen, being 15ml, 20ml, 25ml, 35ml and 45ml and were asked which of the numbered bottles most closely related to the amount of sunscreen they would apply to themselves as a single dose. If asked the interviewers advised that the sunscreen in the bottles was SPF 15. In order to check the veracity of the answer given interviewees were then shown a full 250ml bottle of sunscreen and asked how long the bottle would last them if used continuously by them, if they were the only person using it. Using 35ml and applying every 2 hours and assuming exposure to the sun between 10.00am and 4pm the appropriate answer would be approximately 1½ days.

They were also asked in their view how long the same bottle would last a family of 2 adults and 2 children aged under 10 years on a beach holiday. Again taking 35ml as the adult dose and 15ml as the dose for a child under 10 years of age and applying every 2 hours and assuming exposure to the sun between 10.00am and 4pm the appropriate answer would be about ½ day – or less than 3 complete applications.

Time lag for maximum effectiveness

In order to determine whether interviewees had an understanding of the way in which sunscreen works they were asked how long after application sunscreen operated at maximum effectiveness and were offered 4 choices of response, being immediately after application, 15 minutes, 30 minutes and 1 hour after application. Advice is that sunscreen should be applied at least 30 minutes before exposure to the sun and reapplied every 1½ to 2 hours thereafter.

Sun Protection Factor

Interviewees were asked to explain the difference between sunscreen with a Sun Protection Factor (SPF) of 15 and one with an SPF of 30. SPF is a measure of the effectiveness of the sunscreen at preventing UVB rays from reaching the skin. A sunscreen of SPF 15 filters out 93% of UVB radiation, a sunscreen of SPF 30 filters out 96% (Cancer Research UK). It is a common misconception that SPF 30 is twice as strong as SPF 15 and therefore that a sunscreen of SPF 15 should be applied twice as often as one of SPF 30. Auiter et al (2007) reported failure to understand difference between SPF levels leads to the belief that higher

SPF allows for longer safe exposure time and that use of higher factor sunscreens commonly leads to overexposure and burning.

Sun tan –v- Sun bed

Interviewees were asked whether a ‘natural’ sun tan was safer than a sun tan obtained using a sun bed. The best medical view is that there is no such thing as a healthy tan and that any colouring of the skin is indicative of skin damage. The ‘no tan at all’ prompt was not given as it was considered a leading response and that interviewees would select it believing that it to be the correct response. Autier (2004) notes that there is a misconception amongst individuals that tanning in a UV sun bed is ‘controlled’ and is therefore safer than uncontrolled tanning in sunlight. This suggestion is not supported by epidemiological data. There is also a belief that a pre-tan, acquired from a sun bed offers some protection from burning when skin is exposed to natural sunlight, and that this erroneous belief leads people to use less sun protection and to engage in more risky behaviour in the mistaken belief that their sun tan will afford them a degree of protection. Again there is no epidemiological or laboratory evidence to support this belief.

Interviewees who identified that a natural tan was safer than a sunbed tan were asked the basis for their belief. The question was a deliberate reversal of the misconception noted by Autier (ibid).

Use of After Sun products

Interviewees were asked whether they used After Sun Products and those who responded positively were asked why they did so. The research team wished to establish interviewees attitude to use of After Sun Products and specifically whether they considered that the purpose of After Sun Products was to treat sunburned skin. Such a belief would suggest that interviewees were willing to overexpose their skin and considered that After Sun Products could be used to treat the over exposure.

Protective effect of sun tans

Interviewees were asked whether they believed that having a sun tan protected them from the risk of developing skin cancer. Research suggests that individuals are over optimistic in their assessment of the protective effect of a number of factors, the protective value of a pre-existing sun tan being one such factor. There are a number of beliefs, such as that ‘having a sun tan is a good base for further tanning and protects against burning’ and ‘having a sun tan can reduce the risk of skin cancer’. Neither is correct. The research wished to establish whether the interviewees believed that having a sun tan offered any protection against the risk of developing skin cancer.

Results

Interviews were carried out with 202 adults. When asked what they were doing when interviewed 21.3% said that they were working or visiting the town centre for business purposes, 45% said that they were on holiday and 33.2% were engaged in a sporting activity.

