

# NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

## Sunlight Exposure: Communicating the Benefits and Risks of Ultraviolet Light to the General Population: Effectiveness and Cost-Effectiveness Review

### Final Report

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## References

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# Executive Summary

## 1. INTRODUCTION

The National Institute for Health and Care Excellence (NICE) Centre for Public Health (CPH) commissioned this review of the evidence on the effectiveness and cost-effectiveness of interventions that seek to present and disseminate complex health risk information relating to ultraviolet (UV) radiation exposure.

## 2. METHODS

This evidence review was conducted according to the NICE public health guidance methods manual <sup>1</sup>. The review was guided by a project protocol, based on the NICE scope document <sup>2</sup> and contract of work, developed in collaboration with the NICE CPH.

### 2.1 Research Questions

The evidence review investigated the following questions:

- 1a. What are the most effective methods of presenting complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- 1b. What are the most effective methods of disseminating complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- 1c. What are the most cost-effective methods of presenting complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- 1d. What are the most cost-effective methods of disseminating complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- 2a. What are the most effective ways to change people's beliefs about the risk of sun exposure and to encourage them to change their sun protection practices accordingly?
- 2b. What are the most cost-effective ways to change people's beliefs about the risk of sun exposure and to encourage them to change their sun protection practices accordingly?
- 3a. What content do effective primary skin cancer prevention messages contain?
- 3b. What is the most effective content in primary skin cancer prevention messages?

## **2.2 Review Eligibility Criteria**

This review was guided by a protocol agreed 'a priori' with selection criteria derived from the NICE Public Health Guidance final scope <sup>2</sup> and discussions with the NICE team. Eligible studies were required to have been:

- Conducted in an OECD (Organisation for Economic Co-operation and Development) country;
- Published in English;
- Published in 2008 or later.

The review specifically excluded studies that were conducted in skiers and expatriate populations. Interventions were excluded when they aimed to manage vitamin D deficiency or skin cancer (or health conditions that may increase the risk of these), or conditions treated with drugs for which increased sun exposure is inadvisable; prevent secondary skin cancer; or assess the effectiveness of, or compliance with, indoor tanning regulations. A comparator was not essential for studies to be included in the effectiveness review, whereas studies needed to feature a comparator for inclusion in the cost-effectiveness review. Burden of disease and cost of illness studies were not eligible for inclusion in the cost-effectiveness review.

Extensive literature searches were undertaken and records retrieved from the literature search were subject to a three stage selection process of initial screening to remove obviously irrelevant records (first pass), selection based on title and abstract assessment, and selection based on assessment of full text.

## **2.3 Quality Assessment Criteria for Effectiveness and Cost-effectiveness Studies**

The quality of the effectiveness studies was assessed using the appropriate appraisal checklists from the NICE public health guidance methods manual. Studies were graded in relation to their study design, population, methodology, outcomes and analyses, with separate grades awarded for internal and external validity, and overall. The AMSTAR quality assessment tool was used for systematic reviews (SRs) <sup>3</sup>. The quality assessment was conducted by a single reviewer and checked by a second reviewer, and any disagreements resolved through consensus or by a third reviewer.

## **2.4 Data Extraction**

Data were extracted from the included studies using a data extraction template appropriate for the study design (systematic reviews, randomized controlled trials, economic evaluations or observational studies) and specified in, where available, the NICE public health guidance methods manual <sup>1</sup>.

## **2.5 Evidence Statements**

Evidence statements were constructed taking into account the quality and consistency of the findings and the applicability of the evidence for each of the research questions. For the purpose of generating evidence statements, the strength and consistency of evidence were considered and reported separately, and evidence was described using the criteria:

- Inconclusive evidence: all poor quality studies;
- Weak evidence: at least one moderate quality study;
- Moderate evidence: either mostly moderate, or a combination of good quality and poor/low quality studies;
- Strong evidence: all or mostly high/good quality studies;
- Consistent evidence: direction of effect is the same across studies;
- Inconsistent evidence: direction of effect is different across studies.

### 3. RESULTS

#### 3.1 Summary of Study Identification

23,271 records were retrieved by the searches. Following deduplication and selection rounds, a total of 572 full-text articles were assessed for relevance. 108 reports were assessed to be eligible for the review.

#### 3.2 Quantity and Quality of the Available Evidence

The included studies comprised systematic reviews, randomized controlled trials (RCTs), comparative and non-comparative observational studies, and economic evaluations. The nature of the included studies meant that many studies reported multiple outcomes and, therefore, could contribute to more than one research question.

#### 3.3 Evidence Statements

##### **Evidence Statement 1.1 to 1.4: Interventions that Disseminate Complex Health Risk Information to Aid Assessment of Level of Risk and Benefit from Sun Exposure**

###### **Evidence statement 1.1**

There is strong evidence from one good quality [++] RCT<sup>4</sup> conducted in France reporting that educational programmes involving practical classroom-based activities can increase knowledge about the risks of sun exposure in children aged 9 to 12 years. Three additional observational studies all reported improved knowledge about the risks of sun exposure in children<sup>5-7</sup>

<sup>4</sup>Sancho-Garnier et al. (2012) [++]

<sup>5</sup>Stover et al. 2012 [+]

<sup>6</sup>Gilaberte et al. (2008) [+]

<sup>7</sup>Quereux et al. (2009) [+]

###### **Evidence statement 1.2**

There is weak, inconsistent evidence from two RCTs<sup>8,9</sup> that electronic educational interventions may be effective in changing people's knowledge or understanding of how to competently assess their level of risk or benefit from sun exposure. One moderate quality [+] RCT<sup>8</sup> conducted in Belgium university students reported that web-based messages may be more conducive to knowledge change about the risks and benefits of sun exposure if presented in a narrative format while one poor quality [-] RCT<sup>9</sup> conducted in American adults suggested that video content about melanoma recognition may need to be tailored for older (60-92 year old) and younger (18-25 year old) adult age groups. No further details were reported.

<sup>8</sup>Lemal et al (2010) [+]

<sup>9</sup>Isaccowitz et al. (2012) [-]

###### **Evidence statement 1.3**

There is strong, consistent evidence from two good quality [++] RCTs<sup>10,11</sup> both conducted in the US that tailored educational interventions are effective in changing people's knowledge or understanding of how to competently assess their level of risk or benefit from sun exposure.

One good quality RCT [++]<sup>10</sup> in adult relatives of melanoma patients reported that at six months an educational tailored intervention increased the probability of having a total cutaneous examination by

a health professional almost two-fold (OR 1.94 (95%CI: 1.39 to 2.72)  $p < 0.001$ ). There were no significant differences between groups for skin self-examination the probability of having a skin examination from a health professional. The second good quality[++] RCT<sup>11</sup> in siblings of recent melanoma patients reported that personalized counselling and web-based education showed improvements in knowledge regarding location and appearance of melanoma. No further details reported

<sup>10</sup>Manne et al. (2010) [++]

<sup>11</sup>Geller et al. (2006) [++]

#### **Evidence statement 1.4**

There is moderate evidence from one poor quality [-] systematic review<sup>12</sup> and two good quality [++] RCTs<sup>13, 14</sup> that multi-component interventions are effective in changing people's knowledge or understanding of how to competently assess their level of risk or benefit from sun exposure.

While it appears that multi-component interventions are effective in changing people's knowledge or understanding about how to competently assess their risk or benefit from sun exposure it was not possible to determine which specific features of the interventions were the most effective because the included studies used different combinations of interventions in widely varying population groups at varying extent of risk from sun exposure.

<sup>12</sup>Reinart et al. (2013) [-]

<sup>13</sup>Rat et al. (2014) [++]

<sup>14</sup>Emmons et al. (2011) [++]

### **Evidence statement 2.1 to 2.9: Interventions that Disseminate Complex Health Risk Information to Change Perception of Risks and Benefits of Sun Exposure**

#### **Evidence statement 2.1**

There is inconclusive evidence from one poor quality [-] comparative observational study<sup>15</sup> conducted in Australia investigating whether mandatory sun protection policy for outdoor workers in tropical regions reduced sun damage compared with a voluntary policy. 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 the risk of skin cancer ( $p=0.046$ ), were more likely to believe that they were susceptible to developing skin cancer ( $p=0.019$ ), and were more likely to believe that long-sleeved shirts were more hot and uncomfortable than short-sleeved shirts ( $p=0.049$ ).

<sup>15</sup>Woolley et al. 2008 [-]

#### **Evidence statement 2.2**

There is inconclusive evidence from one poor quality [-] systematic review<sup>16</sup> and one poor quality [-] RCT<sup>17</sup> about the effectiveness of UV photographs (with or without photoaging) on participants' perceived susceptibility or vulnerability to skin cancer or sun damage

One poor quality [-] systematic review<sup>16</sup> in teenagers and adults reported that UV photographs with or without photoaging had significant effects on perceived susceptibility to photoaging (7 studies ( $n=252$ ); combined effect size,  $r=0.226$ ,  $p < 0.0001$ ) and on future sun protection intentions (8 studies ( $n=625$ ): combined effect size  $r=0.386$   $p < 0.0001$ ). A poor quality RCT[-] conducted in school-aged

children in the US reported that although adolescents were comparatively optimistic (i.e. believed to be at lower risk than their peers) about their likelihood of developing cancer, non-tanning students given a photo computer-morphed to make a naturally fair-skinned model look more tanned were more optimistic than those given a similar unadulterated photo ( $p=0.001$ )<sup>17</sup>.

<sup>16</sup>Williams et al. 2013 [-]

<sup>17</sup>Roberts et al, 2011 [-]

### **Evidence statement 2.3**

There is weak, consistent evidence from four moderate quality [+] RCTs<sup>18-21</sup> and seven poor quality [-] RCTs<sup>22-28</sup> that UV photographs (with or without photoaging) plus additional interventions (mostly information provision) enhanced participants' perceived susceptibility or vulnerability to skin cancer.

There is weak evidence from one poor quality [-] RCT<sup>22</sup> in 253 German high school students aged 13 to 19 years that an interactive presentation providing general information on the effects of sun exposure plus a personal UV photos was predicted to result in considerable changes in risk perceptions of getting skin cancer compared with a similar intervention focused on interdental hygiene ( $p<0.001$ ) in 253 high school students aged 13 to 19 years from seven schools<sup>22</sup>.

There is weak, consistent evidence from two good quality<sup>18, 19</sup> and five poor quality RCTs<sup>23-27</sup> most of which were conducted in US colleges, that UV photographs (with or without photoaging) plus additional interventions (mostly information provision) enhanced participants' perceived susceptibility or vulnerability to skin cancer. One study conducted in UK reported no statistically significant differences, but found a trend towards higher perceived susceptibility to photoaging and skin cancer in 677 female students from secondary schools and universities (aged 16 to 23 years) given efficacy information as part of a risk message compared with those given a self-affirmation task alone or no intervention.

There is weak evidence from one moderate quality RCT [+] <sup>20</sup> investigating the impact of UV photography interventions (UV photo or no photo plus educational video on photoaging or skin cancer) in 148 US male outdoor road workers. Men who saw their UV photo reported more skin damage from the sun than did those who did not view their UV photo ( $F(1, 146)=5.0, p<0.03, d=0.41$ , means of 5.45 vs. 4.93). In addition, men in each UV group reported significantly higher estimates of damage than those receiving no UV photo and no educational video.

There is inconclusive evidence from two additional RCTs. One poor quality RCT [-] <sup>28</sup> found that neither messages of different levels of persuasion nor UV photos had a significant effect on perceived vulnerability to the negative consequences of UV exposure in 151 mothers of elementary and middle-school aged children in the USA receiving a multicomponent UV intervention<sup>28</sup>. One moderate quality RCT [+] <sup>21</sup> reported that in 266 high-risk people (adults and children) visiting a public science event in Germany, those who were asked to rate their own personal strengths and values (self-affirmation task) reported a slight increase in risk perception to a personal UV photo compared with those not given the chance to self-affirm (difference not significant)<sup>21</sup>.

While it appeared that UV photographs (with or without photoaging) plus other interventions were effective in enhancing participants' perceived susceptibility or vulnerability to skin cancer, it was not possible to determine which specific features of the additional interventions were the most effective. Most of the included studies used additional education interventions (videos, lectures, written information) in varying population groups (children, university students, high risk groups and the general population).

<sup>22</sup>Schuz et al. 2013 [-]



- <sup>18</sup>Good et al. 2011 [+]
- <sup>19</sup>Mahler et al. 2010 [+]
- <sup>29</sup>Siegel et al. 2010 [-]
- <sup>30</sup>Walsh et al. 2012 [-]
- <sup>25</sup>Moser et al. 2012 [-]
- <sup>20</sup>Stock et al. 2009 [+]
- <sup>26</sup>Mahler et al. 2008 [-]
- <sup>27</sup>Mahler et al. 2013 [-]
- <sup>28</sup>Dykstra et al. 2008 [-]
- <sup>21</sup>Schuz et al. 2013 [+]

#### **Evidence statement 2.4**

There is weak, consistent evidence from two moderate quality [+] RCTs from Ireland<sup>31</sup> and the USA<sup>32</sup> and two poor quality [-] RCTs from the US<sup>33, 34</sup> that message framing is not effective in changing young adults perceived susceptibility or vulnerability to skin cancer. The included RCTs investigated health messages framed as either a loss (emphasizing the risks of sun exposure) or a gain (emphasizing the beneficial effects of sun protection). RCTs reported no significant differences between gain- or loss-framed messages for sun protection or skin cancer messages.

- <sup>31</sup>Thomas et al. (2011) [+]
- <sup>32</sup>Hwang et al. (2012) [+]
- <sup>33</sup>Nan et al. (2011) [-]
- <sup>34</sup>Hoffner et al. (2009) [-]

#### **Evidence statement 2.5**

There is inconclusive, inconsistent evidence from two poor quality [-] RCTs from Northern Europe<sup>35, 36</sup> about the effect of motivational interventions on participants' perceived susceptibility or vulnerability to skin cancer or sun damage.

One poor quality RCT<sup>35</sup> reported that a self-affirmation task, which was incorporated into a leaflet presenting health risk information to 162 white female sunbathers, showed a significant improvement in perceived susceptibility or vulnerability of skin cancer or sun damage ( $p < 0.0001$ ). The second poor quality RCT<sup>36</sup> in Dutch sunbed users reported that personal testimony evoked more feelings of risk than factual risk information using cognitive-laden ( $p = 0.02$ ) or affective-laden words ( $p = 0.001$ ) immediately following the intervention. No significant differences in perceived susceptibility or vulnerability to skin cancer or sun damage were found between any of the interventions at follow up three weeks later.

- <sup>35</sup>Jessop et al. (2009) [-]
- <sup>36</sup>Janssen et al. (2013) [-]

#### **Evidence statement 2.6**

There is inconclusive, inconsistent evidence from one moderate quality systematic review [+] <sup>37</sup> about the effect of multi-component interventions on participants' perceived susceptibility or vulnerability to skin cancer. The included studies reported a variety of different interventions (for example verbal advice, mass media, printed material, web-based resources) and it was not possible to determine which specific features of the interventions were the most effective.

Although the systematic review was considered moderate quality, this has been downgraded to inconclusive because the majority of the included primary studies did not provide sufficient detail of their interventions.

<sup>37</sup>Eagle et al. (2009) [+]

### **Evidence statement 2.7**

There is weak evidence from one moderate quality [+] RCT conducted in the US <sup>38</sup> that written information provision does not enhance perceived susceptibility or vulnerability to skin cancer in children or their parents. No further information was reported.

<sup>38</sup>Crane et al. (2012) [+]

### **Evidence statement 2.8**

There is moderate evidence from one good quality [++] RCT <sup>14</sup> and two poor quality RCTs [-] <sup>39, 40</sup> that tailored interventions do not increase the perception of skin cancer risk in high risk adults.

One good quality RCT [++] conducted in 593 US beachgoers <sup>14</sup> investigating different combinations of biometric feedback, education and dermatologist skin examinations reported a decrease in perceived risk of skin cancer from baseline in all but the feedback plus dermatology examination group: for those reporting a higher than average perceived risk, odds ratios (ORs) were 0.53 for feedback, 1.20 for dermatologist examination, and 1.59 for the combined intervention. a decrease in perceived risk of skin cancer. There was no effect on participants' perceptions of skin damage.

Two poor quality RCTs in 819 US adolescents (aged 10-16 years) and 316 Swedish adults investigated different forms of personalized feedback (combinations of standard letter, personalised risk assessment, GP consultation and photo-tests) <sup>39</sup> and tailored feedback reports as part of a SunSmart campaign <sup>40</sup> and found no differences between intervention and control groups. No further details were reported.

<sup>14</sup>Emmons et al. (2011) [++]

<sup>39</sup>Falk et al. (2011) [-]

<sup>40</sup>Adams et al. (2009) [-]

### **Evidence statement 2.9**

There is inconclusive, consistent evidence from two of moderate quality observational studies <sup>6, 41</sup> and one poor quality observational study <sup>42</sup>, that active participation educational interventions may improve the perceived susceptibility or vulnerability of skin cancer or sun damage.

Two comparative observational studies were conducted in Australian adolescents; one moderate quality [+] study reported stronger sun safe beliefs and intentions following a belief based intervention comprised three, one hour in-school sessions facilitated by Cancer Council Queensland employees <sup>42</sup>, while the other poor quality [-] study reported that the 1588 participants had greater confidence in their perceived ability to protect themselves from skin cancer following an intervention involved a music video showing five recommended forms of sun protection (using sunscreen, wearing sunglasses and hats, getting under shade, and covering up with clothing) that were communicated both visually and lyrically <sup>41</sup>.

A moderate quality [+] non-comparative observational questionnaire<sup>6</sup> was administered before and after SolSano (a sun safety programme) conducted in 1522 children from 215 Spanish primary schools. The percentage of children who desired to be tanned reduced slightly from 48.3% to 43.8% following the intervention. No further details were reported

<sup>42</sup>White et al. (2010) [+]

<sup>41</sup>Potente et al. (2011) [-]

<sup>6</sup>Gilaberte et al. (2008) [+]

### **Evidence Statement 3.1 to 3.3: Interventions that Disseminate Complex Health Risk Information to Change Perception of Risks and Benefits of Sun Exposure in Specific Population Groups**

#### **Evidence statement 3.1**

There is weak, inconsistent evidence from one moderate quality [+] RCT<sup>38</sup> and one poor quality RCT<sup>40</sup> both conducted in children in the US, which found that educational newsletters and interactive tailored computer sessions were not beneficial in changing perceptions in school-aged children.

There is inconclusive evidence from two poor quality RCTs [-] in children from the US<sup>17</sup> and Germany<sup>22</sup> about the effectiveness of UV photographs to change perceptions of school-aged children.

<sup>38</sup>Crane et al. (2012)

<sup>17</sup>Roberts et al. (2011)

<sup>22</sup>Schuz et al. (2013)

#### **Evidence statement 3.2**

There is weak, inconsistent evidence from two moderate quality [+] RCTs<sup>20, 32</sup> (investigating different interventions) about the effect of interventions to improve outdoor workers' perceived susceptibility or vulnerability to skin cancer.

One [+] study<sup>20</sup> conducted in US Department of Transport road workers examined the impact of UV photography interventions (UV photo or no photo plus educational video on photoaging or skin cancer) in 148 men. Men in each UV group reported significantly higher estimates of skin damage than those receiving no UV photo and no educational video. A second [+] RCT<sup>32</sup> was conducted in 219 adolescents aged 12 to 18 years (mean 15.7 years) who were members of Young Farmers of America in the rural US Midwest. Gain-framed messages were found to be more effective when perceived effectiveness was high than when it was low; this effect was non-significant. Participants' preference for the loss-framed message over the gain-framed message generally increased as the level of perceived susceptibility increased, this effect was non-significant.

<sup>20</sup>Stock et al. (2009) [+]

<sup>32</sup>Hwang et al. (2012) [+]

#### **Evidence statement 3.3**

There is inconclusive, consistent evidence from two poor quality [-] RCTs<sup>26, 27</sup> reporting that UV photographs with or without photoaging resulted in significantly greater perceived susceptibility to skin cancer.

<sup>26</sup>Mahler et al. (2008) [-]

**Evidence Statement 4.1 to 4.10: Interventions that Disseminate Complex Health Risk Information to Change Individual Attitudes towards Risks and Benefits of Sun Exposure**

**Evidence statement 4.1**

There is weak, consistent evidence from one poor quality [-] systematic review<sup>16</sup>, one moderate quality [+] RCT<sup>19</sup> three poor quality [-] RCTs<sup>24, 26, 27</sup> and one comparative observational study<sup>43</sup> that UV photographs (with or without photoaging) plus additional interventions (additional information or photos of others) increase participants intentions' to adopt sun protection measures. The interventions used UV-filtered photos, which depict the underlying skin damage caused by sun exposure, with or without the provision of additional information on photoaging and/or skin cancer Two trials combined these with photos of others depicting less or more skin damage (upward/downward condition)<sup>19</sup> and social norms information<sup>26</sup>. There is inconclusive evidence about which of the additional interventions were efficacious.

There is inconclusive evidence from one moderate quality trial [+] <sup>20</sup> reporting attitudes towards sun protection by examining the impact of UV photography interventions (UV photo or no photo plus educational video on photoaging or skin cancer) in 148 male US outdoor road workers (mean age 46.5 years), the majority (90%) of whom spent at least 5 to 6 hours in the sun each day. Overall, men who saw their UV photo and/or the educational video reported more positive attitudes towards sun protection than those in the control group who saw neither a UV photo nor educational video (M=3.6 vs M=3.1; F (1, 146)=11.49, p=0.001, d=0.86). Although all four interventions were significantly different from the control group (all p<0.01; all d>0.81), there was no significant difference between interventions (all p>0.4)<sup>20</sup>.

<sup>16</sup>Williams et al. (2013) [-]

<sup>19</sup>Mahler et al. (2010) [+]

<sup>24</sup>Walsh et al. (2012) [-]

<sup>27</sup>Mahler et al. (2013) [-]

<sup>26</sup>Mahler et al. (2008) [-]

<sup>43</sup>Williams et al. (2013) [+]

<sup>20</sup>Stock et al. (2009) [+]

**Evidence statement 4.2**

There is inconclusive, consistent evidence from one poor quality [-] systematic review<sup>44</sup> (including 33 primary studies) one moderate quality [+] RCT conducted in Ireland<sup>31</sup> and four poor quality RCTs from Ireland<sup>45</sup> and the US<sup>33, 34, 46</sup> that the use of framing messages does not encourage people to engage in protective behaviours.

Gain-framed messages emphasize positive or beneficial effects of engaging in protective behaviours (e.g. using sunscreen keeps skin healthy), while loss framed messages emphasize the negative or detrimental effects of not adopting such behaviours (e.g. risks of sun exposure). Three of the five trials also explored interactions with additional variables, such as the focus of the message<sup>45</sup>, incidental affect (impact of emotional recall)<sup>33</sup>, and the level of efficacy of behaviours described within the message. The systematic review<sup>44</sup> and RCTs<sup>31, 33, 34, 45, 46</sup> reported no significant difference between gain or loss framed messages.

<sup>44</sup>O'Keefe et al. (2012) [-]

<sup>31</sup>Thomas et al. (2011) [+]

<sup>45</sup>Hevey et al. (2008) [-]

<sup>34</sup>Hoffner et al. (2009) [-]

<sup>33</sup>Nan et al (2011) [-]

<sup>46</sup>Stoner et al. (2009) [-]

#### **Evidence statement 4.3**

There is weak, consistent evidence from one moderate quality [+] RCT<sup>47</sup> and three poor [-] quality RCTs<sup>48-50</sup> that health messages manipulated to invoke a sense of fear or increase worry are effective in promoting behavioural change (sun protection practices). Three trials<sup>47, 48, 50</sup> were conducted in the US and one in Australia<sup>49</sup>. The majority of participants were young women (university aged) who were seeking to tan.

<sup>47</sup>Prentice-Dunn et al. (2009) [+]

<sup>48</sup>Cooper et al. (2014) [-]

<sup>49</sup>Notebaert et al. (2014) [-]

<sup>50</sup>Cox et al. (2009) [-]

#### **Evidence statement 4.4**

There is weak, inconsistent evidence from five RCTs regarding the effect of motivational interventions on individuals' intentions to adopt more sun protective behaviours, or the effectiveness of individual components. One moderate quality [+] RCT investigated dissonance induction in 260 female US psychology undergraduate students (90% non-Hispanic) and showed no differences between groups.<sup>51</sup> Four poor [-] quality RCTs were also identified; one investigating instructions on how to view videos presenting health information in younger (aged 18-25) and older (aged 60 -92) US adults reporting that adults showed significantly greater intentions to adopt more protective behaviours than did younger adults<sup>9</sup>; one investigating self-affirmation tasks in 163 female sunbathers in the UK aged 18 to 92 years reporting no differences in participants intentions to use sunscreen<sup>35</sup>; one investigating social support in 59 US Caucasian females aged 18 to 24 years<sup>52</sup> and computer-morphed photos given to 211 public school students in the USA, aged 11 to 14 years<sup>17</sup>.

<sup>51</sup>Chait et al. (2011) [+]

<sup>9</sup>Isaacowitz et al. (2012) [-]

<sup>52</sup>Midboe et al. (2011) [-]

<sup>35</sup>Jessop et al. (2009) [-]

<sup>17</sup>Roberts et al. (2011) [-]

#### **Evidence statement 4.5**

There is inconclusive evidence from one moderate quality [+] systematic review<sup>53</sup> about the effective of health care programmes based on the UV index in changing individuals' attitudes towards tanning and the risk of skin cancer. The review identified one RCT conducted in Sweden evaluating four different information packages, two of which contained a UV meter. No significant differences were found between the information packages.

<sup>53</sup>Italia et al. (2012) [+]

#### **Evidence statement 4.6**

There is inconclusive evidence from one poor quality [-] RCT<sup>54</sup> that text messages are ineffective in changing individuals' attitudes towards tanning and the risk of skin cancer. The trial found no significant differences between subscribers to a mobile advertising service (aged 16 to 29 years; 5% born with dark skin) who were randomized to receive fortnightly text messages promoting sun safety or safe sex. The odds ratios were 1.1 (95% CI: 0.6–2.4, p=0.72) and 1.0 (95% CI: 0.6–1.5, p=0.98), respectively, for attitudes towards a tan (preference for a dark tan) and attitudes towards the risk of skin cancer (believe about risk of skin cancer)

<sup>54</sup>Gold et al. (2011) [-]

#### **Evidence statement 4.7**

There is weak, inconsistent evidence from one moderate quality [+] RCT conducted in France<sup>55</sup> and two poor quality [-] RCTs conducted in Sweden and the US<sup>39, 56</sup> that tailored interventions improve individuals' intentions to adopt sun protection behaviours for adults.

One moderate quality [+] trial<sup>55</sup> in 316 US women under 75, 22% of whom had a personal diagnosis of skin cancer, compared provision of personalized normalized feedback with information alone and reported significantly increased intentions to adopt sun protection measures both immediately post-test and at follow-up (M=4.64 vs M=4.38, d=0.35 at 4 weeks, p-value not reported). A second poor [-] quality trial<sup>39</sup> in 316 Swedish adults compared a standard letter with a personalized risk assessment with a personal GP consultation plus individualized information, with or without a phototest. After 3 years, no significant differences in giving up sunbathing, use of sunscreen and use of protective clothing.<sup>39</sup>

There is weak, consistent evidence from two moderate quality [+] RCTs<sup>13, 55</sup> that tailored interventions are not effective in changing attitudes in relation to the risks of sun exposure and sun protection behaviours.

One moderate quality [+] French trial<sup>13</sup> in 173 predominantly female adults identified as being at elevated risk for melanoma compared a targeted screening and education intervention or a conventional information-based campaign in 20 GP practices. There were no significant differences between groups. A second poor quality [-] trial<sup>55</sup> assessed the addition of personalized normative feedback to standard of care in 316 US women under 75, 22% of whom had a personal diagnosis of skin cancer. There was no significant effect on intention to sunbathe, either immediately post-test or at the 4-week follow-up (M=2.70 vs M=2.33, d=0.13).

<sup>55</sup>Reid et al. (2013) [+]

<sup>39</sup>Falk et al. (2011) [-]

<sup>56</sup>Reid et al. (2011) [-]

#### **Evidence statement 4.8**

There is moderate, inconsistent evidence from one good quality [++] RCT conducted in French school children<sup>4</sup>, one moderate quality [+] RCT conducted in US lifeguards<sup>57</sup> and one poor quality [-] RCT conducted in Danish teenagers<sup>58</sup> about the effectiveness of active participation education sessions in changing individuals' attitudes towards sun exposure and protection.

Two trials<sup>4, 22</sup> reported the active participation sessions were effective. One trial evaluated the impact of the 'Living with the Sun' (LWS) programme<sup>4</sup> - a sun safety education programme aimed at improving children's knowledge and modifying their behaviour and attitudes towards sun safety

through a series of classroom activities. 1365 French school children aged 9 to 12 years showed positive changes in attitudes immediately after completion of the programme, with significant differences observed between groups for questions on whether tan offers protection from sunburn (35.4% vs. 48.6%,  $p < 0.04$ ), when sun protection is necessary (when walking: 69.2% vs 76.7%,  $p < 0.04$ ; in the mountains: 60.0% vs 79.1%,  $p < 0.04$ ), the need for sun protection (sunscreen use helps avoid later skin damage: 20.5% vs. 27.6%,  $p < 0.04$ ) and approach to sun protection (best protection is a combination of behaviours: 59.6% vs. 67.0%,  $p < 0.04$ ).<sup>4</sup> An additional poor quality trial [-],<sup>22</sup> conducted in German school children used an interactive presentation providing general information on the effects of sun exposure plus a personal UV photo compared with a similar intervention focused on interdental hygiene in 253 high school students aged 13 to 19 years. Being in the intervention group predicted significant changes in outcome expectancies (beta = 0.30 [SE 0.06],  $p < 0.001$ ), health-related time perspectives (beta = 0.12 [SE 0.05],  $p < 0.01$ ), and appearance motives (beta = -0.12 [SE 0.05],  $p < 0.01$ ), but not self-efficacy (efficacy (beta = -0.03 [SE 0.06])

Two trials reported no effect of active participation sessions. One moderate quality [+] trial<sup>57</sup> investigated the Pool Cool programme for preventing skin cancer in 3014 US lifeguards and one poor quality and one poor quality trial [-]<sup>58</sup> examined an education intervention on sunbed use (e-magazine and educational exercises) in Danish teenagers (aged 14 to 17).

Three moderate quality [+] non-comparative observational study reported mixed results, two studies showed improvements<sup>59,60</sup>, while one study reported no differences.<sup>5</sup>

<sup>4</sup>Sancho-Garnier et al. (2012) [++]

<sup>57</sup>Hiemstra et al. (2012) [ + ]

<sup>58</sup>Aarestrup et al. (2014) [-]

<sup>22</sup>Schuz et al. (2013) [-]

<sup>59</sup>Dobbinson et al. (2008) [ + ]

<sup>60</sup>Lee et al. (2013) [ + ]

<sup>5</sup>Stover et al. (2012) [ + ]

#### **Evidence statement 4.9**

There is moderate, inconsistent evidence from one good quality [++] RCT conducted in US university students<sup>61</sup>, one moderate quality [+] RCT conducted in British university students<sup>62</sup> and one poor quality [-] RCT conducted in US high school students<sup>63</sup> and two observational studies<sup>64, 65</sup> that information provision alone is effective in changing individuals' attitudes and beliefs towards the use of sun protection.

One good quality trial [++]<sup>61</sup> evaluated the effects of a brief appearance-focused intervention in 430 female university students in the USA with prior indoor tanning or with future intentions to tan. Compared with the control (no intervention), the appearance-focused booklet significantly reduced both intentions to indoor tan ( $F$  (df = 1400) = 15.64;  $p < 0.001$ , 2-tailed) and attitudes towards indoor tanning ( $p < 0.01$ ) at the long-term follow-up (6 months).

No effect of information provision was found in one moderate quality trial [+] <sup>62</sup> conducted in 121 British university students and staff (aged 14 to 61) recruited from an outdoor setting and who liked to tan, examining the impact of temporal framing of messages providing information about the use of sunscreen, or from a poor quality [-] US trial<sup>63</sup> comparing a summer programme of newsletters aimed at adolescents (Summer Raze) and parents (Sun Scoop) with no summer programme in 599 high school students aged 11 to 15 years and their parents

Two observational studies compared information interventions to investigate the effectiveness of educational interventions; one study<sup>64</sup> discouraged mothers from exposing themselves and their

infants to sunlight for therapeutic reasons and was found to be ineffective, while the other study<sup>65</sup> aimed to increase midwives' and nurses' knowledge and confidence in talking to mothers about sunlight exposure and was thought to be successful.

<sup>61</sup>Hillhouse et al. (2008) [++]

<sup>62</sup>Orbell et al. (2008) [+]

<sup>63</sup>Reynolds et al. (2008) [-]

<sup>64</sup>Harrison et al. (2013) [+]

<sup>65</sup>Devine et al. (2008) [+]

#### **Evidence statement 4.10**

There is moderate, inconsistent evidence from one good quality [++] RCT conducted in adult siblings of melanoma patients from the US<sup>11</sup>, one moderate quality [+] RCT conducted in British female students (high school and university)<sup>18</sup>, and two poor quality [-] RCTs conducted in US university students and US mothers<sup>28, 66</sup> about the effectiveness of multi-component educational interventions in changing individuals' intentions to use sun protection.

Two studies employed motivational techniques as part of their intervention<sup>11, 66</sup>. In one good quality [++] trial<sup>11</sup>, 494 adult siblings (age 18 to >51) of recently diagnosed melanoma patients in the US received either a multi-component intervention (comprising a motivational and goal-setting session, individually tailored feedback, telephone counselling, mailed information and links to free screening) or the suggestion to notify family members and encourage screening (i.e. usual care). After 12 months, there was no difference between the two groups in terms of intentions to use sunscreen, but participants receiving the multi-component intervention reported greater intentions to see a dermatologist than those receiving usual care (69.9% vs 65.2%; OR 1.68, 95% CI: 1.16 to 2.44), and also greater confidence in seeing a dermatologist (61.2% vs 53.3%; OR 2.14, 95% CI: 1.2 to 3.7)<sup>11</sup>. In a poor quality trial [-]<sup>66</sup>, the use of sun protection was significantly affected by the addition of photos and/or a motivational interviewing counselling session to educational material in 197 university psychology students in the USA (aged 18 to 24) with at least one risk factor for skin cancer. The use of photos was significantly more effective in improving stage of change compared with education (OR 2.58, 95% CI: 1.06 to 6.28, p=0.04), while motivational interviewing was marginally more effective than education (OR 2.20, 95% CI: 0.91 to 5.31; p=0.08). It was unclear why the effects of the multi-component intervention did not differ significantly from the control (education)<sup>66</sup>.

One moderate quality trial [+] <sup>18</sup> compared the effects of a combination of self-efficacy information and self-affirmation (a written task on the importance of personal values) with no intervention or either of the intervention components alone, in 677 female UK students (aged 16 to 23) in their final year of secondary school or enrolled on a university psychology course. When presented with a message evoking the threat of skin cancer, students who received the efficacy information showed significantly greater intentions to use sun protection than those who did not (M=6.15 vs M=5.68, p=0.03); no such difference was observed when the message related to photoaging (M=5.93 vs M=5.89, p=0.87).<sup>18</sup>

One poor quality trial [-]<sup>28</sup> found the addition of persuasive messages and UV photos depicting skin damage to have no effect on intentions to use sun protection. in 151 US mothers of elementary and middle-school aged children.

There is weak, consistent evidence from one moderate quality RCT [+] conducted in US university students<sup>67</sup> and one poor quality systematic review [-] including eight primary studies<sup>12</sup> that multi-component interventions are not effective in changing attitudes towards sunscreen use and sun exposure in people whose occupational or leisure pursuits could cause excessive sun exposure.

<sup>11</sup>Geller et al. (2006) [++]



- <sup>18</sup>Good et al. (2011) [+]  
<sup>66</sup>Heckman et al. (2013) [-]  
<sup>28</sup>Dykstra et al. (2008) [-]  
<sup>67</sup>Roberts et al. (2009) [+]  
<sup>12</sup>Reinau et al. (2013) [-]

## **Evidence Statement 5.1 to 5.6: Interventions that Disseminate Complex Health Risk Information to Change Individual Attitudes towards Risks and Benefits of Sun Exposure in Specific Population Groups**

### **Evidence statement 5.1**

There is moderate, inconsistent evidence from five RCTs<sup>4, 17, 22, 58, 63</sup> relating to children of school age (ranging from 9 years to high school) about the effectiveness of interventions to change attitudes of school-aged children.

One good quality [++] trial<sup>4</sup> evaluated the impact of the 'Living with the Sun' (LWS) programme, a sun safety education programme delivered through classroom sessions, in 1365 French school children aged 9 to 12 years; significant between-group differences ( $p < 0.02$ ) were observed for questions relating to whether tan offers protection from sunburn and sun protection behaviours; these differences decreased throughout the year but remained significant<sup>4</sup>.

There were no significant effects of an education intervention on sunbed use (e-magazine and educational exercises), delivered partly through classroom sessions, to 2351 pupils aged 14 to 17 years from continuation schools in Denmark<sup>58</sup>; between those who did and did not receive a tailored newsletter summer programme in 599 high school students or their parents<sup>63</sup>. A poor quality trial [-]<sup>22</sup> reported significant changes in outcome expectancies ( $\beta = 0.30$  [SE 0.06],  $p < 0.001$ ), health-related time perspectives ( $\beta = 0.12$  [SE 0.05],  $p < 0.01$ ), and appearance motives ( $\beta = -0.12$  [SE 0.05],  $p < 0.01$ ), but not self-efficacy (efficacy ( $\beta = -0.03$  [SE 0.06]) in 253 German high school students aged 13 to 19 years receiving general information on the effects of sun exposure plus a personal UV photo compared with a similar intervention focused on interdental hygiene<sup>22</sup>. A second poor quality [-] trial<sup>17</sup> reported that female students were significantly more likely to rate a photo computer-morphed to make a naturally fair-skinned model look more tanned as more attractive than their male counterparts ( $p = 0.05$ ) studied the effects of tanning appearance in photos given to 211 public school students in the USA, aged 11 to 14 years.

- <sup>58</sup>Aarestrup et al. (2014) [-]  
<sup>22</sup>Schuz et al. (2013) [-]  
<sup>4</sup>Sancho-Garnier et al. (2012) [++]  
<sup>17</sup>Roberts et al. (2011) [-]  
<sup>63</sup>Reynolds et al. (2008) [-]

### **Evidence statement 5.2**

There is weak, inconsistent evidence from one poor quality systematic review [-] including eight primary studies<sup>12</sup> and two moderate quality [+] RCTs about the effectiveness of interventions to change the attitudes of people at risk of occupational skin cancer.

In one poor quality SR [-]<sup>12</sup> only one of the eight included primary studies reported a significant positive short-term effect of an education programme conducted in outdoor occupational settings on attitudes towards skin cancer and sun behaviours ( $p$ -value not reported). One RCT<sup>20</sup> investigating UV

photographs in 148 male outdoor road workers reported that men who saw their UV photo and/or the educational video reported more positive attitudes toward sun protection than the control group (no UV photo and no educational video) ( $M=3.6$  vs  $M=3.1$ ;  $F(1, 146) = 11.49$ ,  $p=0.001$ ,  $d=0.86$ ). A second RCT<sup>57</sup> found no effect of basic and enhanced versions of an active participation education programme in 3014 US lifeguards.

<sup>12</sup>Reinau et al. (2013) [-]

<sup>20</sup>Stock et al. (2009) [+]

<sup>57</sup>Hiemstra et al. (2012) [+]

### Evidence statement 5.3

There is weak, inconsistent evidence from one moderate quality [+] RCT investigating the impact of temporal framing of information messages in British university students and staff<sup>62</sup> and two poor quality [-] RCTs, one investigating impact of fear appeals on messages in US beach going adults<sup>48</sup> and one investigating magazine articles to manipulate the appeal of pale skin in US women<sup>50</sup>, on the effectiveness of interventions to increase intentions to use sun protection in people who seek to tan.

One moderate quality trial [+] <sup>62</sup> examined the impact of temporal framing of information messages in 121 British university students and staff (aged 14 to 61) recruited from an outdoor area and who liked to tan. The messages were framed as long-term positive and short-term negative consequences, or vice versa, while participants were categorized as either high or low responders, based on responses to the Future Consequences Scale. High responders exhibited more positive intentions to use sunscreen than low responders ( $F(1, 117) = 7.13$ ,  $p<0.01$ ), but there was no significant difference in message frame. One poor quality [-] trial<sup>48</sup> conducted in 147 predominantly white (95%) US beach goers (mean age 24.5 years) examined the impact of fear appeals on messages highlighting the effectiveness or ineffectiveness of sun protection behaviours. When fear appeals consciously primed death, sun protection intentions were decreased for behaviours considered ineffective compared with those considered effective (sun protection scores 3.36 vs 5.45,  $p=0.02$ ); the framing of the message had no effect when death was no longer a conscious thought. A second poor quality [-] trial<sup>50</sup> evaluated the effect of magazine articles primed to manipulate the appeal of pale skin in 53 Caucasian women in the USA (mean age 22.98) recruited from a beach. Reminders of death increased sunscreen intentions in participants reading an article about the attractiveness of fair skin ( $F(1, 49) = 4.64$ ,  $p=0.04$ ,  $d=0.56$ ), but decreased sunscreen intentions in the control group who read a similar article focusing on natural looking skin (i.e. no reference to skin tone) ( $F(1, 49) = 4.36$ ,  $p=0.04$ ,  $d=0.54$ ). Participants reminded of death and exposed to the fair skin prime also chose products with a higher SPF level as a gift than participants in the control group ( $F(1, 48) = 7.92$ ,  $p = .01$ ,  $d = 0.78$ ); no such differences were found for those exposed to the neutral article<sup>50</sup>.

There is moderate, inconsistent evidence from one good quality [++] RCT investigating an appearance-focused intervention based on decision-theoretical models of health behaviour in US university students<sup>61</sup> and three moderate quality [+] RCTs (all conducted in US university students) investigating either adissonance induction strategy<sup>51</sup>, essays that manipulate the level of threat and coping information<sup>47</sup>, or a community-based informational campaign with or without a cognitive-behavioural small group intervention, about the effectiveness of interventions to change the attitudes of people with intentions to tan.

One good quality trial [++] <sup>61</sup> found that a brief appearance-focused intervention based on decision-theoretical models of health behaviour significantly reduced both intentions to indoor tan ( $F(df = 1400) = 15.64$ ;  $p < 0.001$ , 2-tailed) and attitudes towards indoor tanning ( $p < 0.01$ ) at 6 months, relative to no intervention, in 430 female university students in the USA (mean age 19 years) with prior indoor tanning or with future intentions to tan. One moderate quality trial [+] <sup>51</sup> investigated whether a dissonance induction strategy would successfully change UV-related behaviour in 260 female US

psychology undergraduate students (90% non-Hispanic) who reported frequent indoor/outdoor tanning ( $\geq 6$  times in the past year). The dissonance induction strategy, which comprised an interactive participation session focusing on the negative aspects of the 'ideal tan' – tanning group, was compared with a similar dissonance strategy in healthy living controls and a psycho-educational control focused on tanning. The dissonance induction tanning group showed decreased intentions to tan indoors and increased intentions to use sunscreen relative to the healthy living controls, but similar behaviour to the psycho-educational controls<sup>51</sup>. In a second moderate quality trial [+]<sup>47</sup>, 254 Caucasian female undergraduates in the USA who had previously sought a tan read one of four essays that manipulated the level of threat and coping information. High and low threat essays, respectively, emphasized and minimized concerns in relation to sun exposure, whilst high and low coping essays focused on the effectiveness and inconvenience, respectively, of the recommended measures. Both the high threat and high coping appraisal information elicited significantly higher intentions to use sun protection than their low equivalents ( $F=92.32$ ,  $p<0.001$  and  $F=5.84$ ,  $p<0.02$ ), respectively<sup>47</sup>. A third moderate quality trial [+]<sup>67</sup> found no significant effect between a community-based informational campaign with or without a cognitive-behavioural small group intervention on sun-related attitudes and beliefs of 61 white, predominantly female (73%) US undergraduate students who were intending to have a spring holiday at  $<35^\circ$  latitude (i.e. subtropics).

<sup>50</sup>Cox et al. (2009) [+]

<sup>48</sup>Cooper et al. (2014) [-]

<sup>62</sup>Orbell et al. (2008) [-]

<sup>51</sup>Chait et al. (2011) [+]

<sup>47</sup>Prentice-Dunn et al. (2009)

<sup>61</sup>Hillhouse et al.(2008) [++]

<sup>67</sup>Roberts et al. (2009) [+]

#### **Evidence statement 5.4**

There is inconclusive evidence from two poor quality [-] RCTs (investigating different interventions)<sup>9, 46</sup> of the effectiveness of interventions to change behavioural intentions in older people (age 65 and older).

One trial<sup>9</sup> investigated how age-related changes in attention to negative information can impact on the health behaviour of younger (18-25 year old) and older adults (60-92 year old) US adults who viewed health-related videos. Older adults showed significantly greater intentions to adopt more protective behaviours than did younger adults: they chose more give-away sun protection items ( $M=3$  vs  $M=2$ ,  $F(1, 148) = 16.31$ ,  $p < 0.001$ ), and a higher SPF (30 or 50) sunscreen ( $\chi^2(1, N = 154) = 3.81$ ,  $p = 0.05$ ). Significantly greater selection of a high SPF sunscreen was observed in the information-instruction group overall relative to the emotion-focused and control groups overall ( $p=0.01$ ), but was not reported according to age group. The second trial<sup>46</sup> assessed the impact of four messages framed as either a gain or loss and in terms of the efficacy (high or low) of the skin cancer detection and prevention behaviours described therein in younger and older women in the US. The subgroup of older women comprised 68 women aged 60 and older (mean age 73.95 years), some with a prior diagnosis of cancer or skin cancer (23% and 11%, respectively across the overall population). Older adults reacted similarly to younger adults following exposure to framed messages and endorsed stronger intentions than younger adults to engage in prevention behaviours  $M=4.5$ ,  $SD=1.13$  vs  $M=2.85$ ,  $SD=1.18$ ), regardless of message frame ( $F(1, 132) = 66.02$ ,  $p<0.001$ )<sup>46</sup>.

<sup>9</sup>Isaacowitz et al. (2012) [-]

<sup>46</sup>Stoner et al. (2009) [-]

#### **Evidence statement 5.5**

There is moderate evidence from one good quality [++] RCT conducted in 494 adult siblings of US melanoma patients<sup>11</sup>. After 12 months, there was no difference between a multi-component intervention (comprising a motivational and goal-setting session, individually tailored feedback, telephone counselling, mailed information and links to free screening) or usual care (suggestion to notify family members and encourage screening) in terms of intentions to use sunscreen, however, participants receiving the multi-component intervention reported greater intentions to see a dermatologist and greater confidence in seeing a dermatologist than those receiving usual care.