Use of sun protection.

74.7% (151) of interviewees claimed to use some form of sun protection, 24.7% (50) said that they did not use any form of sun protection. Of the interviewees claiming to use sun protection 91.5% said they used sun screen either as a lotion, spray or oil, 2.5% said that they relied on clothing and covering up in the sun and 0.6% (1 interviewee) indicated that they did not go out in the sun, preferring to stay in shade at all times

Dosage

Questions in respect of dosage were put to interviewees. When asked to identify which of the doses of sunscreen most closely approximated to the dose that an individual would use if applying it to themselves there was a broad range of responses. The correct response is 35ml.

15ml	20ml	25ml	35ml	45ml	Don't use
5.4%	15.3%	14.8%	25.6%	12.3%	26.6%

The same interviewees were then asked how long a 250 ml bottle of sunscreen would last during a hot dry spell if they were the only person using it. The correct response, based on an adult person applying a 35ml dose every 2 hours as recommended is 6.5 applications, which was rounded up to 2 days. This did not take account of increased usage in the event of the sunscreen being reapplied after events such as swimming etc. Responses times were self selected and are shown as percentages,

2 days	3 days	4 days	5-6 days	7- 10 days	2 weeks	3 weeks	1 month	2 months	1 year	3 summers	Don't know
3.9	8.8	4.9	5.9	35.3	20	4.9	8.8	0.5	0.5	1.0	5.4%

The same interviewees were then asked how long a 250 ml bottle of sunscreen would last a family of 4, consisting of 2 adults and 2 children under 10 years during a hot dry spell if applied correctly. The correct response is 4 hours or half a day (2 full and one part application) Response times were self selected and are shown as percentages.

0.5 days	1 day	2 days	3 days	4-5 days	1 week	2 weeks	3 weeks	1 month	Don't know
2.0	24.5	24.5	7.5	6.0	27.5	2.5	0.5	0.5	4.5

Time lag for maximum effectiveness

Interviewees were asked how long it took for sunscreen to become fully effective after application. 4 response times and a ‘Don’t know’ option were offered. The correct response is 30 minutes after application. Responses are shown as percentages.

Immediately	15mins after application	30 mins after application	1 hour after application	Don’t know
30.5	25.5	30.5	6.0	7.5

Sun Protection Factor

Interviewees were asked to describe the difference between a sunscreen marked SPF 15 and one marked SPF30. The correct response is that a sunscreen marked SPF 30 blocks 4% more UVB than one marked SPF15 (97% -v- 92%). Interviewees provide a freeflow response.

66.6% thought that the protection offered by SPF 30 was higher but did not quantify by how much. 16.5% thought that when using SPF 30 the user could stay out in the sun for longer.

0.5 % thought that SPF related to sun temperature and that the higher the sun temperature the higher the SPF required. 0.5% thought that different skin types required different SPF factors. 1% thought that there is no difference between SPF 15 and SPF 30. 15% gave a ‘don’t know’ response.

Sun tan –v- Sun bed

Interviewees were asked whether a ‘natural’ sun tan was safer than a sun tan from a UV sun bed. 48% of interviewees said that a ‘natural’ tan was safer, 39% said that a UV sun bed tan was safer and 13% gave a ‘don’t know’ response.

The interviewees who responded that a ‘natural’ suntan was safer were asked why they believed that to be the case. Freeflow responses were recorded. Reasons cited for the belief were that sun light is more natural and therefore less harmful (28%) sunlight is not as intense as artificial UV (31%) the sun is less dangerous than a sunbed(11.5%) different UV is emitted by a sun bed (8%) and no sunscreen is used on sunbeds (5%) and 14% gave a ‘don’t know’ response.

Use of After Sun products.

54% of interviewees said that they used After Sun products, 46% said that they did not.

Those interviewees who said they did use After Sun products were asked why they did so. 65% said that they used After Sun products as a remedy when their skin has been over exposed, citing reasons such as ‘to take the sting out’, ‘take the heat out of burned skin’ ‘ reduce pain from red skin’ ‘reduce temperature of the skin’ and to ‘stop peeling’.

Other reasons cited were to moisturise skin (30%), to help maintain tan(0.9%) and to prevent aging (1.8%) .

Protective effect of sun tan

11% of interviewees said that having a sun tan provided a degree of protection from skin cancer. 73% said that there was no protection given by having a sun tan, 16% gave a 'don't know' response.

Discussion

The research shows that although 75% of respondents said that they used sunscreen as a form of protection against the effects of the sun less than 25% correctly identified the recommended dose when asked to select the dose that most closely correlated with the amount that they would apply to themselves. This figure however is significantly undermined when compared to the responses given to the question regarding how long a 250ml bottle of sunscreen would last an individual if properly applied, where only 4% of the persons questioned gave the correct response and when compared to responses given to the same question but where applied to 2 adults and 2 children under 10 years of age where 2% gave the correct response. The results show that although a significant percentage (38%) of those interviewed recognised the appropriate dose of sunscreen for one application, or chose the dose greater 10ml greater than that recommended in practice this is not the dose applied, and in general terms a 250ml bottle of sunscreen is made to last as long as it is required. This was demonstrated by the responses of individuals who suggested that a 250ml bottle would last 1 week or 2 weeks, being the length of their holiday.

One of the factors that may be contributing to use of insufficient amounts of sunscreen is cost. 250ml bottles of SPF 15 sunscreen range in costs from £2 for a basic product, sold as supermarket own brand no frills product to £9 for a heavily marketed high visibility brand. The average price for a 250ml bottle of SPF 15 sunscreen based on a supermarket offer of 9 brands was found to be £5.31, with each product other than the own brand no frills product being sold with a similarly priced and match branded 250ml bottle of after-sun lotion. The average cost of a 35ml adult dose of sunscreen was found to be £0.75. Using the average cost of sunscreen one adult holidaying for one week would have to spend £21 to protect themselves, a family of 2 adults and 2 children would have to spend £60.58 on sun screen if applied at the recommended dose and rate of application.

The results also show significant confusion regarding SPFs and what they mean. 66% of interviewees believed that a higher SPF gave greater protection in terms of longer exposure time but were not able to say by how much and an additional 16% directly responded that a higher SPF allowed the user to stay in the sun for longer. Over 10% of interviewees in free flow response suggested that SPF 30 was twice as strong as SPF 15 and allowed the user to remain in the sun twice as long for a single application.

30% of interviewees understood that there is a 30 minute time lag between sunscreen being applied and it offering maximum protection. This suggest that in 70% of cases a degree of unprotected exposure to the sun has taken place before sunscreen is applied and that skin damage may have occurred in consequence.

The responses to the question in respect of the relative safety of a 'natural' tan when compared to a tan obtained by using a UV sun bed show that that those individuals

interviewed did not understand that all exposure of skin to UV radiation, irrespective of source is potentially dangerous. Some interviewees pointed to reports in the local media that had been carried at the time of the research regarding children being burned on UV sun beds as reasons not to use artificial tanning equipment, but failed to appreciate that exposure to the sun carries the same risk.

Over 70% of those interviewed appreciated that having a sun tan did not offer any protection against skin cancer. 11% of interviewees did believe that there was a degree of protection afforded by having a sun tan and 16% gave a 'don't know' response. It is a matter of concern that individuals appear to know there is no health benefit in terms of protection against skin cancer to be gained from having a sun tan, but do not appear to realise that there is an elevated risk of getting skin cancer associated with getting a skin tan.

Conclusions

Whilst a high percentage of individuals understand the need for protection against the effects of the sun and use sunscreen as protection there is strong optimistic bias about the degree of protection the sunscreen applied affords them. This research shows that individuals recognised that the required dose and claim to apply it, but in practice do not do so. It is also evident from the research that sun screen is applied too late, in that some unprotected exposure has already taken place before sunscreen is applied in over 60% of cases, and a failure to understand the SPF system as applied to sun protection products which also contributes to a mistaken belief in the degree of protection afforded. The high proportion of interviewees who stated that they used After Sun products to deal with the adverse effects of over exposure supports the evidence in respect of over exposure, as individuals appear to have an expectation that they will suffer from a degree of sun burn and believe After Sun products are intended to deal with this, rather than for their intended purpose, to moisturise skin and prolong sun tan. It appears to be widely recognised that a sun tan confers no health benefit in terms of protection from skin cancer, but there is a clear failure to appreciate that getting a sun tan whether through deliberate action or in consequence of unintentional over exposure can elevate the risk of getting skin cancer.