<sup>11</sup>Geller et al. (2006) [++]

### **Evidence statement 5.6**

There is weak, consistent evidence from three poor quality [-] RCTs<sup>26, 27, 66</sup> that UV photos and/or photoaging information, with or without additional interventions, are effective in increasing intentions to use sun protection in people with multiple risk factors.

Two poor quality trials [-] trials by the same author studied undergraduate students considered to represent high-risk populations. The first poor quality [-] trial<sup>26</sup> examined whether the efficacy of an appearance-based sun protection intervention (personal UV photo plus photoaging information) could be enhanced by the addition of social norms information in 125 predominantly female (83.2%) university undergraduates in the USA aged 18 to 38 years. Significantly stronger intentions to use sun protection were found for UV photo/photoaging information relative to the control (no intervention) (M=3.28 vs M=2.80,  $p<0.01$ ,  $d=0.66$ ), and for any norms information relative to UV photo/photoaging information (M=3.37 vs M=3.01,  $p<0.05$ ,  $d=0.43$ ), but there was no significant difference between the norm conditions. The second poor quality [-] trial<sup>27</sup> compared the efficacy of two appearance-based sun protection interventions in a similarly high-risk population of 442 US undergraduates recruited from two universities located in climatologically in different regions of the USA. Participants who viewed a photoaging video reported significantly greater intentions to use sun protection than those who did not ( $F(1, 425) = 33.40$ ,  $p<0.001$ ,  $\eta^2=0.27$ ) and slightly greater feelings of self-efficacy for engaging in regular sunscreen use ( $p=0.06$ ). There were marginally greater intentions for sun protection use ( $F(1, 425) = 3.52$ ,  $p=0.06$ ,  $\eta^2=0.09$ ), but no significant difference in self-efficacy ( $p>0.20$ ) in those seeing a UV photo compared with those who did not. One moderate quality [+] trial<sup>13</sup> assessed the effect of a targeted screening and education intervention in 173 predominantly female (77%) French patients (mean ages 43.6 and 42.8 years) identified as being at elevated risk for melanoma. GPs in the intervention group identified patients at elevated risk for melanoma with a validated assessment tool, the Self-Assessment Melanoma Risk Score (SAMScore), examined their skin, and provided counselling and information, whereas GPs in the control group (conventional information-based campaign) displayed a poster and the leaflets in their waiting room and performed skin examinations at their discretion. Intervention patients were more likely to worry about developing melanoma (M=28% vs M=18.4% for the control,  $p=0.16$ ) and more likely to consult their GP again to discuss the disease (M=15.5% vs M=9.2%,  $p=0.23$ ), but not significantly so<sup>13</sup>. One poor quality [-] trial<sup>66</sup> reported that the use of sun protection was significantly affected by the addition of photos and/or motivational interviewing counselling to educational material in 197 university psychology students in the USA (aged 18 to 24) with at least one risk factor for skin cancer (sunbathing 95%; indoor tanning 58%; low sunscreen use 66%; or family history of skin cancer 37%). Photos were significantly more effective in improving stage of change compared with education (OR 2.58, 95% CI: 1.06 to 6.28,  $p=0.04$ ), while motivational interviewing was marginally more effective than education (OR 2.20, 95% CI: 0.91 to 5.31;  $p=0.08$ ). The effects of the multi-component intervention did not differ significantly from the control (education)<sup>66</sup>.

<sup>26</sup>Mahler et al. (2008)

<sup>27</sup>Mahler et al. (2013)

<sup>66</sup>Heckman et al. (2013)

<sup>13</sup>Rat et al. (2014)

## **Evidence Statement 6.1 to 6.3: Interventions that Present Complex Health Risk Information to Promote Knowledge/Awareness of Diseases Related to Sun Exposure**

### **Evidence statement 6.1**

There is inconclusive, inconsistent evidence from two poor quality [-] RCTs, both conducted in the USA<sup>9, 23</sup>, about the effectiveness of motivational interventions to improve individuals' knowledge and/or awareness of diseases related to sun exposure.

The first poor quality trial [-] investigated how age-related changes in attention to negative information can impact on the health behaviour of younger (18-25 years) and older adults (60-92 year) in the USA<sup>9</sup>. Although there were no significant effects between groups, there was a significant interaction effect with age. Older adults had significantly greater knowledge before the trial than younger adults (mean score 12.1 vs 10.5), however, they learned less following the trial compared to younger adults (mean score 16.7 vs 17.6)<sup>9</sup>. The second poor quality trial [-]<sup>23</sup> compared UV filtered photography treatment plus skin cancer lecture with the skin cancer lecture alone and a control group who received no intervention in 90 US student nurses. Significant differences were reported between pre- and post-intervention scores in the lecture group (mean difference -3.10 (SD 3.93),  $p < 0.0001$ ) and in the UV photo plus lecture group (mean difference -3.32 (SD 4.47),  $p = 0.001$ ). There was no evidence of a significant difference between pre- and post- values in the control group (mean difference -0.29 (SD 4.93),  $p = 0.76$ )<sup>23</sup>.

<sup>9</sup>Isaacowitz et al. (2012) [-]

<sup>23</sup>Siegel et al. (2010) [-]

### **Evidence statement 6.2**

There is weak evidence from one moderate quality [+] RCT<sup>67</sup> and one poor quality [-] trial<sup>68</sup> that the addition of cognitive behavioural therapy to a community-based information campaign in 61 white, predominantly female (73%) US undergraduates who were intending to have a spring holiday at <35° latitude (i.e. subtropics) and an Internet-based system within Spanish schools to improve the knowledge and behaviour of 1290 adolescents aged 12 to 16 years in relation to sun exposure had no significant impact on individuals' knowledge and/or awareness of diseases related to sun exposure.

There is weak evidence from one moderate quality [+] RCT<sup>38</sup> that a partially tailored mailed intervention may increase awareness of skin cancer risk compared to an annual invitation to attend a data collection session in school-aged children in the US.

<sup>67</sup>Roberts et al. (2009) [+]

<sup>68</sup>Buendia Eisman et al. (2013) [-]

<sup>38</sup>Crane et al. (2012) [+]

### **Evidence statement 6.3**

There is weak, inconsistent evidence from two moderate quality [+] systematic reviews; one review<sup>53</sup> (including three RCTs) reported no significant impact of using the UV Index as a health promotion instrument as part of several different interventions on participants' knowledge about skin cancer, while the other<sup>37</sup> reported that multi-component interventions are effective in increasing knowledge of the risk of skin cancer or which components were most effective. Although the systematic review was

considered moderate quality, the included primary studies investigated a variety of methods of communicating messages and the majority did not provide sufficient detail of these interventions.

An additional moderate quality trial [+] <sup>69</sup> assessed the effect of a multi-component intervention on parental knowledge, sun avoidance behaviours, and sun protection practices in 197 parents in the USA and their children who were aged between 3 and 10 years. Although knowledge in both groups significantly improved following the intervention, the intervention group showed a more significant increase than the control group. The intervention group, in which the parent received a brief presentation and a brochure and the child received an educational video and sun protection incentives, scored 2.8 (SD 1.3) out of five points on a questionnaire at baseline and significantly improved following the intervention (score 3.6 (SD 1.1),  $p=0.0004$ ). The control group, which received a brochure containing information on topics such as the epidemic of skin cancer, its relationship to the sun, and the importance of the three key sun protection practices (i.e. shirt, sunscreen, hat use), also significantly improved from 2.4 (SD 1.3) at baseline to 2.8 (SD 1.2).

<sup>53</sup>Italia et al. (2012) [ + ]

<sup>37</sup>Eagle et al. (2009) [ + ]

<sup>69</sup>Glasser et al. (2010) [ + ]

### **Evidence statement 7.1 to 7.3: Interventions that Present Complex Health Risk Information to Promote Knowledge/Awareness of Practices that Protect against Sun Exposure**

#### **Evidence statement 7.1**

There is inconclusive evidence from one poor quality [-] comparative observational study<sup>15</sup> conducted in Australia which investigated whether mandatory sun protection for outdoor workers in tropical regions is associated with reduced sun damage by comparing 26 employees working under mandatory sun protection policy (mean age 42 years (SD  $\pm$  11); 89% male) with 21 employees working under a voluntary sun protection policy (mean age 44 years (SD  $\pm$  16); 100% male). There were no significant changes in individuals' knowledge and/or awareness of practices that protect against sun exposure between groups

<sup>15</sup>Woolley et al. (2008) [-]

#### **Evidence statement 7.2**

There is weak evidence from one moderate quality [+] systematic review<sup>37</sup> reporting 25 studies in primary school children that new media, lesson-based delivery, health fair, and other mixed methods may be effective in increasing knowledge about sun protection. Several studies reported improvements in sun protection behaviours, however, inadequate reporting of interventions made it impossible to determine the effects of individual delivery strategies or components within them. An additional moderate quality [+] non-comparative observational study<sup>70</sup> conducted in Germany reported an increase in staff knowledge (baseline 8/14 points vs. post-intervention 12/14 points;  $p=0.002$ ) and an increase in parental knowledge (baseline 6/12 vs. post-intervention 11/12;  $p=0.001$ ) in a certification programme for sun protection among 12 staff and 27 parents of children aged 0 to 6 years attending a kindergarten.

<sup>37</sup>Eagle et al. (2009) [ + ]

<sup>70</sup>Aulbert et al. (2009) [ + ]

#### **Evidence statement 7.3**

There is weak, inconclusive evidence from one moderate quality [+] RCT<sup>71</sup>. conducted in 94 US adults, two poor quality [-] trials; one conducted in 80 German school children<sup>72</sup> and one conducted in 1033 elementary school aged children from the US<sup>73</sup> and one moderate quality [+]non-comparative observational study<sup>6</sup> conducted in 1522 Spanish children.

The trial from the US reported that an online video improved people's knowledge significantly more than print-based material<sup>71</sup>. There was a significantly greater improvement in the video group who improved from 6.9 (SD 1.3) correct answers at baseline to 8.8 (SD 1.4) correct answers post-intervention compared to the pamphlet group who improved from 6.5 (SD 1.4) correct answers at baseline to 7.6 (SD 1.2) correct answers post-intervention (p = 0.003). The trial in German school children<sup>72</sup>. reported that implementing a theatre play in nursery schools, in addition to an environmental intervention, led to an increase in knowledge in young children; the number of correct answers improved from 2.9 (SD 1.2) to 3.6 (SD 1.3, p<0.05) in the intervention group compared to no change in the comparator group. The trial in US elementary school children<sup>73</sup> reported that children receiving both the computer program and the teacher-led presentation (combination group) had a greater increase in knowledge following the intervention than the group receiving a computer program only (p=0.0101) and a teacher-led presentation only (p=0.0229). The observational study administered a questionnaire before and after 'SolSano', a sun safety programme where children were scored one point for each correct drawing of a sun protection practice. The number of points scored increased following the intervention from 1.69 (SD 1.71) to 2.72 (SD 1.45); p<0.001<sup>6</sup>.

<sup>71</sup>Armstrong et al. (2011) [+]

<sup>72</sup>Seidel et al. (2013) [-]

<sup>73</sup>Buller et al. (2008) [-]

<sup>6</sup>Gilaberte et al. (2008) [+]

## **Evidence Statements 8.1 to 8.11: Interventions that Achieve Changes in Sun Protection Practices and the Effects of Sun Exposure**

### **Evidence statement 8.1**

There is moderate, inconsistent evidence from two systematic reviews<sup>53, 74</sup>, five RCTs<sup>4, 40, 57, 63, 75</sup> and seven observational studies, three comparative<sup>15, 30, 76</sup> and four non-comparative<sup>5, 6, 59, 77</sup> about the effects of sun protection policies and programmes on changes in sun protection practices and the effects of sun exposure.

One moderate quality [+] systematic review<sup>53</sup> assessed studies using the UV index as a health promotion instrument and reported one trial showed an increase in general sun protection and one showed no effect. Five cross-sectional studies showing an increase in sun protection behaviour, but a further five cross-sectional studies showed no effect. For use of protective clothing, the SR also reported mixed results: one trial showed no effect in hat use, one trial showed a decrease with the use of UV meters and an additional cross-sectional study found an increase in use of protective clothing. Similarly, mixed results were reported for sunscreen use: one trial showed no effect, one trial showed a decrease and an additional cross-sectional study found an increase in use of sunscreen<sup>53</sup>. Another poor quality [-] systematic review<sup>74</sup> assessed the effects of employer policies on individual workers through the provision of awnings, protective clothing and skin examinations and identified one study in the SR reporting increased sunscreen use with the intervention but details on this finding were sparse.

There is moderate, inconsistent evidence from five RCTs about the effects of sun protection policies and programmes on changes in sun protection practices and the effects of sun exposure. One good quality [++] RCT<sup>4</sup> reported that the Living in the Sun programme results in increased sun protection behaviour including wearing a hat, using a sunshade on the beach, and reapplying sunscreen more frequently in French children aged 9 to 12 years. A second, moderate quality [+] RCT<sup>40</sup> reported that the SunSmart intervention increases sun protection behaviour through increases in shirt wearing, staying in the shade, avoiding sun at midday and using a sunscreen in US adolescents. Three RCTs (two moderate quality [+] <sup>57, 75</sup> and one poor quality [-] <sup>63</sup>) reported that the Pool Cool programme in adult lifeguards, and the Sun Safe and SunScoop educational programmes in children do not change sun protection practices or the effects of sun exposure.

In Australian children there were no differences in hat wearing <sup>76</sup> however, schools with a written policy were found to have more comprehensive sun protection practices than schools without a written policy.<sup>30</sup> Australian outdoor employees working under a voluntary sun protection policy were less likely to usually wear a long-sleeved shirt while out in the sun at work than those under a mandatory policy ( $p < 0.001$ ). A SunSmart-paid television media aimed at the Australian general public found that the use of hats and sunscreens significantly increased over time and peaked during the mid to late 1990s, compared with the pre-SunSmart baseline<sup>59</sup> while a second SunSmart study saw significant improvements in the extent of body cover occurred over the decade observed, such that the odds of the proportion of people wearing clothes cover above the median level increased by 3% per year (95% confidence interval, 2 to 4%)<sup>77</sup>. In Germany a 'Sunpass' programme found significant increases in sun protection behaviour in kindergarten children ( $p < 0.001$ ). The number of parents who did not use sunscreen on their children decreased from 4.3% to 2.6%<sup>5</sup> while in Spanish children, a 'SolSano' programme reported that sunscreen re-application rates increased in children who always (change 3.2% (0.3 to 6.3) and sometimes (change +1.9% (1.1 to 4.9) reapplied sunscreen. The use SPF >15 increased overall by 20.3% (17 to 23.6). There were improvements in sun protection practices while doing outdoor activities in parks (change of 7.7% (4.6 to 10.7); during sports (change of 5.5% (2.2 to 8.8) and in the mountains (change of 4.9% (1.5 to 8.3) but not at beaches<sup>6</sup>.

<sup>53</sup>Italia et al. (2012)

<sup>74</sup>Kutting et al. (2010)

<sup>40</sup>Adams et al. (2009) [+]

<sup>4</sup>Sancho-Garnier et al. (2012) [++]

<sup>75</sup>Buller et al. (2011)

<sup>57</sup>Hiemstra et al. (2012)

<sup>63</sup>Reynolds et al. (2008)

<sup>76</sup>Turner et al. (2014)

<sup>30</sup>Dono et al. (2014)

<sup>15</sup>Woolley et al. (2008)

<sup>5</sup>Stover et al. (2012)

<sup>6</sup>Gilaberte et al (2008)

<sup>77</sup>Dixon et al. (2008)

<sup>59</sup>Dobbinson et al. (2008)

## Evidence statement 8.2

There is inconclusive, consistent evidence from two RCTs<sup>78-80</sup> that the provision of sun protection clothing or sunscreen is an effective way to increase their use.

A poor quality trial [-]<sup>78</sup> of 83 female undergraduate golfers at a US college reported that making sunscreen readily available to athletes in the locker room significantly increased the initial application



of sunscreen by over 1 day per week, however there was no significant increase in the re-application of sunscreen during practice for either group<sup>78</sup>. A poor quality trial in a single study in elementary school in Florida<sup>79,80</sup> reported that observed the wearing of hats increased by 41% at the end of one year in the intervention group, compared to the control who received similar sessions on topics other than sun protection but whose hat use declined to an increase from baseline of 19% after 2 years ( $p < 0.001$ ).

Students were provided with two free wide-brimmed hats (one to use at school and one to use at home) and took part in classroom sessions targeting sun protection attitudes and social norms.

<sup>78</sup>Dubas et al. (2012) [-]

<sup>79</sup>Hunter et al. (2010) [++]

<sup>80</sup>Roetzheim et al. (2011) [-]

### **Evidence statement 8.3**

There is moderate, consistent evidence from one moderate quality RCT [+]<sup>81</sup> and four poor quality RCTs [-]<sup>21, 23, 25, 27</sup> that UV photographs with or without photoaging are effective in increasing sun and sunbed protective practices in adults.

There is moderate, consistent evidence from one moderate quality systematic review [+]<sup>81</sup> and one poor quality review [-]<sup>16</sup> that UV photographs with or without photoaging are effective in reducing indoor tanning practices.

There is moderate, inconsistent evidence from two systematic reviews<sup>16, 81</sup> and five RCTs<sup>21, 23, 25, 27, 39</sup> about the effects of UV photos with or without photoaging in combination with other interventions in increasing sun protection behaviours.

One systematic review<sup>81</sup> and two RCTs<sup>21, 25</sup> reported significant effects of UV photographs (with or without photoaging) in increasing sun protection behaviours. One moderate quality [+] systematic review<sup>81</sup> included four trials in university students; three trials reported that an appearance-based behavioural intervention (UV photos showing the effects of photoaging) successfully reduced indoor tanning in women. No further details were reported. A moderate quality [+] RCT<sup>21</sup> comparing a UV photo group with a combined UV photo and self-affirmation group in 266 people (aged 11 to 71 years) visiting a public science event reported that individuals receiving self-affirmation interventions reported lower rates of deliberate sun exposure. A poor quality trial [-]<sup>25</sup> in 352 US undergraduate females aged from 18 to 49 years reported that a combined intervention (graphic images of photoaging and skin cancer to elicit a strong emotional response plus details of how to use sunscreen effectively) with emotional arousal resulted in significantly greater sun protection behaviours than found in the control group, including sunscreen use, attempts to stay in the shade and avoiding the sun.

Two RCTs, one of moderate quality [+]<sup>39</sup> and one of poor quality [-]<sup>23</sup> found no statistically significant difference in individuals' perceptions of risk of skin cancer in participants receiving UV photo interventions.

One poor quality [-] systematic review<sup>16</sup> and one poor quality [-] RCT<sup>27</sup> reported unclear findings.

<sup>81</sup>Lin et al. (2011) [+]

<sup>16</sup>Williams et al. (2013) [-]

<sup>27</sup>Mahler et al. (2013) [-]

<sup>25</sup>Moser et al. (2012) [-]

<sup>23</sup>Siegel et al. (2010) [-]

<sup>39</sup>Falk et al. (2011) [+]

<sup>21</sup>Schuz et al. (2013) [+]

#### **Evidence statement 8.4**

There is inconclusive, inconsistent evidence from four poor quality [-] RCTs<sup>35, 82-84</sup> and two observational studies<sup>42, 85</sup> about whether other motivational interventions (including UV photographs, motivational interventions compared with volitional interventions, self-affirmation strategies, and formulating specific plans with regard to sunscreen use) are effective in changing sun protection practices or sun exposure.

One RCT<sup>82</sup> in 100 Australian female netball players (aged 17 to 25 years) showed no differences in those who studied bar graphs, read statements about different norms of sun protection behaviour and examined colour photos of a recreational sportswoman (pale or tanned). A second RCT<sup>83</sup> in 222 women aged 18 to 66 years reported that women in a volitional group (participants were asked to develop an online interactive action plan after being told about someone who makes an action plan for sunscreen use, and also asked to think about ways to overcome obstacles to sunscreen use) were significantly more likely to use sunscreen when compared to a motivational (including a message about the risk of unprotected sun exposure, highlighting negative consequences, plus a description of positive outcomes to be expected with the use of sunscreen of SPF15+ group) or control (mean 1.94 vs 1.73 and 1.73, respectively). A third RCT<sup>35</sup> in British female sunbathers (aged 18 to 32) reported that women who received a positive traits affirmation condition were significantly more likely to request a free sample of sunscreen (63% versus 40% in the control group). A fourth trial<sup>84</sup> in parents and children found no differences between formulating specific plans with regard to sunscreen use and having no plan.

Two observational studies reported that counselling was positively associated with regular sunscreen use, appropriate sunscreen application practices, and intermittent hat use<sup>85</sup> and that an increase in sun protection behaviours was seen following educational school sessions.<sup>42</sup>

<sup>82</sup>Robinson et al. (2013) [-]

<sup>83</sup>Craciun et al. (2012) [-]

<sup>35</sup>Jessop et al. (2009) [-]

<sup>84</sup>van Osch et al. (2008) [-]

<sup>85</sup>Bandi et al. (2010) [+]

<sup>42</sup>White et al. (2010) [-]

#### **Evidence statement 8.5**

There is weak, inconsistent evidence from one moderate quality RCT [+]<sup>86</sup> and one poor quality RCT [-]<sup>54</sup> about the effectiveness of text reminders in increasing sunscreen use.

One moderate quality [+] RCT<sup>86</sup> in 70 American adults (mean age 33 to 34 years) reported that daily text-message reminders to use sunscreen via cellular telephone for 6 significantly increased use compared to no text messages (p<0.001). The poor quality [-] RCT<sup>54</sup> found no significant differences in sun protection measures such as use of hats, sunscreen, shade or clothing in participants receiving sun safety messages compared with participants receiving safe sex messages in 7606 Australian young people aged 16 to 29 years.

<sup>86</sup>Armstrong et al. (2009) [+]

<sup>54</sup>Gold et al. (2011) [-]

#### **Evidence statement 8.6**

There is weak, consistent evidence from one moderate quality RCT [+] <sup>71</sup> and three poor quality RCTs [-] <sup>73, 87, 88</sup> and one observational study <sup>41</sup> that electronic interventions (including educational videos, interactive computer-assisted learning and tailored computer programmes) increase sun protective and sun exposure behaviours compared to paper-based or teacher-led educational interventions or no intervention in children and adults.

One good quality [++] RCT <sup>71</sup> reported that participants who saw the online video had significantly higher frequency of sunscreen use (baseline 1.7 days (SD 2.5) vs. post-intervention 3.4 days (SD 2.6) compared to participants who received the pamphlet (baseline 2.0 days (SD 3.0) vs post-intervention 2.4 days (SD 2.6)) in 94 adults (mean age 35 to 40 years)

One poor quality [-] RCT <sup>68</sup> conducted in 730 students from seven Spanish schools reported significantly increased use of sun protection clothing, sunscreen and use of protection on cloudy days and a reduction in sunburns in the intervention group compared to the control group in both the inland schools (control: 43.8% (SE=1.3); intervention: 19% (SE= 4.3) from a baseline of 53.4% (SE=1.8)) and coastal schools (control: 52.8% (SE= 2.7); intervention: 44.8% (SE=3.4) from a baseline of 56.2% (SE=1)). A second poor quality [-] RCT <sup>88</sup> reported that participants in computer groups (accessing interactive computer-assisted learning) were more than twice as likely to wear sun protective clothing at the end of the study compared to control (OR 2.4, 95% CI: 1.09-5.29, p=0.03) but there were no significant differences reported for sunscreen use. A third poor quality [-] RCT <sup>73</sup> reported that computer programs with teacher-led presentation improved knowledge over either treatment individually (p= 0.001) and compared with teacher-led presentation improved self-reported sun protection in younger but not older children (p=0.005) in 1033 children from 12 US elementary schools. An additional observational study <sup>41</sup> found that entertainment-education strategies (a music video showing five recommended forms of sun protection; using sunscreen, wearing sunglasses and hats, getting under shade, and covering up with clothing) resulted in a greater proportion of participants in the intervention group compared to the control group reported using sunscreen (88% vs. 84%; p=.02) hats (42% vs. 37%; p=0.03) and sun-protective clothing (32% vs. 27%; p=0.04). There were no significant differences in reported use of sunglasses or seeking shade to reduce sun exposure.

<sup>71</sup>Armstrong et al. (2011) [++]

<sup>87</sup>Basch et al. (2013) [-]

<sup>88</sup>Aneja et al. (2012) [-]

<sup>73</sup>Buller et al. (2008) [-]

<sup>41</sup>Potente et al. (2011) [+]

### **Evidence statement 8.7**

There is moderate, inconsistent evidence from two good quality RCTs [++] <sup>10, 89</sup>, five moderate quality RCTs [+] <sup>13, 38, 39, 67, 90</sup> and one poor quality [-] RCT <sup>63</sup> about the effectiveness of tailored interventions (of varying compositions) in promoting sun protection and exposure behaviours.

A good quality [++] trial <sup>10</sup> reported that participants in a tailored intervention group (tailored print and telephone counselling) reported significantly increased sun protection habits compared to the generic intervention (p<0.02); these increases were mediated by sun protection intentions including using sunscreen, wearing a hat, seeking shade, wearing shirt with sleeves, wearing sunglasses in 443 first degree relatives (mean age 47.6 years) of patients with cutaneous melanoma. A second good quality trial [++] <sup>89</sup> compared tailored communication with less intensive education in 1301 children (mean age 7.1 years) at moderate to high risk of skin cancer in New York or Hawaii. The tailored communication participants received multiple mailings, risk feedback, skin cancer information,

suggestions for overcoming barriers and reminders to engage in prevention practices, while the control group received a single mailing of a standard skin cancer prevention and detection information brochure. Significant increases in the Sun Protection Habits index were found for total sun protection, use of sunscreen, wearing of protective clothing and sunglasses, but not for staying in the shade, in children who received the tailored intervention compared to control. One moderate quality [+] trial<sup>38</sup> reported no significant effect on child tanning, but a significant effect was reported on the incidence of severe (log odds severe sunburn occurring -0.52 (95% CI: -1.23 to +0.19), p=0.15) and non-severe (log odds non-severe sunburn occurring = -0.25 (95% CI = -0.47 to -0.04), p=0.02) sunburn in one of the follow-up years in 677 white (non-Hispanic) six year olds. Children in the intervention group received three sets of educational newsletters and related sun protection resources such as a swim shirt, sun hat, sunscreen, and backpack, while the control group received a letter each spring inviting them to complete data collection. One moderate quality [+] RCT<sup>90</sup> reported that 724 predominantly female (77.5%) adults receiving the tailored intervention (including multiple mailings at two-week intervals of risk feedback information, instructions for skin self-examination and practice tools, UV self-monitoring and information on skin cancer prevention and detection) had a significantly greater increase in their sun protection habits index (measured by diary entries) than a control group (effect size=0.13) but the effect was moderated by location (less in Honolulu, effect size 0.04 vs. 0.23 for Long Island)

No significant effects were found for one RCT<sup>63</sup> comparing a Summer Raze program for adolescents and the Sun Scoop programme for parents; one RCT<sup>67</sup> comparing a community-based information campaign with or without a cognitive-behavioural small group intervention; one RCT<sup>39</sup> comparing different combinations of general sun protection advice, individualised feedback and a GP consultation; one study<sup>13</sup> comparing GP consultations offering targeted screening and education intervention or a conventional information-based campaign

<sup>89</sup>Glanz et al. (2013) [++]

<sup>10</sup>Manne et al. (2010) [++]

<sup>38</sup>Crane et al. (2012) [++]

<sup>90</sup>Glanz et al. (2010) [++]

<sup>13</sup>Rat et al. (2014) [++]

<sup>39</sup>Falk et al. (2011) [++]

<sup>67</sup>Roberts et al. (2009) [++]

<sup>63</sup>Reynolds et al. (2008) [-]

### **Evidence statement 8.8**

There is weak evidence from one moderate quality [+] systematic review<sup>81</sup> that counselling information provision can result in changes in sun protection practices in adults and adolescents to reduce sunburns, naevi, keratoses, or skin cancer. Counselling interventions were variously defined and included single 15-minute self-directed sessions, several sessions with in-person counselling, phone counselling, written assessments followed by tailored written feedback, a self-guided booklet, a brief video, 30-minute 1:1 peer-counselling sessions, brief counselling with in-office computer support to generate printed tailored feedback and counselling integrated into well-child visits. Four of five trials conducted in adults (n=6949 participants) reported that primary care-relevant counselling with tailored feedback (with or without computer support) can modestly affect self-reported sun protection behaviours. Three of four trials in young adults (n=897 participants), an appearance-focused counselling intervention successfully reduced indoor tanning among women who had the intention to tan indoors. Although the interventions decreased indoor tanning behaviour by up to 35%, follow-up for these trials was only 3 to 6 months.

<sup>81</sup>Lin et al. (2011) [++]

### **Evidence statement 8.9**

There is weak evidence from one moderate quality [+] RCT<sup>91</sup> conducted in US women aged 17 to 21 that written information (a booklet) about the effects of sun exposure focused on appearance and skin cancer information provision can reduce indoor tanning behaviour in females with seasonal affective disorder and intentions to tan by up to 35%.

<sup>91</sup>Hillhouse et al. (2010) [+]

### **Evidence statement 8.10**

There is moderate, inconsistent evidence from one good quality [++] systematic review<sup>92</sup> two moderate quality [+] systematic reviews<sup>37, 81</sup> one poor quality [-] systematic review<sup>12</sup>, one good quality [++] RCT<sup>14</sup>, five moderate quality [+] RCTs<sup>55, 69</sup>, and two poor quality [-] RCTs<sup>93</sup> about the effectiveness of multi-component interventions for changing sun protection behaviour.

A good quality [++] systematic review<sup>92</sup> showed that multiple component interventions (a mixture of educational and environmental components) had a significant effect on sun protective behaviour overall, although with high heterogeneity. Interventions targeting children had the most evidence of effectiveness. There was no evidence that interventions increased the use of protective clothing or use of shade. Use of sunscreen was significantly influenced by interventions in children and youths, but not in adults. The intervention groups reviewed had a small, significant decrease in reported sunburns (SMD = -0.11 (95% CI = -0.18; -0.03) with heterogeneity I<sup>2</sup> (squared) = 55% and chi squared = 9.69 11.12 (df = 4, df=5, p = 0.05). The review suggested that evidence for the efficacy of interventions in preventing sunburn is inconclusive for adults (SMD = -0.10 (95% CI = -0.19; -0.01) with heterogeneity I<sup>2</sup> (squared) = 59% and chi-squared = 9.69 (df = 4, p = 0.05)). Interventions targeting children found no evidence of efficacy in preventing sunburn ((1 study): SMD = -0.15 (95% CI = -0.29; -0.02)). No numerical data were reported for change in skin colour and there was no significant effect in favour of the intervention. The intervention resulted in a significant decrease in self-reported sun-exposure amongst adults, with a moderate effect size but when all studies were taken into account, there was mixed evidence of benefit.

A moderate quality SR [+] reported on the effects of a range of combined motivational interventions on sun protection behaviour<sup>37</sup>. Two of the studies reviewed investigated the use of new media with school children and found no significant changes in sun protection behaviour. Ten studies investigating lesson-based sun protection education did not provide strong evidence of behaviour change. The impact of a health fair was reported in one RCT and did not result in significant differences in behaviour. Twelve studies of mixed method education for children (lessons plus verbal advice, videos and/or printed materials) did not report strong evidence of behaviour change. The review authors noted the potential for contamination effects and lack of clarity over which parts of the intervention had the most impact. However, very few primary studies provided sufficient detail of the content of the interventions, or were not designed to enable comparison of different components or content, precluding any evaluation of what intervention components were most effective<sup>37</sup>.

A second moderate quality SR [+] reported mixed findings<sup>81</sup> of behavioural counselling in studies predominantly from Australia, Canada, European countries and the USA. In adults, four of five trials (n=6949 participants) showed that primary care-relevant counselling with tailored feedback (with or without computer support) can modestly affect self-reported sun protective behaviours, as measured by composite behaviour scores. The differences in these scores, although statistically significant, were small, and it is unclear whether these differences translate into clinically meaningful behaviour change. In three trials in young adults (n=897 participants), the appearance-focused counselling intervention successfully reduced indoor tanning among women who had the intention to tan indoors.

Although the interventions decreased indoor tanning behaviour by up to 35%, follow-up for these trials was only 3 to 6 months. In one trial (n=819 participants), young adolescents randomly assigned to brief counselling by their primary care providers, coupled with in-office computer support to generate printed tailored feedback, reported both higher composite sun-protection scores and a greater likelihood of avoiding or limiting midday sun exposure or using sunscreen on the face or sun-exposed areas at 24 months than the attention control group. The other cluster RCT in children, conducted in a large managed care organization, integrated counselling into four sequential well-child visits at the discretion of the primary care provider. Parents of newborn babies (728 participants) in practices randomly assigned to receive the intervention reported higher composite sun-protection scores at 36-month follow-up than those in control practices. The clinical significance of these higher scores, however, is unclear, given the very small numerical differences and the lack of statistically significant differences in 6 of the 7 sun-protection questions that contribute to the composite score.

A poor quality SR [-] <sup>12</sup> investigated the effectiveness of sun-safety education programmes in outdoor occupational settings including outdoor workers and participants in outdoor leisure pursuits, provided from 16 interventional studies undertaken in countries all over the world (. The interventions reviewed included combinations of educational lectures, educational video, information brochures, posters, logos, skin examinations, eye examinations, sun-protective gear, UV photos of the face and interactive tasks. The age range of the populations was not reported. Four studies reported a significant decrease in the incidence of sunburn following sun safety education. Significant improvements in at least one of the sun-protective behaviours were also observed. Six authors reported positive long-term effects of 12 months or more. The most favourable changes were found for the use of sunscreen <sup>12</sup>.

Five RCTs <sup>14, 39, 55, 58, 69</sup> reported positive effects of multicomponent interventions for changing sun protection behaviour.

One good quality [++] trial <sup>14</sup> in mixed gender beach goers compared interventions with increasing number of components: a combined intervention of education, biometric feedback, and dermatologist skin examinations was compared to three control interventions (skin cancer prevention education, education plus biometric feedback and education plus dermatologist skin examinations). The greatest increases in sun protection behaviours (hat wearing and sunscreen use) were reported in the combined feedback/education/skin examination group and the feedback/education groups compared to the other two groups (hat use: significant condition difference; sunscreen use: significant time by condition difference). There was no evidence of a difference in the time spent in the sun between randomized groups. A moderate quality trial [+] <sup>55</sup> compared information flyers plus normative feedback with flyers alone in 189 women aged 39 to 77 years. The study reported significantly greater facial sun protection at the end of study in the intervention group, mainly through the use of hats, but no changes in body sun protection. A moderate quality [+] trial <sup>69</sup> assessed the effect of a multi-component intervention on parental knowledge, sun avoidance behaviours, and sun protection practices in children aged 3 to 10 years in the USA. After controlling for differences, the intervention group was found to have more significant increases in sun protection practices including wearing shirts, sunscreen and/or possessing wide brimmed hats. There was no significant difference between the groups in terms of sun avoidance. A moderate quality trial [+] <sup>39</sup> compared multiple interventions in response to a pre-study questionnaire in 316 adults in primary care. Groups received general sun protection advice plus either a letter containing feedback, risk assessment and printed information, feedback from a personal GP consultation, or personal GP consultation plus phototest <sup>39</sup>. Findings were generally mixed, although benefits were found for sunscreen use in the group having a GP consultation alone. A poor quality [-] RCT <sup>58</sup> studied adolescents (aged 14 to 17 years) in a school setting randomized to an e-magazine containing numerous components (exercises, oral teacher-led presentation, teamwork, advocacy, writing, creative work, using social media and debating scientific facts). The trial reported that girls and boys receiving the educational intervention had a 40% and

42% reduced risk of sunbed use over 6 months, respectively, compared with girls and boys in the control group<sup>58</sup>.

No significant effects were found in six RCTs.<sup>13, 51, 52, 80, 93, 94</sup> One RCT<sup>93</sup> compared print booklets, DVD and children's activity packages (a melanoma survivor-centred intervention) with general educational mailings on skin cancer in 340 adults with diagnosed melanoma and their children aged 12 or younger; one RCT<sup>52</sup> compared multiple interventions addressing interpersonal factors with control (social support) in 59 Caucasian females aged 18 to 24 years; one RCT<sup>80</sup> among 2491 fourth grade children. Children in the intervention group were issued two new hats and received a brief educational lesson on sun safety, followed later by two 60 minute reinforcement classes; one RCT<sup>13</sup> compared an intervention (personal total skin examination, GP counselling plus the information leaflet detailing primary and secondary prevention measures) with a conventional public health campaign (posters plus information on risk factors) in primary care adults; one RCT<sup>94</sup> compared melanoma checking(including digital imaging), was augmented with additional guidance about sun protection and regular parent meetings with a dermatologist with printed materials; one RCT<sup>51</sup> compared a variety of dissonance induction tools (videos, focus groups, tasks, role play) compared to education alone and dissonance induction relating to healthy lifestyle in 260 undergraduate females

Five observational studies<sup>95-99</sup> reported positive effects of multicomponent interventions, while two observational studies<sup>7, 70</sup> reported no significant effects.

<sup>92</sup>Rodrigues et al. (2013) [++]

<sup>81</sup>Lin et al. (2011) [ + ]

<sup>37</sup>Eagle et al. (2009) [ + ]

<sup>12</sup>Reinau et al. (2013) [ - ]

<sup>14</sup>Emmons et al. (2011) [ ++ ]

<sup>55</sup>Reid et al. (2013) [ + ]

<sup>39</sup>Falk et al. (2011) [ + ]

<sup>58</sup>Aarestrup et al. (2014) [ - ]

<sup>93</sup>Gritz et al. (2013) [ - ]

<sup>52</sup>Midboe et al. (2011) [ - ]

<sup>80</sup>Roetzheim et al. (2011) [ - ]

<sup>13</sup>Rat et al. (2014) [ + ]

<sup>94</sup>Wollina et al. (2014) [ ++ ]

<sup>51</sup>Chait et al. (2011) [ + ]

<sup>95</sup>Makin et al. (2013) [ + ]

<sup>96</sup>Thieden et al. (2013) [ + ]

<sup>97</sup>Kahn et al. (2011) [ + ]

<sup>98</sup>Hay et al. (2009) [ + ]

<sup>99</sup>Koster et al. (2011) [ + ]

<sup>7</sup>Quereux et al. (2009) [ + ]

<sup>70</sup>Aulbert et al. (2009) [ + ]

### **Evidence statement 8.11**

There is weak evidence from one moderate quality [ + ] RCT<sup>100</sup> that exposure to sunlight does not increase serum 25 hydroxy vitamin D levels, fracture incidence, or skin cancer events over a 12 month period among elderly rest home residents(mean age 86.4 years, 71% female) conducted in 51 residential homes in Australia.

<sup>100</sup>Sambrook et al. (2012) [ + ]

**Evidence Statement 9.1: Cost-effectiveness**

**Evidence statement 9.1**

There is inconsistent evidence from one study [++] (with minor limitations and four studies [+] (with potentially serious limitations that community- or school-based educational programmes on sun exposure with or without exposure protection resources are cost-effective.

The cost-effectiveness of provision of information in schools was shown in one US study [+] with potentially serious limitations.<sup>101</sup> Two Australian studies, one with minor limitations [++] and the other with potentially serious limitations [+]<sup>102, 103</sup> found that a community-based programme promoting daily use of sun cream, providing sun exposure guidance and limited provision of sun cream is cost-effective. Two studies with potentially serious limitations [+]<sup>104, 105</sup> that took effectiveness data from overseas studies and applied them to UK models of sun exposure and skin cancer risk contradicted these findings. These two studies showed that assuming effectiveness in the overseas studies on behaviour change was also seen in the UK, then community, school and work-based interventions that provided information with or without additional sun care resources or change of the environment were highly cost-ineffective.

The exception was provision of an information booklet for parents, which was estimated to have an ICER of £6,200/QALY. However, the authors noted that this finding was limited by the weakness of the modeling approach linking behavioural change to reduction in cancer risk.

The evidence is limited by the absence of cost-effectiveness studies based upon effectiveness data generated in the UK.

<sup>101</sup>Kyle et al. (2008) [+]

<sup>102</sup>Hirst et al. (2012) [++]

<sup>103</sup>Gordon et al. (2009) [+]

<sup>104</sup>Matrix Evidence (2010) [+]

<sup>105</sup>Andronis et al. (2009) [+]



**Evidence statement 10: Primary Skin Cancer Messages: Effective Content and Effective Interventions**

There is moderate evidence from good [++] quality and moderate [+] quality trials about the effectiveness of a variety of different interventions and the content of the messages contained within the interventions. Although the interventions and messages appeared to be effective in these trials, the trials were heterogeneous; no two interventions were the same. Many interventions contained multiple components; these components were heterogeneous and it was unclear which component or components contributed to effects or whether there were components that were unnecessary. It is not possible to determine which specific messages contained within effective interventions are effective.

**3.3.1 Changes in people’s knowledge or understanding of how to competently assess level of risk and benefit from sun exposure**

Twelve studies reported changes in people’s knowledge or understanding of how to competently assess the level and risk and benefit from sun exposure: one systematic review (SR), seven randomized controlled trials (RCTs) and four observational studies (two comparative and two non-comparative).

The systematic review was judged to be of poor quality [-], based on the AMSTAR quality criteria. Of the seven included RCTs, four were considered to be of good quality [++], two were moderate quality [+] and one was poor quality [-]. The four observational studies comprised three moderate quality [+] studies (one comparative and two non-comparatives) and one poor quality [-] comparative study.

**3.3.2 Changes in individuals’ perception of or attitudes to the risks and benefits of sun exposure**

Sixty studies reported changes in individuals’ perceptions of or attitudes towards the risks and benefits of sun exposure: five SRs, 44 RCTs and 11 observational studies (six comparative and five non-comparatives). Twenty-eight studies (two SRs, 22 RCTs, four observational) assessed changes in perceptions and 47 studies (four SRs, 36 RCTs, seven observational) assessed changes in attitudes; 15 of these studies (one SR, 14 RCTs) assessed changes in both perceptions and attitudes.

The quality of the 28 included studies assessing individuals’ perceptions ranged from good [++] to low/poor [-]. Of the two included SRs, one was considered moderate quality [-] and the other was considered low quality [-]. Only one of the 22 RCTs was judged to be good quality [++] for the overall quality assessment; the majority of trials (13 RCTs) were graded poor quality [-]. There were two moderate quality [+] observational studies (one comparative and one non-comparative) and two poor quality [-] observational studies (both comparative).

The quality of the 47 included studies assessing individuals’ attitudes ranged from good [++] to low/poor [-]. Of the four included SRs, one was considered moderate quality [-] and the other three were considered low quality [-]. Only three of the 36 RCTs were judged to be good quality [++] for the overall quality assessment; the majority of trials (21 RCTs) were graded poor quality [-]. There were five moderate quality [+] observational studies (one comparative and four non-comparatives) and two poor quality [-] observational studies (both comparative).

### **3.3.3 Changes in individuals' knowledge and/or awareness of diseases related to sun exposure**

Eight studies reported changes in individuals' knowledge and/or awareness of diseases related to sun exposure (either under or over exposure) including non-melanoma and malignant melanoma skin cancer and sunburn: two SRs and six RCTs. Four of the eight studies explicitly focused on, or included, at-risk groups (four in children and one in workers at occupational risk).

The two SRs were both assessed to be of moderate quality [+] according to the AMSTAR quality criteria. Of the six included RCTs, three were judged to be of moderate quality [+] and three were of poor quality [-].

### **3.3.4 Changes in individual's knowledge and/or awareness of practices that protect against sun exposure**

Eight studies reported changes in individuals' knowledge and/or awareness of practices that protect against sun exposure, e.g. wearing sunscreen, wearing protective clothing, and avoiding sunlight in the middle of the day. The included studies comprised one SR, four RCTs and three observational studies (one comparative and two non-comparatives).

The SR was assessed as being of moderate quality [+] according to the AMSTAR criteria. One of the four included RCTs was assessed as being of moderate quality [+], while the remaining three were considered poor quality [-]. The observational studies comprised one poor quality [-] comparative study and two moderate quality [+] non-comparative studies.

### **3.3.5 Effective interventions for achieving changes in sun protection practices and the effects of sun exposure**

Sixty-eight studies investigated the effectiveness of interventions for achieving changes in sun protection practices and the effects of sun exposure: seven SRs, 43 RCTs and 18 observational studies (seven comparative and 11 non-comparatives). Twenty-three studies (three SRs and 20 RCTs) explicitly focused on, or included, at-risk groups such as people who work outdoors or who have lifestyles or leisure pursuits associated with excessive UV exposure, children and adults considered at risk, people with a family history of skin cancer, and young children.

Of the seven SRs, one was assessed as being of a high quality [++], three were considered to be of moderate quality [+] and the remaining three were considered to be of low quality [-]. The overall quality assessment of the RCTs ranged from good [++] to poor [-], with eight RCTs graded good quality [++], 18 RCTs graded moderate quality [+], and the remainder (18 RCTs) considered poor quality [-]. Sixteen observational studies were assessed as moderate quality [+] (five comparative and 11 non-comparative studies); the other two comparative observational studies were both considered poor quality [-].

### **3.3.6 Cost-effectiveness studies**

Six studies met the inclusion criteria for the cost-effectiveness review. On quality assessment one of the studies <sup>106</sup> was found to have very serious limitations as the study was a comparison of spending on a programme between Australian states using retrospective cancer registry data. Of the remaining studies, four were cost-utility analyses and one was a cost-effectiveness and cost-benefit analysis. One cost-utility analysis was considered to have minor limitations [++]; the other four economic evaluations were all considered to have potentially serious limitations [+].

### **3.3.7 Effective content and effective interventions**

This section only explored interventions found to be effective in trials of good [++] or moderate quality [+]. Seven of the 24 RCTs identified were assessed as good quality [++].

### **3.4 Intervention Impact**

The heterogeneity of the study objectives, populations, interventions and outcome measures preclude a meta-analysis of their results. A narrative synthesis of the data is therefore presented, with studies grouped primarily according to research question, type of interventions and outcome measures (see Sections 4 to 8 and Section 10).

### **3.5 Economic Studies**

The heterogeneity of the studies in terms of their aims, design, settings, interventions and outcome measures precluded meta-analysis. Only five of the six studies that met the inclusion criteria for the cost-effectiveness review were included in the narrative synthesis (see Section 9). The five included studies comprised four cost-utility analyses and one cost-effectiveness and cost-benefit analysis. Two were modelling studies conducted in the UK but using effectiveness data from other countries<sup>104, 105</sup>.

## **4. DISCUSSION**

### **4.1 Findings into Context**

This review has focused on many countries that have similar cultures and climates to the UK. However, there are also several studies in the review that were undertaken in countries with very different climates to the UK, such as Australia and the southern States of the USA, where the applicability of the findings to a UK population are not clear. Countries whose inhabitants spend a greater proportion of their time in the sun are likely to have different views and practices related to sun protection. Additionally, interventions or sun protection practices may be culture-specific and adaptation to UK settings should consider the applicability to different cultural groups.