Of considerable interest is the response to the question regarding the relative safety of 'natural' tans when compared to tans obtained using UV tanning equipment. There was little recognition that neither is safe, with both those who elected a natural tan and those who supported the safety of tans obtained using tanning equipment citing reasons in support of their respective belief. It is impossible to say from the research whether this belief affected the way in which these individuals behaved, either by not using artificial tanning equipment or by using it in preference to tanning in the sun, however the very clear confusion that exists suggests that there is a need for clear and unequivocal health messages addressing the issue to be promulgated.

The research shows that there is an understanding of the need for individuals to protect themselves in the sun and that a high percentage of those interviewed did actively take steps to do so by using sunscreen. It is clear however that where sunscreen is used incorrect assumptions are made about its efficacy based on the SPF factor it has, it is applied too late and too little is applied. In consequence individuals are under protected and suffer from the effects of over exposure to the sun, which appears to be their expectation given their use of

After Sun products to treat the effects. It is suggested that health professionals need to build on the awareness of the need for protection with clear and simple messages about how sun screen works and the need to ensure that it is used properly if over exposure and the elevated risk of skin cancer that is associated with it are to be avoided.

References

Autier P.(2004) Perspectives in melanoma prevention: the case of sunbeds . Eur J Cancer. 40 (16) :2367 -2376

Autier P, Severi G, Doré J-F, Boniol M, Azurdia R, Rhodes L(2000) Has the sun protection factor had its day? BMJ 2000 320: 1274

Autier P, Boniol M, Doré J-F(2007) Sunscreen use and increased duration of intended exposure: still a burning issue. Int J Cancer Vol 121 Issue 1: 1-5

Bennetts K, Borland R, Swerissen H (1991) Sun protection behaviour of children and their parents at the beach. Psychology and Health, Vol 5 Issue 41 279-287

Cancer Research UK. Cancer Mortality Statistics -
<http://info.cancerresearchuk.org/cancerstats/mortality/?a=5441>

Cancer Research UK – Sunsmart Advice and Preparation -
<http://info.cancerresearchuk.org/healthyliving/sunsmart/advice-and-prevention/sunscreens>

Clarke V, Williams T , Arthey S. (1997) Skin Type and Optimistic Bias in Relation to the Sun Protection and Suntanning Behaviors of Young Adults Journal of Behavioural Medicine. Vol 20 :2 207-222

Fleming C, Newell J, Turner S, Mackie R 1995 A study of the impact of Sun Awareness Week British Journal of Dermatology Vol 136, Issue 5 719-724

Herlihy E, Gies P , Roy C, Jones M(1994) Personal Dosimetry of Solar UV Radiation for Different Outdoor Activities. Photochemistry and Photobiology Vol 60 Issue 3 289-294

McGee R, Williams S, Cox B, Elwood M, Bulliard JL 1995 A community survey of sun exposure, sunburn and sun protection. N Z Med J Dec 8; 108(1013) 508-10

McGregor JM, Young AR. Sunscreens, suntans, and skin cancer. 1996 BMJ:312:1621-2 (29 June)

Stenberg C, Larkö O. 1985:Sunscreen application and its importance for the sun protection factor. Arch Dermatol. 121:1400-2

Thieden E, Philipsen PA, Sandby-Møller J, Wulf HC 2005 Sunscreen Use Related to UV Exposure, Age Sex, and Occupation Based on Personal Dosimeter Readings and Sun-Exposure Behaviour Diaries. Arch Dermatol. Issue 141 967-973

Welsh Cancer Intelligence and Surveillance Unit Cancer Incidence in Wales 2002-2006 NHS
Wales 31.01.08