Many of the interventions reviewed were multi-component. For many of these studies it was unclear which component or components contributed to effects or whether there were components that were unnecessary. This lack of clarity is compounded by the absence of detail around the content of components in many of the interventions.

There were few long-term studies which measured the impact of interventions beyond a year. This means it is difficult to assess whether interventions that were reported to be effective, would have long lasting impacts on knowledge and behaviour. In some studies, such as the study of distributing hats to children, although the intervention was effective at one year, there was a drop off in adherence to hat wearing during the second year. As well as the lack of knowledge and behaviour outcomes at longer term, there were few studies that reported quantifiable measures of sun practice change, such as numbers of sunburns and numbers of naevi, over the longer term. Since naevi and other skin damage takes time to develop, a greater number of studies that follow up study participants to investigate the long term impact of interventions would be helpful.

The following table gives a summary of the outcomes, particular interventions and strength of the evidence for those interventions.

| <b>Outcome</b>  | <b>Intervention</b>  | <b>Strength of evidence</b>         |
|---|--|-------------------------------------|
| Knowledge of risks of sun exposure                        | Education programmes   | Strong, consistent evidence         |
|   | Tailored interventions   | Strong, consistent evidence         |
|   | Multi-component interventions  | Moderate, consistent evidence       |
| Perceptions   | Education programmes   | Inconclusive                        |
|   | UV photographs with/without photoaging                               | Inconclusive                        |
|   | UV photographs with/without photoaging plus additional interventions | Weak, consistent evidence           |
|   | Message framing  | Weak, consistent evidence           |
|   | Multi-component interventions  | Inconclusive, inconsistent evidence |
|   | Information provision  | Weak evidence                       |
|   | Tailored interventions   | Moderate, consistent evidence       |
| Attitudes   | Education programmes   | Inconclusive, consistent evidence   |
|   | UV photographs with/without photoaging                               | Weak, consistent evidence           |
|   | Message framing  | Inconclusive, consistent evidence   |
|   | Threat/fear scenarios  | Weak, consistent evidence           |
|   | Tailored interventions   | Weak, inconsistent evidence         |
|   | Education programmes   | Moderate, inconsistent evidence     |
|   | Information provision  | Moderate, inconsistent evidence     |
| Change in knowledge/awareness of disease                  | Multi-component interventions  | Moderate, inconsistent evidence     |
|   | Motivational interventions   | Inconclusive, inconsistent evidence |
|   | Educational interventions  | Weak, consistent evidence           |
| Change in knowledge/awareness of sun protection practices | Educational interventions  | Weak, inconsistent evidence         |
| Adoption of sun safe practices                            | Multi-component interventions  | Moderate, inconsistent evidence     |
|   | Tailored interventions   | Moderate, inconsistent evidence     |
|   | Electronic education interventions                                   | Weak, consistent evidence           |
|   | Text messages  | Weak, inconsistent evidence         |
|   | UV photographs with/without photoaging                               | Moderate, consistent evidence       |
|   | Provision of hats and sunscreen                                      | Inconclusive, consistent evidence   |
|   | Education programmes   | Moderate, inconsistent evidence     |

#### **4.1.1 Changes in people's knowledge or understanding of how to competently assess level of risk and benefit from sun exposure**

Among the studies assessed for this review, there were a few trials relevant to the UK which provided information on interventions to change individual's knowledge. Educational programmes involving practical classroom-based activities were shown to increase knowledge in French children aged 9 to 12 years <sup>4</sup>, and a Belgian trial showed that narrative format web-based messages may be more conducive to knowledge change <sup>8</sup>. Other evidence came from two good quality US trials that tailored interventions and showed that these were effective in changing people's knowledge or understanding of how to competently assess their level of risk or benefit from sun exposure.

For multi-component interventions, this review benefits from the inclusion of evidence from a systematic review, as well as two more recent good quality RCTs (conducted in France and the USA). Multi-component interventions were shown to be effective, however, the specific features of the interventions which were the most effective are difficult to determine since the studies report different combinations of communication in widely varying population groups at varying extent of risk from sun exposure. The studies of multi-component interventions reviewed are from many different countries, so there is also a question about whether, even if specific elements and combinations of elements were identified as effective, they would be applicable to the UK.

#### **4.1.2 Changes in individuals' perception of or attitudes to the risks and benefits of sun exposure**

UV photos and photoaging were frequently used interventions intended to alter individuals' perceptions of the risks of sun exposure. UV photographs alone may not be as effective as UV photos (with or without photoaging) plus additional interventions (mostly information provision). These combined interventions appeared to enhance participants' perceived susceptibility or vulnerability to skin cancer, although there is inconclusive evidence about which of the additional interventions were most effective. These interventions also seemed to increase individuals' intentions to adopt sun protection behaviours. The use of UV photos with or without photoaging is likely to be applicable to the UK, but which of the additional interventions (which were investigated in several different countries) would be applicable to the UK may be more challenging to identify.

The ways that risk and benefit information is conveyed to individuals were investigated, and studies reported no significant difference between gain- or loss-framed messages for promoting sun protection through attitude change or changing intentions to practice sun protection. Trials reported no significant differences between gain- or loss-framed messages for sun protection or skin cancer messages.

University students were the subject of a systematic review of 18 studies of multi-component motivational interventions. These were studies conducted worldwide; therefore their applicability to the UK is unclear. However, the review provides inconclusive evidence about the effect of multi-component interventions on students' perceived susceptibility or vulnerability to skin cancer.

#### **4.1.3 Changes in individuals' knowledge and/or awareness of diseases related to sun exposure (either under or over exposure) including non-melanoma and malignant melanoma skin cancer and sunburn**

Few published studies addressing this outcome were identified since 2008, and the evidence from them was inconclusive about the effectiveness of motivational interventions to improve individuals' knowledge and/or awareness of diseases related to sun exposure. One moderate quality trial conducted in the USA found that a partially tailored mailed intervention may increase children's awareness of skin cancer risk compared to an annual invitation to attend a data collection session<sup>38</sup>. The value of this trial was its length (three years), but the participants were probably unusual in comparison to the UK population in that they were regularly receiving skin examinations. Thus, they seem likely to be relatively affluent with parents in employment and able to afford health insurance.

#### **4.1.4 Changes in individual's knowledge and/or awareness of practices that protect against sun exposure**

Few studies and only one systematic review published since 2008 addressed this question. Weak evidence was identified which reported that new media, lesson-based delivery, health fair, and other mixed methods may increase school children's knowledge about sun protection. Several studies reported improvements in sun protection behaviours, however, inadequate reporting of interventions made it impossible to determine the effects of individual delivery strategies or components within them, and hence their applicability to the UK is difficult to assess.

There was weak evidence from one moderate quality US trial reporting that an online video improved people's knowledge of sun protection practices significantly more than print-based material. The content of the video would need to be assessed for applicability to the UK.

#### **4.1.5 Effective interventions for achieving changes in sun protection practices and the effects of sun exposure**

Sun protection practices were found to increase following certain interventions, including the Living in the Sun and SunSmart programmes. The former was conducted in the USA and was based on receiving information while at the physicians' office. The latter was an intervention comprising 10 practical workshops delivered in primary schools in France. Other studies investigating sun policy interventions, all conducted in the US, were not effective in increasing sun protection behaviour.

Evidence of the effectiveness of providing hats to school children would seem highly applicable to the UK.

UV photos and photoaging alone seem to result in increased sun protection practices and, as noted previously are likely to be applicable to the UK. Evidence that text reminders to use sunscreen and other electronic interventions also increase sun protection behaviours, compared to paper-based or teacher-led educational interventions, suggest these interventions are applicable to the UK setting.

Tailored risk feedback (counselling) can have a small but significant difference in self-reported sun protection behaviours (measured by a composite behaviour score). These interventions vary, but the majority described seem applicable to the UK, although the content may require adaptation.

#### **4.1.6 Cost-effectiveness studies**

Two studies (both of moderate quality [+]) took effectiveness data from overseas studies and applied them to UK models of sun exposure and skin cancer risk. Results showed that when assuming the effectiveness seen in the overseas studies on behaviour change was also seen in the UK, then community, school and work-based interventions that provided information with or without additional sun care resources or change of the environment were highly cost-ineffective. The exception was provision of an information booklet for parents, which was estimated to have an incremental cost-effectiveness ratio of £6,200/QALY. However, the model was weakened by its linking of behavioural change to reduction in cancer risk.

The evidence on cost-effective interventions is limited by the absence of cost-effectiveness studies based upon effectiveness data generated in the UK.

## 4.2 Implications of Findings

There was very little evidence on the issue of conveying messages about both the benefits and risks of sun exposure. The vast majority of research reviewed here focused on investigations around the reduction of harmful sun exposure. There is research into the understanding of the UV index and times of day when sun exposure is best avoided, but this does not seem to be coupled with information about the benefits of achieving some sun exposure. Research into gaining or changing individuals' knowledge focused on reducing sun exposure and on increasing the use of sun protection activities. This means there is very little evidence on how to convey the more complex messages about the benefits as well as the risks of sun exposure. The one study which did report an intervention among elderly people in a residential home to increase their sun exposure, in order to increase vitamin D levels and reduce fractures, found no significant difference among residents who received more exposure than those who continued normal activities, in terms of serum 25-hydroxy vitamin D (OHD), serum parathyroid hormone (PTH), fracture incidence or new skin cancer events.

Many of the interventions in the included studies were multi-component and the relative value of the individual components is difficult to determine. The multi-component interventions are also difficult to compare to each other, since they differ in their individual components. The multi-component interventions have been the subject of systematic reviews and results have been inconclusive in terms of knowledge change.

There seems to be a body of evidence supporting the impact of UV photos and photoaging in combination with other activities, such as information giving, on perceived susceptibility or vulnerability to skin cancer, and intentions to adopt sun protection behaviour. UV photos and/or photoaging, with or without additional interventions, can increase the intentions of people with multiple risk factors to use sun protection. There is also evidence that the intervention (with or without additional interventions) increases sun protection practice.

In terms of changing perceptions of risk and intentions to adopt sun protection behaviour, from the studies reviewed in this review, there seems to be no value in framing risk messages as either gain- or loss-framed messages in terms of altering the perceptions of sun exposure risk. However, health messages manipulated to invoke a sense of fear or increase worry did seem to be effective in promoting intentions to adopt sun protection practices.

Multi-component interventions do not seem to affect university students' perceived susceptibility or vulnerability to skin cancer and there is inconsistent evidence that they change individuals' intentions to use sunscreen. Evidence from a US study showed that interventions tailored to adult beach goers' risk of skin cancer do not seem to increase perception of skin cancer risk. Other studies of tailored information provision provided inconsistent evidence of improvement in individuals' intentions to adopt sun protection behaviours or improvement in self-reported sun protection behaviour.

There is inconclusive evidence about the effectiveness of interventions to change perceptions of cancer risk in school-aged children, people at risk of occupational skin cancer, people seeking to gain a tan and people with multiple risks. There is inconsistent evidence of the effectiveness of active participation education sessions (evidence from Australia and the USA) and information giving in changing individuals' attitudes towards sun exposure and protection.

Improving knowledge of skin cancer risk seems best achieved, from the evidence reviewed here, by the use of partially tailored, mailed interventions involving parents and children: these may increase children's awareness of skin cancer risk. Using the UV index as a health promotion instrument as part of several different interventions has no significant impact on participants' knowledge about skin cancer. There is inconclusive evidence on the effects of multi-component interventions on increasing knowledge of skin cancer.

New media, lesson-based delivery, health fairs, and other mixed methods may increase school children's knowledge about sun protection, and one study suggests that an online video may improve people's knowledge of sun protection practices significantly more than print-based material. New media (rather than paper-based or teacher-led interventions) may increase sunscreen use (text messages) and sun protection behaviour and reduce sun exposure.

It is difficult to conclude, from the studies reviewed, which of the sun protection policies are effective in achieving sun protection behaviours and reductions in sunburn and naevi, but providing hats to school children can increase their use as sun protection, at least in the short term.

Weak consistent systematic review evidence suggests that counselling in primary care with tailored feedback can have modest impact on self-reported UV exposure protection behaviours, including reducing indoor tanning over periods of three to six months. When considering effects in specific subgroups, there appeared to be greater benefits (in terms of sun protection behaviour) found for the widely differing interventions designed to provide sun safety information to consumers in specific subgroups of participants with a potentially elevated risk of skin cancer, compared to the general population. Future studies could be designed to explore this possibility further. Potential interventions should be compared with each other in specifically targeted groups of participants, particularly those at risk, to enable conclusions to be reached on the relative effectiveness of different approaches.

#### **4.2.1 Cost-effectiveness evidence**

There were few studies retrieved since 2008 and the UK models reviewed showed some of the challenges of adapting the evidence from non-UK studies to the UK setting. The vast majority of interventions were not cost-effective and the only cost-effective intervention (providing an information booklet to parents) was subject to caveats by the authors.

#### **4.3 Limitations of the Evidence**

Many subgroups of the general population were of interest to this review, but relatively few of the studies identified investigated sun exposure issues in specific subgroups or explored subgroups within a larger population. There was some research in outdoor workers, sports people, beach goers, children and individuals at higher risk of melanoma, but other groups, such as people who are non-English speaking or whose first language is not English, people from different religious or cultural backgrounds, people with dark skin, or people who have low or no exposure to the sun, were not investigated at all in those studies identified in the search period for this review. This means that within this review there is little evidence for many of the subgroups, and for those subgroups that were investigated, there may not be evidence across all of the questions investigated.



The quality of the studies reviewed was very variable. A high percentage of the systematic reviews and RCTs reviewed were of poor quality. Systematic reviews suffered from poor reporting of their methods, which leads to concerns about the rigour with which they were conducted. RCTs suffered from issues that affected their validity, including concerns about randomization, allocation concealment, blinding and the use of intention-to-treat analysis, as well as the comparability of the treatment groups in terms of baseline characteristics and the number of dropouts from studies. This review has only explored studies published since 2008, but it is likely that earlier studies would display at least the same levels of weakness.

Many of the studies report little information on the nature and content of their interventions, although some do provide further detail in linked publications. This absence of detail hampers the comparison of interventions and the identification of the content of effective interventions.

The paucity of UK studies published since 2008 impacts on the applicability and relevance of the findings from this review. In particular, the absence of UK studies impacts on the ability to develop relevant economic models.

#### **4.4 Limitations of the Review and Potential Impact on Findings**

This review searched for studies published since 1994, but resources only permitted the analysis of studies published in 2008 or later. The original intention was to include studies from 1994 onwards, but due to the volume of material, a pragmatic decision was made to limit the review to studies conducted from 2008; this was because other reviews on similar topics had previously been commissioned by NICE and searches were conducted up to 2008. Systematic reviews which reviewed studies published earlier than 2008 were included, but were not identified for all of the research questions; this means that not all of the available evidence was included in the review. The consequence of this, in terms of the impact on the direction and strength of the evidence statements, is therefore unknown. There may also be studies in subgroups that had been published earlier than the date cut-off for this review, which might have informed evidence statements for subgroups.

The searches were limited to studies in English, which may have led to the omission of some studies in languages other than English relevant to the climate of Northern Europe. This factor has unknown consequences in terms of the impact on the direction and strength of the evidence statements.

Eligible studies were those conducted in OECD countries. Again, this includes countries which may be very different to the UK in terms of climate and culture, and also excludes some Northern European countries whose climate and culture may be similar to the UK. This factor has unknown consequences in terms of the impact on the direction and strength of the evidence statements.

# Abbreviations

|      |   |
|------|---|
| AAD  | American Academy of Dermatology                   |
| CPH  | Centre for Public Health                          |
| CI   | Confidence interval                               |
| DALY | Disability-adjusted life years                    |
| GP   | General Practitioner                              |
| ICER | Incremental cost-effectiveness ratio              |
| IRR  | Inter-rater reliability                           |
| LYS  | Life years saved                                  |
| MN   | Melanocytic naevi                                 |
| NEG  | Nutritional Epidemiology Group                    |
| NHS  | National Health Service                           |
| NICE | National Institute for Health and Care Excellence |
| OR   | Odds ratio  |
| PH32 | Public Health Guidance 32                         |
| QALY | Quality-adjusted life year                        |
| RCT  | Randomized controlled trials                      |
| SD   | Standard deviation                                |
| SMD  | Standardized mean difference                      |
| SPF  | Sun protection factor                             |
| SR   | Systematic review                                 |
| SSE  | Skin self-examination                             |
| TCE  | Total cutaneous examination                       |
| UV   | Ultraviolet radiation                             |
| UVA  | Ultraviolet A                                     |
| UVB  | Ultraviolet B                                     |
| UVC  | Ultraviolet C                                     |
| UVI  | UV index  |
| YHEC | York Health Economics Consortium                  |

# Glossary

|                               |  |
|-------------------------------|--|
| Message framing:              | The act of presenting one of more equivalent value outcomes either in positive or “gain” terms (positive framing) or in negative or “loss” terms (negative framing).   |
| Motivational interventions:   | Interventions designed to enhance an individual’s motivation for change.   |
| Multicomponent interventions: | Employing a variety of methodologically distinct approaches.   |
| Naevi:                        | Plural of naevus, a birthmark or a mole on the skin (often taking the form of a raised red patch).   |
| New media:                    | Generic term for any means of mass communication using digital technologies such as the Internet or other technologies enabling digital interactivity.   |
| Photoaging:                   | The damage done to an individual’s skin over a lifetime of exposure to UV radiation.   |
| Phototype:                    | Otherwise known as the Fitzpatrick skin type; the classification of skin type according to the amount of melanin pigment in the skin.  |
| SAM score:                    | Self-Assessment Melanoma Risk Score  |
| Serum PTH:                    | Measure of parathyroid hormone, a protein hormone released by the parathyroid gland. PTH controls levels of calcium, phosphorus, and vitamin D in the blood and is important for regulating bone growth.   |
| Serum 25OHD:                  | Used as a biomarker of the adequacy of vitamin D supplies due to its stability over a number of weeks (unlike levels of circulating Vitamin D). Vitamin D from diet or sun is converted in the liver to 25OHD; the kidneys then convert it into to the active form of vitamin D. |
| Tailored interventions:       | Interventions adapted to fit the needs and characteristics of a specific population.   |
| UV reflectance photography:   | The recording of images using only light from the ultraviolet (UV) spectrum; can be used to determine the level of skin damage caused by repeated exposure to UV light.  |

# Section 1: Introduction

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The National Institute for Health and Care Excellence (NICE) Centre for Public Health (CPH) has contracted York Health Economics Consortium (YHEC) and the University of Leeds' Nutritional Epidemiology Group (NEG) to produce three evidence reviews, a documentary analysis and an economic model of interventions that present and disseminate the health risks and benefits of ultraviolet radiation (UV) to the general public. This is the report of the effectiveness and cost-effectiveness reviews.

## 1.1 BACKGROUND

Ultraviolet radiation is electromagnetic radiation given off by the sun. It spans 100 nm to 400 nm and can be subcategorised as ultraviolet A (UVA), ultraviolet B (UVB) and ultraviolet C (UVC) <sup>107</sup>. Exposure to UV radiation carries with it both positive and negative consequences for human health. Too much UV radiation is associated with an increase in the risk of developing a range of negative health conditions including, most notably, skin cancers, eye conditions including cataracts, and immunosuppression that can cause the reactivation of the virus herpes simplex <sup>108</sup>. Exposure to too little UV radiation can also lead to health problems. UVB radiation is an important source of vitamin D, which is produced in the skin through a photosynthetic reaction <sup>108</sup>. It is an essential nutrient required to help maintain calcium and phosphate levels in the body and to maintain healthy bone and skeletal growth. Vitamin D deficiency can result in bones not forming properly and the development of rickets in children, which is characterised by growth retardation and skeletal deformities. In both children and adults, vitamin D deficiency can also result in bone pain, such as osteomalacia <sup>109</sup>. Furthermore, there is some evidence that vitamin D may have an important role to play in human health, beyond its involvement in bone health. Poor vitamin D status has been linked with a range of chronic diseases such as cancers and cardiovascular disease (CVD) as well as markers of cardiometabolic health including obesity and type 2 diabetes mellitus, although the evidence is generally insufficient to attribute causality <sup>110</sup>.

Vulnerability to the health conditions associated with too much or too little UV exposure is complex and multi-faceted. Problems may arise as a result of exogenous factors (exposure levels that are too high or too low) or endogenous factors (variations in an individual's ability to utilise or withstand the amount of UV radiation received). Exogenous parameters include geographical variables such as latitude and climate <sup>110</sup>, alongside cultural and behavioural considerations such as clothing practices, the amount of time spent outdoors, or the use of sun tanning beds <sup>110</sup>. Endogenous factors include genetic characteristics such as skin pigmentation, age-related changes <sup>109</sup>, and gender-specific circumstances such as pregnancy and breast feeding <sup>109</sup>.

In the UK, attempts to proactively communicate the risks associated with too much or too little UV exposure have been made through various media. Sun protection messages have been advanced through the mass media <sup>111</sup>, through workplace leaflets produced by the Health and Safety Executive <sup>112</sup>, through checklists for school children and teachers produced by charitable organisations, and through the direct advice of health practitioners working in the National Health Service (NHS) and local authorities, amongst others <sup>113</sup>.

These interventions have employed a variety of techniques. Appearance-based interventions use imagery of the damaging effects of UV exposure to try to change attitudes and behaviours towards UV protection <sup>114</sup>. Behavioural counselling techniques involve directly communicating UV protection messages through a number of channels, such as primary care interactions, self-guided booklets and 30-minute peer counselling sessions.

The overall efficacy of attempts to communicate the risks of UV exposure is unclear. While there is evidence that awareness of the risks has increased, so has the incidence of skin cancer <sup>114</sup>. This has been explained through the 'knowledge-behaviour gap' <sup>115</sup>, which is not fully understood, whereby individuals are aware of the consequences of activities but continue to practise them. Conflicting agendas that seek to advise both more sun exposure, in the case of vitamin D deficiency, and less exposure, in the case of skin cancer avoidance, may have resulted in a confused message <sup>111</sup>.

In the UK NICE have published Public Health Guidance 32 (PH32), which sets out the need to communicate the risks related to UV exposure from the perspective of skin cancer risk <sup>113</sup>. The guidelines make recommendations for a national mass-media campaign alongside local information provision, and set out who should be involved and how. The guidelines promote an integrated message targeted at high risk population groups that acknowledges and challenges commonly held perceptions around UV exposure. They also acknowledge the need for a balanced message that incorporates an understanding of the health benefits of UV exposure. NICE will also publish guidelines to inform the implementation of existing guidance on the prevention of vitamin D deficiency in November 2014.

To complement these guidelines, NICE CPH is developing further guidance on UV exposure focusing on communicating the risks and benefits to the general population. This review will inform the development of that guidance.

## **1.2 AIM OF THE REVIEW**

The aim of this review was to review the evidence of effectiveness and cost-effectiveness of interventions that seek to present and disseminate complex health risk information relating to safe sun exposure.

### 1.3 RESEARCH QUESTIONS

The evidence review investigated the following questions:

- 1a. What are the most effective methods of presenting<sup>1</sup> complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- 1b. What are the most effective methods of disseminating<sup>2</sup> complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- 1c. What are the most cost-effective methods of presenting complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- 1d. What are the most cost-effective methods of disseminating complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- 2a. What are the most effective ways to change people's beliefs about the risk of sun exposure and to encourage them to change their sun protection practices accordingly?
- 2b. What are the most cost-effective ways to change people's beliefs about the risk of sun exposure and to encourage them to change their sun protection practices accordingly?
- 3a. What content do effective primary skin cancer prevention messages contain?
- 3b. What is the most effective content in primary skin cancer prevention messages?

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<sup>1</sup> Presenting is about the way the information looks and includes narrative, numeric, verbal, visual presentation formats.

<sup>2</sup> Disseminating is the process of giving information and includes: verbal - one to one/group based/planned/opportunistic, print - leaflets, poster internet/email/text- mass media.

## Section 2: Methodology

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This evidence review was conducted according to the NICE public health review guidance <sup>1</sup>. The review was guided by a project protocol developed in close collaboration with the NICE Centre for Public Health (CPH). The protocol was developed on the basis of a NICE scope document (and contract of work). Together, the scoping document and the contract of work specified the research questions, the eligibility criteria and record selection process, the quality assessment and data extraction process, and the timelines of the project.

### 2.1 SELECTION CRITERIA

Studies eligible for inclusion in this review needed to meet the inclusion and exclusion criteria described below. These criteria were derived from the NICE Public Health Guidance final scope <sup>2</sup> and discussions with the NICE team.

#### 2.1.1 Populations

To be included in the review, studies needed to either investigate the general population or one of the subgroups listed below:

- People at increased risk of skin cancer:
  - People with fair skin;
  - People with fair or red hair;
  - People with more than 50 moles or atypical moles;
  - Babies and children;
  - Outdoor workers and people whose lifestyles or leisure pursuits cause excessive UV exposure (such as water sports or gardening);
  - People with a family history of skin cancer.
- People at increased risk of vitamin D deficiency:
  - Pregnant and breastfeeding women;
  - Infants and young children (younger than 5 years);
  - People with dark skin, for example, people of African, African–Caribbean, Middle Eastern and South Asian origin;
  - Older people (65 and older);
  - People who have low or no exposure to the sun (for example, people who cover their skin for cultural reasons, and people who are housebound or confined indoors for long periods).
- People with different levels of education;
- People with learning disabilities;
- People with physical impairments;
- People who are non-English speaking or whose first language is not English;
- People from different religious and cultural backgrounds;
- People of different ages.

Studies featuring only the following populations were excluded (these were protocol amendments in discussion with NICE):

- Skiers; NICE suggest that this was a pragmatic decision, given there was not the resources to cover all groups and activities and opted to focus on those activities more common within England;
- Expatriate populations; NICE suggested that this was a pragmatic decision - while populations from other countries were included, these studies addressed a very specific population group and it is unclear how transferable findings would be to a general population group in England;
- Non-OECD countries; The decision to use only studies from OECD countries tallied with the inclusion criteria for the reviews conducted for the NICE skin cancer guidance (PH32).

### **2.1.2 Interventions**

Eligible research studies were those that investigated interventions that aimed to achieve one or more of the following:

- Convey information about sun exposure, sun risks and sun exposure benefits;
- Increase understanding about sun exposure, sun risks and sun exposure benefits;
- Modify individuals' sun exposure practices.

Studies were excluded if they only investigated interventions that aimed to:

- Manage vitamin D deficiency;
- Manage skin cancer;
- Prevent secondary skin cancer (activities that aim to prevent a re-occurrence);
- Manage conditions that may increase the risk of vitamin D deficiency. Examples include: end-stage liver disease; renal disease; fat malabsorption syndromes such as cystic fibrosis, coeliac disease and inflammatory bowel disease; or conditions treated with drugs that affect vitamin D metabolism;
- Manage conditions that may increase the risk of skin cancer, (for example, epidermolysis bullosa, Gorlin syndrome or a weakened immune system);
- Manage conditions treated with drugs that mean increased exposure to sunlight is not advised (for example, certain antipsychotic drugs);
- Assess the effectiveness of, or compliance with, indoor tanning regulations (introduced as a protocol amendment).



### 2.1.3 Comparators

To be included in the effectiveness review, studies did not have to feature a comparator. We anticipated that evidence from a wide range of study types would be of interest. Where effectiveness studies did feature a comparator, they were eligible for inclusion in the review if they were compared against one of the following:

- Another eligible intervention;
- No activity.

To be included in the review of cost-effectiveness studies, studies needed to feature a comparator. Eligible comparators were:

- Any other eligible intervention;
- No activity.

### 2.1.4 Outcomes

To be eligible for inclusion in the effectiveness review, studies needed to report at least one of the following effects as a primary outcome in relation to sun exposure:

- Changes in people's knowledge/understanding of how to competently assess their individual (or those they care for) level of risk and benefit from sun exposure;
- Changes in individuals' perception of or attitudes to the risks and benefits of sun exposure;
- Changes in individuals' knowledge and/or awareness of diseases related to sun exposure (either under or over exposure) including non-melanoma and malignant melanoma skin cancer and sunburn;
- Changes in individuals' knowledge and/or awareness of practices that protect against sun exposure e.g. wearing sunscreen, wearing hats, avoiding sunlight in the middle of the day;
- Changes in either the timing, intensity, frequency or duration of sun exposure and sun protection practices:
  - People's sun exposure (this could be an increase for people at increased risk of vitamin D deficiency and a decrease for people at increased risk of skin cancer);
  - Sun protection practices.
- Changes in quantifiable markers of health/outcomes of sun exposure, including:
  - Melanocytic naevi counts;
  - Skin colour measures;
  - Frequency of sunburn;
  - Incidence of vitamin d deficiency;
  - Prevalence of vitamin D deficiency or vitamin D deficiency morbidities;
  - Skin cancer incidence (basal cell, squamous cell, melanoma);
  - Eyelid malignancies.
- Reductions in the incidence of morbidity attributable to sun exposure (either under or over exposure).

To be eligible for inclusion in the review, cost-effectiveness studies needed to report one of the following outcomes:

- Cost per quality-adjusted life year (QALY);
- Cost per case of relevant condition/disease averted, including the following:
  - Skin cancer (any kind);
  - Vitamin D deficiency (bone health markers)<sup>34</sup>;
  - Osteomalacia;
  - Osteoporosis;
  - Rickets;
  - Sunburn;
  - Eyelid malignancies.
- Cost per life year gained;
- Cost per benefit, where the benefit is a relevant outcome listed above;
- Costs and benefits of an intervention presented as a cost-consequences analysis, where the benefit is a relevant outcome listed above;
- Return on investment.

### 2.1.5 Study Features

Eligible studies were:

- Published from 2008 onwards. Searches were conducted from 1994 to present, however, given the large number of studies identified; a pragmatic decision to limit to 2008 was agreed;
- Published in English;
- Conducted within an OECD (Organisation for Economic Co-operation and Development) country.

Studies were not eligible for this review if they were:

- Published in abstract form only;
- Case reports;
- Case series;
- Non-systematic reviews<sup>5</sup>;
- Editorials, opinion papers.

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<sup>3</sup> In order to align with anticipated guidance from the Scientific Advisory Committee on Nutrition (SACN), this review focused on the relationship between vitamin D deficiency and bone health markers (e.g. rickets, osteoporosis and osteomalacia) as this is where the strongest evidence lies.

<sup>5</sup> Systematic reviews were defined, for the purposes of this review, as reviews that have the following characteristics:

- A stated and clear research question;
- A statement of the eligibility criteria which have guided the selection of studies for the systematic review, including a statement about eligible study designs;
- Indications of an extensive search for relevant studies, i.e. searches beyond MEDLINE;
- A description of study selection methods;
- A synthesis of the included studies, either narrative or statistical.

For the cost-effectiveness review only the following studies types were eligible:

- Cost-utility analyses;
- Cost-effectiveness analyses;
- Cost-benefit analyses;
- Cost-minimisation analyses;
- Cost-consequences analyses.

Burden of disease and cost of illness studies were not eligible for inclusion in the cost-effectiveness review.

## **2.2 LITERATURE SEARCHES**

The search strategies captured both published and unpublished studies relevant to the review questions.

### **2.2.1 Bibliographic Database Strategies**

The searches required for this project were complex due to the nature and range of the evidence required and one sensitive search strategy was used to retrieve evidence for several reviews to inform the NICE guidance, to maximise efficacy in the identification and screening of studies. The full search strategy can be found in Appendix A. One set of records was therefore screened for both this review and a review of barriers and facilitators to risk communication.

Capturing concepts such as risk/benefit communication and public knowledge, attitudes and beliefs in a robust way was challenging due to the range of free-text and index terms that could be used to describe them. Developing a strategy to attempt to capture these concepts (particularly in choice of index terms), and adapting for other database interfaces, involved inevitable trade-offs in order to ensure that the volume of results returned was manageable within the context of the project. Whilst the search strategy was designed to be as sensitive as possible within the time and resource constraints, it was unlikely that any strategy would be able to fully capture these concepts and there was always the risk of potentially missing relevant studies.

The searches were limited to publications published from 1994 to date. The strategy, where allowed by the database interface, also limited the search to English-language studies only, safely removed any animal studies, and excluded any publication types that were unlikely to be relevant (case reports, news, historical articles, letters and commentaries).

## 2.2.2 Electronic Databases and Websites

The following databases were searched via the specified interfaces. The searches for the cost and clinical effectiveness evidence were performed and exported together:

- ASSIA (Applied Social Science Index and Abstracts);
- CINAHL (Cumulative Index of Nursing and Allied Health Literature) (EBSCONet);
- Cochrane Central Register of Controlled Trials (CENTRAL) (Cochrane Library, Wiley);
- Cochrane Database of Systematic Reviews (Cochrane Library, Wiley);
- Database of Abstracts of Reviews of Effectiveness (DARE) (Cochrane Library, Wiley);
- Embase (Ovid SP);
- Health Management Information Consortium (HMIC) (Ovid SP);
- MEDLINE and MEDLINE in Process (Ovid SP);
- PsycINFO (OvidSP);
- Social Policy and Practice (Ovid SP);
- Social Science Citation Index (Web of Knowledge);
- Social Care Online (<http://www.scie-socialcareonline.org.uk/>);
- NHS Economic Evaluation Database (NHS EED) (Cochrane Library, Wiley);
- EconLit (Ovid SP);
- HEED (EBSCO);
- CEA Registry (<https://research.tufts-nemc.org/cear4/>).

The following resources to locate unpublished studies and other grey literature were also searched:

- OAISTER (<http://oaister.worldcat.org/>);
- OpenGrey (<http://www.opengrey.eu/>);
- NICE Evidence (<https://www.evidence.nhs.uk/>);
- NICE webpages (<http://www.nice.org.uk/>);
- Public Health Observatories webpages (<http://www.apho.org.uk/>);
- Guidelines International Network (GIN) website (<http://www.g-i-n.net/>);
- National Guidelines Clearing House (<http://www.guideline.gov/>);
- EPPI Centre databases (<https://epi.ioe.ac.uk/cms/Default.aspx?tabid=185>):
  - DoPHER;
  - TRoPHI.

Although WHOLIS (<http://www.who.int/library/databases/en/>) was intended to be searched, the interface was continually unavailable during the search period and so could not be used.

To identify reports from individual health authorities that have made attempts to communicate public health measures on the risks and benefits of sun exposure, Google search was used, limited to NHS, local authority, Public Health Observatory and Department of Health sites using the 'site' limit. Additionally, the webpages of organisations producing guidance on sun exposure risks and benefits, or undertaking research in the field of risk communication, were searched or browsed.

The reference lists of identified systematic reviews were not searched due to resource constraints. This amendment to the protocol was agreed with NICE.

### **2.2.3 Running the Search Strategies and Downloading Results**

We conducted appropriate searches on each of the databases or resources listed in Section 2.2.2. The search strategies are set out in Appendix A.

The search results were then downloaded into EndNote bibliographic software where they were deduplicated using several algorithms.

## **2.3 ASSESSING THE RELEVANCE OF STUDIES TO THE REVIEW**

To screen the records for eligibility, the search results were assessed and categorised according to the criteria set out in Section 2.1. The number of records included and removed at each selection stage was recorded according to the PRISMA flow chart (Figure 2.1) <sup>116</sup>. A single process incorporated the screening for both the effectiveness and cost-effectiveness reviews, and the barriers and facilitators review, which has been reported separately.

Record selection was undertaken using several passes. The first pass was undertaken in EndNote, by an experienced information specialist. It removed obviously irrelevant records, specifically studies which were:

- Ineligible study designs;
- Animal studies;
- In languages other than English;
- Published before 1994;
- Anonymous or had no author;
- Conference abstracts;
- About diagnosing disease;
- Laboratory studies;
- Environmental science research;
- Assessing interventions or risk factors for diseases not related to UV exposure;
- Not about human health;
- Included only because of the author name 'Tan'.

The remaining records were then loaded into DistillerSR systematic reviewing software. Studies published since 2008 were loaded as per initial discussions with NICE. Studies published in the period 1994 – 2008 were held back in order to manage the number of studies eligible for the review.

Second pass record selection was then undertaken by two reviewers independently, using the title and abstract of the records. The reviewers sought to identify the studies most likely to contain evidence of the effectiveness or cost-effectiveness of interventions that conveyed information relating to the health risks and benefits of UV exposure, or were likely to modify UV exposure practices. To do this, a screening form based on the eligibility criteria in the protocol and agreed by NICE was created in DistillerSR to facilitate the reviewing process.

The inter-rater reliability (IRR) was calculated by DistillerSR on an ongoing basis. Over the course of the second pass the IRR was approximately 0.93. Lower rates of 0.82, 0.85 and 0.89 were calculated between reviewers over the first 100 records each respectively reviewed. These values then rose as reviewer proficiency increased.

Third pass record selection was also undertaken by two reviewers independently, using the full text of the records. At this stage reviewers sought to identify studies that met all of the eligibility criteria and could be included in the review. As in the second pass, a form, agreed by NICE was constructed in DistillerSR to facilitate the screening process. For the third pass, the IRR over the selection questions yielded a weighted overall kappa of 0.57 (moderate).

Figure 2.1 shows the number of studies included at each stage. The searches returned a total of 23,271 records, of which 13,900 remained to be screened after deduplication. A further 8478 studies were excluded through initial screening to remove obviously irrelevant records, leaving a total of 5,422 studies to be taken forward. At the second pass an additional 4,851 studies were removed, leaving 572 to be taken forward for full-text review. During the third pass 444 studies were excluded, leaving 109 eligible studies to be included in this review.

DistillerSR systematic reviewing software was used for the record selection and coding of studies.

## **2.4 STUDY SELECTION REASSESSMENT**

A review of the eligibility criteria was undertaken while the screening process was underway to ensure that the number of studies being included for further processing remained realistically achievable within the resources available. Following discussion with NICE, several amendments to the original criteria were adopted and have been incorporated into this report (noted in Section 2.1).

Records that had already been screened were then reprocessed to ensure that they complied with the new criteria.

## 2.5 ASSESSING QUALITY OF STUDIES

Each study was quality assessed using the appropriate appraisal checklists from the NICE public health guidance development manual <sup>1</sup>. For systematic reviews (SRs) The AMSTAR quality assessment tool was used <sup>3</sup>.

The quality of the included studies was assessed by a single reviewer and checked by a further reviewer. Any disagreements were resolved through consensus and if necessary a third reviewer was consulted.

The SRs were graded as 'good quality' if they met eight or more of the eleven AMSTAR criteria, 'moderate quality' if they met five to seven of the criteria, and 'poor quality' if they met four or fewer criteria.

The RCTs were given one of the following quality ratings:

- '++' (All or most of the checklist criteria have been fulfilled and the conclusions are unlikely to alter where the criteria has not been fulfilled);
- '+' (Some of the criteria have been fulfilled and the conclusions are unlikely to alter for the criteria that have not been fulfilled or not adequately described);
- '-' (Few or no criteria have been fulfilled and the conclusions are likely to alter).

Studies that received a '++' quality rating were referred to as 'good quality', those receiving a '+' rating were referred to as 'moderate quality', and those that received a '-' rating were referred to as 'poor quality'. Where information that could have been included was missing the denotation 'not reported/unclear' was used. If a particular criterion was not applicable to a study it was marked 'not applicable'.

The cost-effectiveness studies were graded using the NICE economic evaluations quality assessment checklist, as per Appendix I of the NICE public health guidance development manual.

The economic studies were given one of the following quality ratings:

- '++' (All or most of the checklist criteria have been fulfilled and the conclusions are unlikely to alter where the criteria has not been fulfilled);
- '+' (Some of the criteria have been fulfilled and the conclusions are unlikely to alter for the criteria that have not been fulfilled or not adequately described);
- '-' (Few or no criteria have been fulfilled and the conclusions are likely to alter).

Studies that received a '++' quality rating were referred to as having 'minor limitations', those receiving a '+' rating were referred to as having 'potentially serious limitations', and those that received a '-' rating were referred to as having 'very serious limitations'.

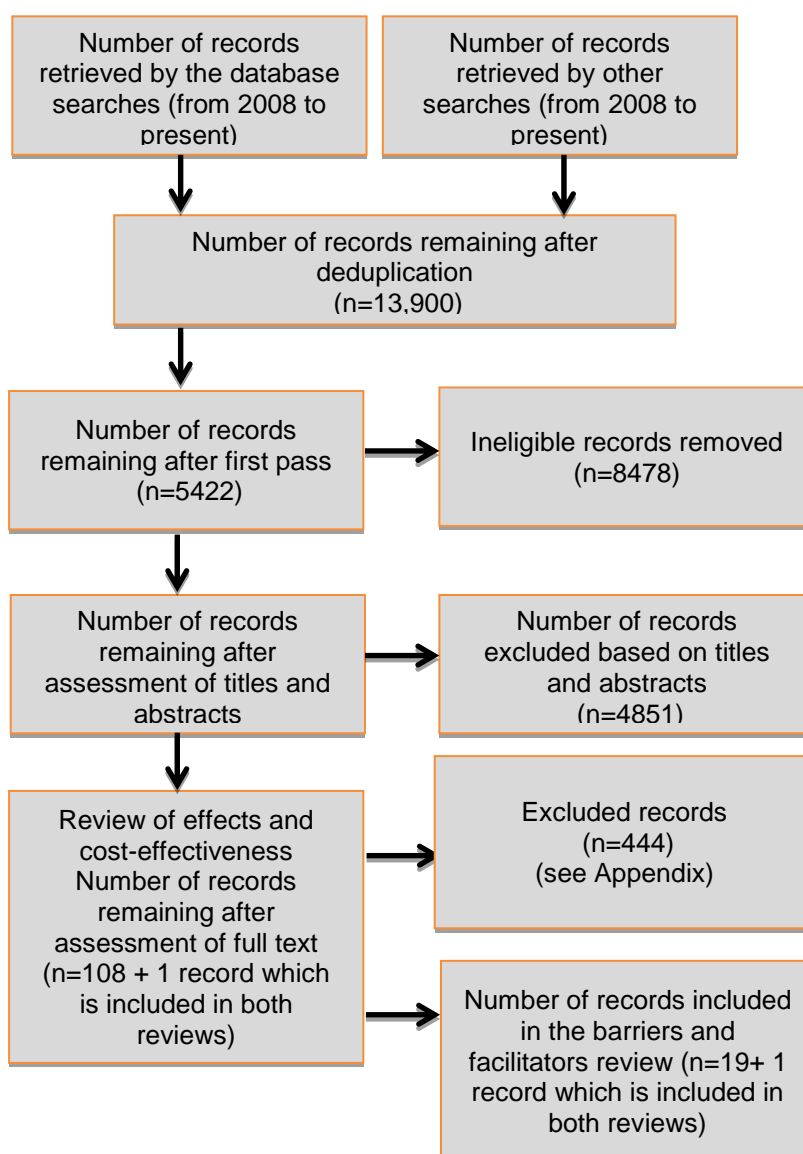
## 2.6 DATA EXTRACTION

One reviewer extracted the data from each of the included studies using a standardised template, and a second researcher checked the extraction. Any discrepancies were resolved through discussion or by consulting a third researcher. Three types of data extraction template were used based on the study type (SRs, RCTs or observational studies).

For RCTs, the data extraction table was based on the template presented in Appendix K1 of the NICE public health guidance development manual <sup>1</sup>. For SRs, the template presented in Appendix K4 was used as the basis of the data extraction table. For observational studies, the data extraction tables were based on tables presented in the NICE public health guidance development manual. We utilised several of these templates because of the different study designs used in the observational studies. The fields of data extracted are shown in Appendix A.

DistillerSR systematic reviewing software and MS Excel was used for data extraction.

**Figure 2.1: PRISMA diagram**





For economic evaluations, the data extraction was based on the template presented in Appendix K of the NICE public health guidance methods manual <sup>1</sup>.

## **2.7 DATA SYNTHESIS**

Data synthesis incorporated narrative summaries and evidence tables for all studies and provided concise detail on the populations, interventions, settings and outcomes. Results were presented in tables and in the text by outcome. There were insufficient data available to carry out meta-analysis for any intervention.

### **2.7.1 Overlap**

Where possible, the degree of overlap between systematic reviews and randomized controlled trials was assessed. It was not possible to undertake this assessment until data had been extracted from all of the studies because in several instances one study contributed to a number of sections. Where overlap has been identified between a systematic review and a randomized controlled trial, the systematic review has been reported in the text and tables, and the randomized controlled trial has been reported in the tables only. Overlap between systematic reviews and observational studies was not assessed.

### **2.7.2 Evidence Statements**

Evidence statements were constructed taking into account the quality and consistency of the findings and the applicability of the evidence for each of the research questions. For the purpose of generating evidence statements, the strength and consistency of evidence were considered and reported separately and evidence was described using the criteria:

- Inconclusive evidence: all poor quality studies;
- Weak evidence: at least one moderate quality study;
- Moderate evidence: either mostly moderate, or a combination of high quality and poor quality studies;
- Strong evidence: all or mostly high quality studies;
- Consistent evidence: direction of effect is the same across studies;
- Inconsistent evidence: direction of effect is different across studies.

Where a good or moderate quality systematic review included primary studies that were of poor quality, were heterogeneous, or did not provide sufficient detail of interventions, these reviews were downgraded. Observational studies did not contribute to the evidence statements where evidence from systematic reviews or randomized controlled trials was available.

### **2.7.3 Effective Content of Interventions**

In order to answer research questions 3a and 3b, effective interventions from each of the results sections of the review were identified. This section explores the interventions that were found to be effective in trials of good [++] or moderate [+] quality and reports details of those interventions. The interventions reported in trials of poor quality were not investigated because of the quality of the trials. Twenty-four trials were identified as having effective interventions. Because of resource constraints, the details of interventions reported within the primary studies of included systematic reviews were not included in this section.

## Section 3: Results

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The results are reported in separate sections and relate to the research questions as follows:

| Research question   | Report section  |
|---|---|
| 1a: What are the most effective methods of presenting <sup>6</sup> complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?    | Section 4: Changes in people's knowledge or understanding of how to competently assess level of risk and benefit from sun exposure.   |
| 1b: What are the most effective methods of disseminating <sup>7</sup> complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)? | Section 5: Changes in individuals' perception of or attitudes to the risks and benefits of sun exposure.  |
| 2a. What are the most effective ways to change people's beliefs about the risk of sun exposure and to encourage them to change their sun protection practices accordingly?  | Section 6: Changes in individuals' knowledge and/or awareness of diseases related to over- or under-exposure to sunlight.   |
| 2b. What are the most cost-effective ways to change people's beliefs about the risk of sun exposure and to encourage them to change their sun protection practices accordingly?   | Section 7: Changes in individuals' knowledge and/or awareness of practices that protect against over- or under-exposure to sunlight.  |
| 3a. What content do effective primary skin cancer prevention messages contain?<br>3b. What is the most effective content in primary skin cancer prevention messages?  | Section 8: Effective interventions for achieving changes in sun protection practices and the effects of sun exposure.<br><br>Section 9: Review of cost-effectiveness studies.<br><br>Section 10: Effective content and effective interventions. |

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<sup>6</sup> Presenting is about the way the information looks and includes narrative, numeric, verbal, visual presentation formats.

<sup>7</sup> Disseminating is the process of giving information and includes: verbal - one to one/group based/planned/opportunistic, print - leaflets, poster internet/email/text- mass media.

## **Section 4: Changes in People’s Knowledge or Understanding of How to Competently Assess Level of Risk and Benefit from Sun Exposure**

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This section provides findings on studies that report changes in people’s knowledge or understanding of how to competently assess level of risk and benefit from sun exposure, and represents one of four outcomes designed to answer research questions 1a and 1b.

- 1a. What are the most effective methods of presenting complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- 1b. What are the most effective methods of disseminating complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?

### **4.1 OVERVIEW OF INCLUDED STUDIES**

#### **4.1.1 Characteristics of Included Studies**

Twelve studies (one SR, seven RCTs and four observational studies) met the inclusion criteria. The majority of studies were concerned with measuring various dimensions of knowledge of sun safety or understanding of how to judge the level of risk from sun exposure. This included general knowledge of skin cancer risk factors (e.g. skin, hair or eye colouring, family history, number of moles etc.), appreciation of whether they were at increased personal risk and whether they would be able to identify suspicious moles. None of the studies reported on knowledge of benefits of sun exposure. A variety of interventions were assessed, though these predominantly concerned the impact of multi-component educational directives. Characteristics of the studies are presented in Table 4.1.

#### **Participants**

The SR <sup>12</sup> included studies of adult outdoor workers including outdoor recreational staff, lifeguards, road workers, outdoor electrical workers and farm workers conducted in the USA, Turkey and Australia. The intervention studies included in the SR that explored knowledge change were limited in number. All except one study included both genders.

Participants in the RCTs varied; one study included primary school children aged between 9 and 12 years old, the other studies included adult beach goers (aged 18 and over), adult patients at high melanoma risk, Flemish university students, and individuals with a family history of melanoma.

The majority of studies focused on subgroups that were at higher risk of skin cancer: one study of beach goers and sunbathers, one study of siblings of recently diagnosed melanoma patients, one study of first degree relatives of patients with cutaneous melanoma and one study of patients assessed to be at higher risk via questionnaire. All studies had mixed genders. The majority of participants were Caucasian.

## **Interventions**

The SR <sup>12</sup> assessed the impact of mainly multi-component educational interventions on sun safety knowledge.

The included RCTs investigated the effects of a variety of interventions. One study assessed the effects of the validated educational programme 'Living with the Sun' <sup>4</sup>, and two studies were concerned with the way in which educational information on sun safety was delivered. In one of these studies, the style of message delivery via a website (a narrative versus non-narrative approach) on health promotion was assessed <sup>8</sup>. In the other, the way in which the participants should view information-delivering videos was varied (with an emotion focus, an information gathering focus, or as if viewed at home) <sup>9</sup>. Four studies investigated multi-component interventions which incorporated one or more of skin examinations, counselling, education, feedback, doctor consultation or photo tests <sup>10, 11, 13, 14</sup>.

The interventions used could be categorised as sun protection policies (often administered in schools or appropriate settings such as swimming pools), various types of education (newsletters, flyers, text messages, presentations by teachers or GPs, videos, E magazines and websites), motivational messages (UV photos and other appearance-focused interventions, self-affirmation, interventions resulting in emotional arousal, skin cancer risk and action plans) and interventions using a combination of approaches. Summary characteristics of the included studies are presented in Table 4.1 and detailed tables are provided in the appendices.

## **Outcomes**

Studies assessed diverse aspects of people's knowledge and understanding of how to assess their level of risk resulting from sun exposure. Aspects measured included knowledge of their elevated risk of melanoma, perceived ability to perform skin self-examination, use of a mirror or another person for skin examination, photography for skin examination, knowledge of likely location of melanomas and melanoma risk factors, and ability to detect a melanoma or change in a mole. These outcomes were mainly assessed by self-report, using some sort of questionnaire or Likert scale, or by scoring images of moles for cancerous changes.

None of the studies reported on knowledge of benefits of sun exposure.

#### **4.1.2 Quality Assessment**

The quality of the methodological reporting in the 12 included studies is shown briefly in Table 4.1 and in detail in the Appendices. The SR<sup>12</sup> was judged to be of poor quality [-]. Issues that affected its quality rating were a lack of clarity around the use of an 'a priori' research design, the use of duplicate study selection and data extraction, the characteristics of the included studies, and the incorporation of quality assessment ratings into any final conclusions. There was also a failure to provide a list of included and excluded studies, to use appropriate methods to combine study findings, to assess the likelihood of publication bias and to include a statement accounting for any conflicts of interest.

Of the seven RCTs included, four were judged as good quality [++], two were moderate quality [+] and one was judged to be low quality [-]. The RCTs met most of the assessment criteria, but there were a number of areas in which they were commonly weak. The concealment of the allocation process was not reported or unclear in five of the studies<sup>4, 9-11, 14</sup>, blinding was not clearly reported in four<sup>9-11, 13</sup> and five studies failed to report an assessment of whether the study was sufficiently powered<sup>8-11, 14</sup>. More generally the studies suffered from a lack of information that would permit judgement about the generalisability of the results, and few or no adjustments for potential confounding variables.

**Table 4.1: Characteristics of the systematic reviews and randomized controlled trials**

| Reference                             | Study design and quality | Country       | Objectives  | Population   | Sample size (number analysed)  |
|---------------------------------------|--------------------------|---------------|---|--|--|
| Reinau (2013)<br><sup>12</sup>        | SR<br><br>Low            | Multiple OECD | Assess sun-related knowledge, attitudes and behaviours and evaluate the effectiveness of sun-safety education.  | Adult outdoor workers.   | 7 RCTs, 30-194 participants  |
| Emmons (2011)<br><sup>14</sup>        | RCT<br><br>++            | USA           | Evaluation of prevention strategies in beach settings.  | Adult beach goers  | 593  |
| Geller (2006)<br><sup>117</sup>       | RCT<br><br>++            | USA           | To test whether an intervention could lead to improvements in siblings' (of recent melanoma patients) skin cancer risk reduction practices.   | Siblings of melanoma patients, within 1 month of diagnosis                                       | 494  |
| Isaacowitz (2005)<br><sup>118</sup>   | RCT<br><br>-             | USA           | To investigate how age related changes in attention to negative but relevant information about skin cancer risk reduction influenced both subsequent health behaviour and mood regulation.  | Adolescents and young adults (18 to 25 years) and older people (60 to 92 years)                  | 1st group: 78, 2nd group: 77   |
| Lemal (2010)<br><sup>8</sup>          | RCT<br><br>+             | Belgium       | To evaluate the effectiveness of narrative and non-narrative skin cancer message types in influencing actual positive health behaviour, comprising of both preventive health actions and information-seeking'.  | Flemish university students  | 230  |
| Manne (2010)<br><sup>10</sup>         | RCT<br><br>++            | USA           | (1) To evaluate the impact of generic print and telephone counseling (generic intervention) versus tailored print and telephone counseling interventions (tailored intervention) on engagement in total cutaneous examination by health provider (TCE), skin self-examination (SSE), and sun protection habits. | First degree relatives of patients with cutaneous melanoma, either parents, siblings or children | 443 (381 completed time 2 and 384 completed time 3)  |
| Rat (2014)<br><sup>13</sup>           | Cluster RCT<br><br>+     | France        | To assess the effect on patient prevention behaviours of a targeted intervention to reduce the risk and increase the early detection of melanoma  | General practitioners and general public   | 20 GPs; 97 patients in intervention group and 76 in control group found to be at elevated risk |
| Sancho-Garnier (2012)<br><sup>4</sup> | RCT<br><br>++            | France        | To determine the effectiveness of a preventive programme entitled "Living with the Sun" (LWS). LWS is a transverse and multidisciplinary sun safety education guide for teachers.   | Primary school children  | 70 classes; 1365 children  |

**Table 4.2: Characteristics of the included observational studies**

| Reference                                    | Study design and quality   | Country   | Objectives   | Population                                     | Sample size (Number analysed)  |
|--|--|-----------|--|--|--|
| <b>Comparative observational studies</b>     |  |           |  |  |  |
| Quereux (2009)<br>7                          | Non-randomized comparative open control study including a self-administered questionnaire.<br><br>+  | France    | To assess the impact of an educational programme on both children's knowledge and behaviour towards the sun  | Children aged between 8 and 11 years           | 13 schools; 1 class per school; 120 children in intervention and 162 in control groups |
| Woolley (2008)<br>15                         | Survey<br>Questionnaire and measurements of current sun damage.<br><br>-   | Australia | 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 | Outdoor workers                                | 69   |
| <b>Non-comparative observational studies</b> |  |           |  |  |  |
| Stover (2012)<br>5                           | Pre- to post-intervention questionnaires.<br><br>+   | Germany   | To evaluate the 'SunPass' project (an interventional lecture, site inspections and a certification)  | Children in kindergartens and their caregivers | 55 kindergartens; 424 children   |
| Gilaberte (2008)<br>6                        | A non-randomized, before/after, community intervention without control group, with schools as the unit of intervention and a questionnaire.<br><br>+ | Spain     | To evaluate SolSano's effects on students' knowledge, attitudes and practices about sun safety   | Elementary school children                     | 5845 children from 215 Aragonese Primary Schools                                       |



## 4.2 SUN PROTECTION POLICIES

One RCT <sup>4</sup> and four observational studies investigated sun protection policies. <sup>5-7, 119</sup> Study results are reported in brief here and in detail in the Appendices.

### Children

One good quality [++] RCT assessed the effects of a validated policy on knowledge of sun risk in French children aged 9 to 12 years randomized to “Living with the Sun at School” programmes in primary schools. The educational programme, involving practical classroom-based activities, brought about a significant increase in knowledge score immediately after completion that was statistically different from the control group <sup>4</sup>. The difference between groups diminished over the one year measurement period, but knowledge remained significantly higher at the final measurement in the intervention group compared with the control group <sup>4</sup>.

A moderate quality [+] observational questionnaire <sup>5</sup> was administered before and after a SunPass project conducted in 5424 children attending 55 kindergartens in Germany. The SunPass project involved an interventional lecture, site inspections and certification of nursery schools. Children were aged between 0 and 12 years (mean 3.8 years). At baseline, 36.5% of staff members did not know the four most important skin types and their individual risk for sunburns, while 40.5% knew about the UV index. Following the intervention, there was a reduction in the number of staff members questioned who did not know the four most important skin types and their individual risk for sunburns (21.3%;  $p < 0.001$ ) and an increase in knowledge about the UV index (83.8%;  $p < 0.001$ ) <sup>5</sup>.

A moderate quality [+], non-comparative questionnaire <sup>6</sup> was administered before and after SolSano (a sun safety programme) conducted in 1522 children with a mean age of 6.6 (SD not reported) from 215 Aragonese primary schools in Spain. The percentage of children who identified correctly the part of the day when the sun is more dangerous increased by 22.6% (95% CI 19.5 to 25.8) following the intervention <sup>6</sup>.

A moderate quality [+], comparative observational study <sup>7</sup> assessed the impact of an educational programme on the knowledge and behaviour of 282 children aged between 8 and 11 years from 13 schools. Children’s knowledge of the risks associated with the sun was assessed six months after paper-based information was shared with them during class. The intervention group scored significantly higher (mean: 7.66,  $n=120$ ) compared with the control group (mean: 6.77,  $n=162$ ,  $p < 0.00001$ ).

## Adults

A poor quality [-], comparative observational study <sup>15</sup> investigated whether mandatory sun protection for outdoor workers in Australia is associated with reduced sun damage by comparing 26 employees working under mandatory sun protection policy (mean age 42 years (SD ± 11); 89% male) with 21 employees working under a voluntary sun protection policy (mean age 44 years (SD ± 16); 100% male). There were no differences for most questionnaire items, however employees working under a voluntary sun-protection policy were less likely to state that UV radiation levels are highest between 10am to 2pm during winter days in the tropics (p=0.049).

### Evidence Statement 1.1

There is strong evidence from one good quality [++] RCT<sup>4</sup> conducted in France reporting that educational programmes involving practical classroom-based activities can increase knowledge about the risks of sun exposure in children aged 9 to 12 years. Three additional observational studies all reported improved knowledge about the risks of sun exposure in children<sup>5-7</sup>.

<sup>4</sup>Sancho-Garnier et al. (2012) [++]

<sup>5</sup>Stover et al. 2012 [+]

<sup>6</sup>Gilaberte et al. (2008) [+]

<sup>7</sup>Quereux et al. (2009) [+]

## 4.3 EDUCATIONAL INTERVENTIONS

### 4.3.1 Electronic Interventions

Two RCTs assessed electronic educational interventions delivered by websites or video <sup>8,9</sup>. These two trials are described briefly here and in detail in the Appendices.

One moderate quality [+] trial of Belgian University students <sup>8</sup> randomized participants to three different web links, a control page (the assessment questionnaire), a narrative skin cancer message (a first person account of dealing with skin cancer) and a non-narrative (information-style) message. The main aim was to assess the impact of the style of skin cancer message on self-reported health promotion activities undertaken one month since message exposure. The activities, which were assessed using a binary scale, included checking the skin for strange moles, looking for additional information about skin cancer, paying more attention to information, and talking to family members, friends or a physician about skin cancer. Exposure to the narrative condition about skin cancer risk significantly increased self-reports of preventive behaviours (2-4 fold) compared with the control condition (no message), although there was some (non-significant) increase also in the non-narrative condition. The impact of the non-narrative condition only differed from that of the control group for searching for more information about skin cancer <sup>8</sup>.

A poor quality trial [-] undertaken in the USA asked participants <sup>9</sup> who were split into young and older age groups (18 to 25 years and 60 to 92 years), to view two videos (one on melanoma and one on how to reduce skin cancer risk by self-examination), but under three different viewing instructional conditions (naturally, as at home, or with an emotion-focus, or with an information-gathering focus). This study was of poor quality, but does potentially suggest that messages about melanoma recognition may need to be differently tailored for older and younger age groups. Knowledge of skin cancer and ability to detect a melanoma were subsequently measured via a 20-item questionnaire, use of the 'Brief Skin Cancer Risk Assessment Tool' (BRAT) and with concern ratings of 22 mole images using a 6-point scale. In all individuals the knowledge score was higher post video viewing than before (mean score post 17.2 vs. pre 11.3,  $p < 0.001$ ). The significant time x age interaction indicated that the older adults had significantly higher levels of knowledge before the intervention and had a smaller post-intervention knowledge score increase than the younger participants. The viewing instruction mode did not influence change in knowledge score. With the mole image ratings, the older adults rated all the moles (regardless of type) of higher concern than the younger adults ( $p = 0.04$ ). A significant Mole Type x Age interaction indicated that younger and older adults did not differ in their concerns about melanoma moles, but older adults were more concerned about normal moles than were younger adults ( $p = 0.005$ ). Thus, younger adults were better able to distinguish harmful moles from normal moles, showing high concerns for only melanoma moles, whereas older adults showed higher concern for moles, regardless of type. There were no effects or interactions with instruction group. <sup>9</sup>

#### **Evidence Statement 1.2**

There is weak, inconsistent evidence from two RCTs<sup>8,9</sup> that electronic educational interventions may be effective in changing people's knowledge or understanding of how to competently assess their level of risk or benefit from sun exposure. One moderate quality [+] RCT <sup>8</sup> conducted in Belgium university students reported that web-based messages may be more conducive to knowledge change about the risks and benefits of sun exposure if presented in a narrative format while one poor quality [-] RCT<sup>9</sup> conducted in American adults suggested that video content about melanoma recognition may need to be tailored for older (60-92 year old) and younger (18-25 year old) adult age groups. No further details were reported.

<sup>8</sup>Lemal et al (2010) [+]

<sup>9</sup>Isaccowitz et al. (2012) [-]

### 4.3.2 Tailored Interventions

Two RCTs both of good quality assessed the influence of tailored interventions on knowledge or understanding of sun risk in individuals at high risk<sup>10,11</sup>. Study results are reported briefly here and in detail in the Appendices.

A good quality trial [++] conducted in the US compared generic with tailored interventions in adult relatives of melanoma patients<sup>10</sup>. Both interventions provided educational communication designed to increase sun protection behaviours, particularly total cutaneous examination by a health professional and skin self-examination; the tailored intervention was more intensive and personal (linked to previous survey answers). The tailored intervention increased the probability of having a total cutaneous examination by a health professional almost two-fold (OR 1.94 (95%CI: 1.39 to 2.72) p<0.001). There were no significant differences between groups for skin self-examination<sup>10</sup>.

A second good quality trial [++], also conducted in the US, investigated whether an intervention could lead to improvements in siblings' (of recent melanoma patients) skin cancer risk reduction practices<sup>11</sup>. Personalized counselling and web-based education was compared with usual care, in which families received the suggestion from the physician that patients diagnosed with melanoma notify their family members about their diagnosis and encourage the family members to be screened. By the 6-month follow-up, intervention participants had significantly greater improvements in knowledge regarding location and appearance of melanoma when compared with those in usual care, controlling for skin type and intention to see a dermatologist. However, there were no differences in awareness that moles are risk factors for melanoma<sup>11</sup>.

#### Evidence Statement 1.3

There is strong, consistent evidence from two good quality [++] RCTs<sup>10,11</sup> both conducted in the US that tailored educational interventions are effective in changing people's knowledge or understanding of how to competently assess their level of risk or benefit from sun exposure.

One good quality RCT [++]<sup>10</sup> in adult relatives of melanoma patients reported that at six months an educational tailored intervention increased the probability of having a total cutaneous examination by a health professional almost two-fold (OR 1.94 (95%CI: 1.39 to 2.72) p<0.001). There were no significant differences between groups for skin self-examination the probability of having a skin examination from a health professional. The second good quality[++] RCT<sup>11</sup> in siblings of recent melanoma patients reported that personalized counselling and web-based education showed improvements in knowledge regarding location and appearance of melanoma. No further details reported

<sup>10</sup>Manne et al. (2010) [++]

<sup>11</sup>Geller et al. (2006) [++]

#### 4.4 MULTI-COMPONENT INTERVENTIONS

One SR <sup>12</sup> and two RCTs <sup>13,14</sup> compared the effects of interventions with multiple components on knowledge and understanding of skin cancer risk. Study results are reported briefly here and in detail in the Appendices.

The poor quality [-] SR <sup>12</sup> of studies of outdoor workers reported that in four of the seven interventional studies (which utilised educational lectures, brochures, posters, logos, skin examination, protective clothing and UV photos); statistically significant improvements in knowledge of sun-related knowledge had occurred. Within the statistically significant studies, the extent of difference between intervention and comparator groups varied from 4 to 29%, but no statistical synthesis was undertaken or estimates of variance provided to permit judgement concerning the overall extent of intervention impact on outdoor workers. One included study of US male road workers assessed the impact of a UV photo of their face with either a photoaging or skin cancer educational video. Regardless of intervention group, all who viewed the educational videos had improved knowledge scores relative to the control group, with no differences found according to the nature of the video. One trial of predominantly male electrical workers that included multiple educational approaches with skin examination reported a 4% increase in knowledge. Two trials of mixed gender young outdoor workers (lifeguards and outdoor recreation staff) failed to improve knowledge of sun safety through the combined use of educational lectures, information brochures, and posters. One trial of predominantly male, older farmers in the USA also reported no beneficial knowledge increase resulting from information brochures and provision of sun protection gear.

Conversely, one trial of Turkish farmers reported a large increase in knowledge of sun safety resulting from an educational lecture, information brochures and provision of sun protection gear. Overall, limited synthesis of knowledge-based outcomes was included in the SR and detailed reporting of the knowledge aspects assessed was not provided <sup>12</sup>.

One good quality RCT [++] <sup>13</sup> conducted in France compared a targeted screening and educational intervention (personal total skin examination, GP counselling plus the information leaflet detailing primary and secondary prevention measures) with a conventional public health campaign (posters plus leaflet information on risk factors) in primary care adults considered at elevated risk of skin cancer. Intervention participants had significantly higher overall knowledge scores around correct identification of melanoma risk factors (high mole count, having freckles, being phototype 1 or 2, childhood sunburn, residence in high UV country and family history of melanoma), assessed 5 months after intervention, than controls.

One good quality trial [++] (14) in mixed gender US beach goers (and therefore at elevated risk of skin cancer) compared several interventions with increasing number of components: a combined intervention of education, biometric feedback, and dermatologist skin examinations was compared to three control interventions (skin cancer prevention education, education plus biometric feedback, and education plus dermatologist skin examinations). In the biometric feedback + education group, information was provided on the participants' personal skin damage caused by UV exposure using a Dermascan analyzer and UV reflectance photography of their face and head. The greatest increases in sun risk knowledge (knowing what to look for when examining moles) were in the biometric feedback intervention group, followed by the feedback plus dermatologist skin examination intervention; the education only intervention had the least amount of improvement in knowledge about skin self-examination.

#### **Evidence Statement 1.4**

There is moderate evidence from one poor quality [-] systematic review<sup>12</sup> and two good quality [++] RCTs<sup>13, 14</sup> that multi-component interventions are effective in changing people's knowledge or understanding of how to competently assess their level of risk or benefit from sun exposure.

While it appears that multi-component interventions are effective in changing people's knowledge or understanding about how to competently assess their risk or benefit from sun exposure it was not possible to determine which specific features of the interventions were the most effective because the included studies used different combinations of interventions in widely varying population groups at varying extent of risk from sun exposure.

<sup>12</sup>Reinau et al. (2013) [-]

<sup>13</sup>Rat et al. (2014) [++]

<sup>14</sup>Emmons et al. (2011) [++]

# **Section 5: Changes in Individuals' Perception of or Attitudes to the Risks and Benefits of Sun Exposure**

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## **5.1 OVERVIEW OF INCLUDED STUDIES**

### **5.1.1 Characteristics of Included Studies**

Sixty studies met the inclusion criteria for research question 1b, outcome two: 44 randomized controlled trials (RCTs), five systematic reviews (SRs) and 11 observational studies. The majority of studies were concerned with measuring attitudes to the risks and benefits of sun exposure and intentions to use sun protection in the general population; fewer studies were targeted at members of at-risk groups, such as people at increased risk of skin cancer. A total of 40 included studies (36 RCTs and four SRs) reported attitude-related outcomes and a total of 24 included studies (22 RCTs and two SRs) reported perception-related outcomes; 15 of these studies (14 RCTs and one SR) reported both types of outcomes. Summary characteristics of the studies are presented separately for studies reporting perception- and attitude-related outcomes in the corresponding sub-sections (Table 5.1 to

Table 5.2).

Twenty-one of the 49 studies targeted individuals considered to belong to at-risk groups (20 RCTs and one SR), either as the main focus of the study or as a sub-group of participants within the study: (a) outdoor workers and people whose lifestyles or leisure pursuits can cause excessive UV exposure, (b) people with a family history of skin cancer, (c) older people (age 65 years and older), and (d) people with multiple risk factors. Although some studies included individuals from at-risk ethnic minority groups, no studies were identified that explicitly targeted people who are non-English speaking or whose first language is not English, people from different religious or cultural backgrounds, people with dark skin, or people who have low or no exposure to the sun. In addition, there were no studies identified that focused on people at increased risk of vitamin D deficiency, people with different levels of education attainment (although many studies recruited from educational establishments) or people with learning disabilities.

- Fifteen studies assessed changes in both individuals' perceptions of and their attitudes to the risks and benefits of sun exposure. These comprised one low quality SR<sup>16</sup>, four moderate quality [+] RCTs<sup>18-20, 31</sup> and ten poor quality [-] RCTs<sup>17, 22, 24, 26-28, 33-35, 39</sup>.
- Thirteen studies assessed only changes in individual's perceptions of the risks and benefits of sun exposure. These comprised one moderate quality [+] SR<sup>37</sup>, eight RCTs and four observational studies. Of the RCTs, one was good quality [++]<sup>14</sup>, three were moderate quality [+]<sup>21, 32, 38</sup> and the remaining four were poor quality [-]<sup>23, 25, 36, 40</sup>.
- Thirty-two studies assessed only changes in individuals' attitudes towards the risks and benefits of sun exposure: three SRs, 22 RCTs and seven observational studies. There was one moderate quality SR<sup>53</sup> and two low quality SRs<sup>12, 44</sup>. Of the 22 RCTs, three were good quality [++]<sup>4, 11, 61</sup>, seven were moderate quality [+]<sup>13, 47, 51, 55, 57, 62, 67</sup> and the remaining 12 RCTs were poor quality [-]<sup>9, 45, 46, 48-50, 52, 54, 56, 58, 63, 66</sup>. There were also seven observational studies.

### 5.1.2 Quality Assessment

Of the five SRs, two were assessed as being of moderate quality<sup>37, 53</sup>, having adequately reported five to seven AMSTAR criteria. The remaining three SRs were assessed as low quality, as only four or fewer of the AMSTAR criteria were adequately reported. Issues that affected the quality of the included reviews were inadequate reporting of the review methods, in particular the study selection and data extraction stages, poor reporting of the characteristics of the included studies, the lack of an assessment of publication bias, and the failure to draw conclusions in light of the quality of the studies included in the review.

Four of the RCTs were assessed as being of good [++] quality (7, 11, 14, 51), 14 were assessed as being of moderate [+] quality<sup>13, 18-21, 31, 32, 38, 47, 51, 55, 57, 62, 67</sup>, and the remainder were assessed as being of poor [-] quality. Issues that affected the validity of the included RCTs included inadequate reporting of research methods, in particular with regard to method



of randomization, allocation concealment, blinding and use of intention-to-treat analysis, and comparability of the treatment groups in terms of baseline characteristics and dropouts from the study.

The summary quality assessment is presented in Table 5.1 and

Table 5.2, and further details are provided in the Appendices.

## **5.2 PERCEPTION OF THE RISKS AND BENEFITS OF SUN EXPOSURE**

### **5.2.1 Characteristics of Included Studies**

Twenty-four studies in total assessed changes in individual's perceptions of the risks and benefits of sun exposure: two SRs and 22 RCTs. Given the variation between studies in terms of the populations included, the potential for overlap exists and so the studies have been loosely grouped in the absence of more specific risk factors. There were seven studies (five RCTs and two SRs) of mixed populations (e.g. general public, patients, mothers, adults aged  $\geq 16$  years, senior school/university students), four RCTs of children of school age (ranging from  $\geq 6$  years to high school), six RCTs of university/college students, and seven RCTs of at-risk groups. Specifically, individuals considered at risk were outdoor workers and people whose lifestyles or leisure pursuits can cause excessive UV exposure (five RCTs) and people with multiple risk factors (two RCTs), such as a family history of skin cancer and behavioural risks (e.g. sunbathing, indoor tanning and low sunscreen use). Characteristics of the included studies are presented in Table 5.1.

Forty studies in total assessed changes in individual's attitudes to the risks and benefits of sun exposure: four SRs and 36 RCTs. Given the complexity and often multi-component nature of the interventions, the potential for overlap exists. Hence, the studies have been loosely grouped based on the approach adopted: motivational interventions and educational interventions. There were 21 studies (two SRs and 19 RCTs) of motivational interventions and 19 studies (two SRs and 17 RCTs) of educational interventions. Of the 40 studies in total, 18 studies (one SR and 17 RCTs) contained individuals considered to represent at-risk groups, such as people who work outdoors or who have lifestyles or leisure pursuits associated with excessive UV exposure, elderly people, people with a family history of skin cancer, and people with multiple risk factors such as family and behavioural risks (e.g. sunbathing, indoor tanning and low sunscreen use). Characteristics of the included studies are presented in Table 5.1 and

Table 5.2.

**Table 5.1: Characteristics of the included systematic reviews and randomized controlled trials**

| Reference                        | Study design and quality | Country  | Objectives  | Population                       | Sample size (Number analysed)   |
|----------------------------------|--------------------------|--|---|----------------------------------|---------------------------------|
| Eagle (2009)<br><sup>37</sup>    | SR<br>moderate           | Australia, Canada, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden, UK, and the USA.       | To assess the effective and cost-effective ways of providing information on skin cancer prevention to change people's knowledge, awareness and behaviour.<br><br>To investigate what content effective and cost-effective primary prevention messages contain and what is the most effective and cost-effective content.  | Children and adults              | 84 studies                      |
| Williams (2013)<br><sup>43</sup> | SR<br>low                | NR   | To assess the effectiveness of appearance-based interventions to reduce UV exposure and/or increase sun protection intentions and behaviours.   | Teenagers and adults             | 21 studies<br>6344 participants |
| O'Keefe (2012)<br><sup>44</sup>  | SR<br>low                | NR   | To provide a meta-analytic review of the accumulated research concerning the relative persuasiveness of gain-framed and loss-framed messages for encouraging skin cancer preventive behaviours.<br><br>To explore the possible moderating roles of three variables: the advocated action, the basis of the persuasive appeal (i.e. the outcome), and the sex of message recipients. | Young adults predominantly       | 33 studies<br>4168 participants |
| Italia (2012)<br><sup>120</sup>  | SR<br>moderate           | Australia, New Zealand, the UK, Sweden, Germany, Italy, Switzerland, Finland, the USA, Canada and Columbia | To conduct a systematic review of the effectiveness of the UV Index as a health promotion instrument.   | Children in childcare and adults | 219                             |
| Reinau (2013)<br><sup>12</sup>   | SR<br>low                | North America, Europe, Australia/New Zealand, Israel, Brazil and Japan                                     | To present an overview of outdoor workers' sun-related knowledge, attitudes and protective behaviours.<br><br>To evaluate the effectiveness of sun-safety education programmes in outdoor occupational settings.  | Outdoor workers                  | 50 studies                      |

| Reference              | Study design and quality | Country | Objectives   | Population                                       | Sample size (Number analysed) |
|------------------------|--------------------------|---------|--|--|-------------------------------|
| Aarestrup (2014)<br>58 | Cluster RCT<br>-         | Denmark | To investigate whether an educational intervention targeting pupils aged 14-18 years at continuation schools in Denmark affected their sunbed use and intentions and attitudes toward sunbed use.  | Secondary school pupils (aged 15-17)             | 2351                          |
| Adams (2009)<br>40     | RCT<br>-                 | USA     | To examine the mediating effects of a special case of the decisional balance construct where the pros of competing behaviours (i.e. sun protection versus exposure) were measured rather than the pros and cons of the same behaviour.   | Adolescents (aged 10-16)                         | 819                           |
| Chait (2011)<br>51     | RCT<br>+                 | USA     | To determine if a dissonance induction intervention might be successful in changing UV-related behaviours.   | Female university undergraduates                 | 260                           |
| Cooper (2014)<br>48    | RCT<br>-                 | USA     | To examine whether messages manipulating the efficacy of a health behaviour moderate health outcomes when participants are presented with a fear appeal that makes death thought conscious.  | Beachgoers (mean age 24.5)                       | 147                           |
| Cox (2009)<br>121      | RCT<br>-                 | USA     | To examine tanning outcomes as a function of priming tanning-relevant standards for attractiveness after reminders of death.   | Female beachgoers (mean age 22.98)               | 53                            |
| Crane (2012)<br>38     | RCT<br>+                 | USA     | To test the effectiveness of a partially tailored mailed intervention based on the Precaution Adoption Process Model, delivered in the spring over 3 years to parents and children.  | Children aged 6                                  | 867 (677)                     |
| Dykstra (2008)<br>28   | RCT<br>-                 | USA     | To explore whether the induction of cognitive dissonance and reactance would (differentially) impact the effectiveness of a persuasive message in determining attitude change as a result of a UV intervention.  | Mothers of elementary and middle school children | 151                           |
| Emmons (2011)<br>14    | RCT<br>++                | USA     | To evaluate four strategies for addressing skin cancer prevention in beach settings.   | Beachgoers (median age 49)                       | 593                           |
| Falk (2011)<br>39      | RCT<br>-                 | Sweden  | To investigate, in primary health care, differentiated levels of prevention directed at skin cancer, and how the propensity of the patients to change sun habits/sun protection behaviour and attitudes towards sunbathing were affected, three years after intervention. To evaluate the impact of the performance of a phototest as a complementary tool for prevention. | Adults   | 316                           |

| Reference                      | Study design and quality | Country   | Objectives   | Population  | Sample size (Number analysed) |
|--------------------------------|--------------------------|-----------|--|---|-------------------------------|
| Geller 2006 <sup>11</sup>      | RCT<br>++                | USA       | To test whether an intervention could lead to improvements in siblings' (of recent melanoma patients) skin cancer risk reduction practices.  | Adult siblings of recently diagnosed melanoma patients. | 494                           |
| Gold (2011) <sup>54</sup>      | RCT<br>-                 | Australia | To evaluate the effectiveness of messages related to safer sex and sun safety.<br>To pilot the use of mobile advertising for health promotion.   | Teenagers and young adults (16-29 years old)            | 7606                          |
| Good (2011) <sup>18</sup>      | RCT<br>+                 | UK        | To compare the effects of self-efficacy, self-affirmation and a combination of these techniques for two risk messages.   | Female students (16-23 years)                           | 677                           |
| Heckman (2013) <sup>66</sup>   | RCT<br>-                 | USA       | To compare the efficacy of a UV-photo intervention alone, motivational interviewing (MI) counselling alone, education alone, and a combination of UV-photo and MI counselling in increasing sun protection stage of change (SOC) among young adults.<br>To examine whether treatment process variables (i.e. therapeutic alliance; treatment credibility; MI spirit, adherence, and competence; as well as MI skills including giving information, asking questions, and reflecting statements) contributed to sun protection SOC. | University undergraduates (aged 18-24)                  | 197                           |
| Hevey (2008) <sup>45</sup>     | RCT<br>-                 | Ireland   | To investigate the impact of messages differing in focus (health vs appearance) and frame (gain vs loss) on intentions for sunscreen use and sunbed use, and the potential moderating role of body consciousness.  | Teenagers and adults (aged 16-26)                       | 390                           |
| Hiemstra (2012) <sup>57</sup>  | RCT<br>+                 | USA       | To examine changes in: (1) sunburn frequency over a summer while controlling for sun exposure, sun protection habits, and participation in a skin cancer prevention programme; and (2) tanning attitudes while controlling for participation in the prevention programme.  | Lifeguards  | 3014                          |
| Hillhouse (2008) <sup>61</sup> | RCT<br>++                | USA       | To evaluate a brief appearance-focused intervention based on a theoretical model with mediational analyses designed to assess whether observed programme effects are a result of changes in targeted individual level variables.   | Female university students                              | 430                           |

| Reference                         | Study design and quality | Country         | Objectives   | Population                                      | Sample size (Number analysed) |
|-----------------------------------|--------------------------|-----------------|--|---|-------------------------------|
| Hoffner (2009)<br><sup>34</sup>   | RCT<br>-                 | USA             | To assess whether personal risk of skin cancer will be higher for the loss frame than for the gain frame, which in turn will be higher than for the control article; to determine how the gain and loss frames differ from the control group on (a) intended sunscreen use and (b) planned SPF; to determine how social comparison orientation will be related to (a) personal risk, (b) intention to use sunscreen, and (c) planned SPF following message exposure; to assess whether social comparison orientation interacts with framing to affect the three dependent variables. | Young adults (18-29 years)                      | 191                           |
| Hwang (2012)<br><sup>32</sup>     | RCT<br>+                 | USA             | To assess the effects of gain- and loss-framed messages on the sun safety behaviour of adolescents through the moderation of risk perceptions.   | High school students                            | 219                           |
| Isaacowitz (2012)<br><sup>9</sup> | RCT<br>-                 | USA             | To investigate how age- related changes in attention to negative but relevant information about skin cancer risk reduction influenced both subsequent health behaviour and mood regulation.  | Adults (group 1 aged 18-25, group 2 aged 60-92) | 155                           |
| Janssen (2013)<br><sup>36</sup>   | RCT<br>-                 | The Netherlands | To compare the effects of narrative and non-narrative risk communication about sunbed use on ease of imagination and feelings of cancer risk.  | Adult female sunbed users                       | 233                           |
| Jessop (2009)<br><sup>35</sup>    | RCT<br>-                 | UK              | To compare the efficacy of three self-affirmation manipulations in reducing defensive processing and instigating behaviour change in response to personally relevant information about the health risks of sunbathing.   | Adult female sunbathers                         | 169 (163)                     |
| Mahler (2008)<br><sup>26</sup>    | RCT<br>-                 | USA             | To examine whether the efficacy of an appearance-based sun protection intervention could be enhanced by the addition of social norms information.  | University undergraduates                       | 125                           |
| Mahler (2010)<br><sup>122</sup>   | RCT<br>+                 | USA             | To examine the impact of adding upward and/or downward social comparison information on the efficacy of an appearance-based sun protection intervention (UV photos and photoaging information).  | College undergraduates                          | 126                           |
| Mahler (2013)<br><sup>27</sup>    | RCT<br>-                 | USA             | To compare the sun protection practices of college students from two universities located in climatologically different regions of the USA. To explore whether there are regional differences in the efficacy of two validated appearance-based sun protection interventions: UV photography and information about photoaging  | College undergraduates                          | 442                           |
| Midboe (2011)<br><sup>52</sup>    | RCT<br>-                 | USA             | To examine interpersonal factors, specifically social support, in the relationship between worry and health decision-making.   | Young women (aged 18-24)                        | 59                            |

| Reference                  | Study design and quality | Country   | Objectives  | Population                          | Sample size (Number analysed) |
|----------------------------|--------------------------|-----------|---|-------------------------------------|-------------------------------|
| Moser (2012)<br>25         | RCT<br>-                 | USA       | To compare the effects of intervention content eliciting strong emotional responses to visual images showing photoaging and skin cancer, specifically fear and disgust, coupled with a message of self-efficacy and benefits of sun protection with an intervention that did not contain an emotional arousal component. These were compared to a control condition that contained an emotional arousal component that elicited emotion unrelated to the threat of skin cancer or photoaging. | Female undergraduates               | 352                           |
| Nan (2011)<br>33           | RCT<br>-                 | USA       | To assess potential interactive effects of incidental affect (positive vs negative) and message framing (gain vs loss) on persuasion in the context of promoting sun protection behaviours.   | Undergraduates                      | 152                           |
| Notebaert (2014)<br>49     | RCT<br>-                 | Australia | To investigate whether inducing a negative rather than a positive interpretation bias for physical threat information can enhance worry elicited when viewing a health campaign video warning against melanoma skin cancer, and consequently lead to more adaptive behaviour (sun protection).  | Undergraduates                      | 40                            |
| Orbell (2008)<br>62        | RCT<br>+                 | UK        | To investigate the interaction of Consideration for Future Consequences Scale (CRC) and temporal framing of messages (positive/negative at different times) on intentions and attitudes towards sunscreen use.  | University students and staff       | 121                           |
| Prentice-Dunn (2009)<br>47 | RCT<br>+                 | USA       | To examine the usefulness of the stage of change model and protection motivation theory (PMT) in creating brief persuasive appeals to promote healthy sun-behaviour.<br>To target perceptions of vulnerability to sunburn and its effects with a brief intervention based on PMT in order to assess its impact on individuals in two preaction stages of change.  | Female undergraduates               | 254                           |
| Rat (2014)<br>13           | Cluster RCT<br>+         | France    | To assess the effect on patient prevention behaviours of a targeted intervention to reduce the risk and increase the early detection of melanoma.   | People at elevated risk of melanoma | 173                           |
| Reid (2011) <sup>56</sup>  | RCT<br>-                 | USA       | To examine whether the influence of injunctive norms on changes in health behaviours is mediated by changes in attitudes.<br>To examine the role of identification with the social group as a moderator of the relationship of injunctive norms to intentions and behaviour.  | Adult women (aged 36 to 79)         | 316                           |
| Reid (2013)<br>55          | RCT<br>+                 | USA       | To examine the utility of correcting misperceptions of injunctive norms for improving sun protection and whether changes in attitudes mediated the injunctive norm-intention relationship.  | Adult women (aged 36 to 77)         | 189                           |



| Reference                          | Study design and quality | Country | Objectives   | Population                               | Sample size (Number analysed) |
|------------------------------------|--------------------------|---------|--|--|-------------------------------|
| Reynolds (2008) <sup>63</sup>      | RCT<br>-                 | USA     | To assess the effectiveness of an intervention that included tailored and non-tailored print communications delivered by mail to adolescents (age 11 to 15) and their parents who were also participating in an evaluation of an in-school intervention. Communications promoted sun protection use and sun avoidance, and fostered family communication and environmental change strategies.  | High school students (aged 11 to 15)     | 599                           |
| Roberts (2009) <sup>67</sup>       | RCT<br>+                 | USA     | To evaluate the efficacy of two interventions to reduce UV exposure in college students prior to an opportunity for high-intensity exposure: a community-based informational campaign with or without a cognitive-behavioural small group intervention.  | Undergraduates                           | 61                            |
| Roberts (2011) <sup>17</sup>       | RCT<br>-                 | USA     | To examine comparative optimism for skin cancer (the belief that one is at lower risk for skin cancer than one's peers) among adolescents in two age groups: 11- and 12-year-olds versus 13- and 14-year-olds. Specifically, the authors tested whether optimism was enhanced when adolescents at lower relative risk (i.e., non-tanners) were exposed to higher-risk comparison targets (photos of tanned models) and whether this effect was moderated by age. | Adolescents (aged 11 to 14)              | 211                           |
| Sancho-Garnier (2012) <sup>4</sup> | Cluster RCT<br>++        | France  | To determine the effectiveness of a preventive programme entitled "Living with the Sun", a transverse and multidisciplinary sun safety education guide for teachers.   | School children (aged 9-12)              | 1365                          |
| Schuz&Eid (2013) <sup>22</sup>     | RCT<br>-                 | Germany | To evaluate the effectiveness of an intervention on adolescent sun protection intentions and behaviour.  | High school students aged 13 to 19 years | 253                           |
| Schuz (2013) <sup>21</sup>         | RCT<br>+                 | Germany | To assess whether a self-affirmation manipulation can mitigate defensive responses to personalized visual risk feedback in the skin cancer prevention context (UV photography), and whether the effects pertain to individuals with high behavioural risk status (high personal relevance of tanning).   | People visiting a public science event.  | 266                           |
| Siegel (2010) <sup>23</sup>        | RCT<br>-                 | USA     | To assess the effectiveness of UV-filtered photography on knowledge of skin cancer, sun protective behaviours, perceptions of acquiring skin cancer, and health promotion in skin cancer prevention in freshman student nurses   | First year student nurses                | 90                            |

| Reference                      | Study design and quality | Country | Objectives  | Population                                 | Sample size (Number analysed) |
|--------------------------------|--------------------------|---------|---|--|-------------------------------|
| Stock (2009)<br><sup>20</sup>  | RCT<br>+                 | USA     | To examine the effectiveness of UV photography and both photoaging and skin cancer information in a sample of high-risk, male outdoor workers over a 1-year period.<br>To examine potential mediators of changes in their protective behaviour.<br>To examine which component of the intervention would be more effective with this population. | Male outdoor workers                       | 162 (148)                     |
| Stoner (2009)<br><sup>46</sup> | RCT<br>-                 | USA     | To investigate variables that affect compliance with framed messages which promote behaviours that aid in the prevention or detection of skin cancer.   | Women (aged 60 and older or aged 18 to 30) | 136                           |
| Thomas (2011)<br><sup>31</sup> | RCT<br>+                 | Ireland | To ascertain whether the health message 'framing effect' occurs for messages concerning the consequences of skin cancer for one's appearance or one's health. Specifically, the effect of the frame and focus of health messages on intentions to perform skin protection behaviours and the perceived threat of skin cancer was investigated.  | Adults (aged 16-26)                        | 390                           |
| Walsh (2012)<br><sup>24</sup>  | RCT<br>-                 | USA     | To examine the impact of an ultraviolet (UV) photography intervention and masculinity on college men's sun protection cognitions, including: perceived vulnerability to skin damage, attitudes toward sun protection, willingness to engage in sun protection behaviours, and intentions to receive a skin cancer exam.                         | Male undergraduates                        | 179                           |

**Table 5.2: Characteristics of the included observational studies**

| Reference                     | Study design and quality                                    | Study objectives   | Population   | Sample size (number analysed)  |
|-------------------------------|---|--|--|--|
| <b>Comparative studies</b>    |   |  |  |  |
| Harrison (2013) <sup>64</sup> | Pre- post-intervention using a survey<br>+                  | To assess the effectiveness of a maternity hospital-based education programme (midwife teaching intervention) to discourage mothers from exposing themselves and their infants to sunlight for therapeutic reasons in an intense ultraviolet radiation environment | Healthy post-partum women in the maternity ward of a large regional public hospital. | 106 (Pre-intervention) and 203 (post-intervention)                     |
| Williams (2013) <sup>43</sup> | Non-randomized comparative study at a university<br>+       | To investigate the impact of a facial-ageing intervention on women's sun protection attitudes and behavioural intentions, compared to a health literature intervention where participants viewed literature on the effect of ultraviolet (UV) exposure on health   | Female undergraduates  | 70 (70)  |
| White (2010) <sup>42</sup>    | Non-randomized comparative study using a questionnaire<br>- | To provide a preliminary test of a theory of planned behaviour (TPB) belief-based intervention to increase adolescents' sun-protective behaviours in a high risk area, Queensland, Australia.  | Secondary school pupils  | 80 (54)  |
| Woolley (2008) <sup>15</sup>  | Survey<br>-   | To investigate whether mandatory sun protection for outdoor workers in tropical regions (North Queensland) is associated with reduced sun damage.  | Outdoor workers  | 69 (47)  |
| Mallett (2012) <sup>123</sup> | Non-randomized comparative survey in secondary care<br>-    | To evaluate the effects of the ABC intervention on patient outcomes to determine if this technique is associated with improvement in patient satisfaction and immediate intentions to enhance their sun-protective behaviours.                                     | Adults receiving a skin examination  | 60 patients recruited from 2 research sites (30 per site), 60 analysed |
| Potente (2011) <sup>41</sup>  | Community online survey<br>+                                | To determine whether entertainment-education strategies could be combined in a creative communication campaign to improve sun protection behaviours  | Teenagers and young adults (aged 14-24)  | 8250 (1588)  |

| Reference                      | Study design and quality   | Study objectives   | Population  | Sample size (number analysed)   |
|--------------------------------|--|--|---|---|
| <b>Non-comparative studies</b> |  |  |   |   |
| Stover (2012) <sup>5</sup>     | Pre- to post-intervention using questionnaires<br><br>+  | To evaluate the 'SunPass' project (an interventional lecture, site inspections and a certification).   | Children in kindergartens and their caregivers            | 55 kindergartens; 5424 children recruited.<br><br>2286 parents and 448 kindergarten workers completed pre questionnaire. 1101 parents and 330 kindergarten workers completed post- questionnaire. |
| Gilaberte (2008) <sup>6</sup>  | Non-randomized, before/after, community intervention without control group, with schools as the unit of intervention using a 'draw and write' research strategy<br><br>+ | To evaluate SolSano's effects on students' knowledge, attitudes and practices about sun safety   | Elementary school children                                | 5845 children from 215 schools (1522)   |
| Devine (2008) <sup>65</sup>    | Pre- to post-intervention using questionnaires<br><br>+  | To describe the development, implementation and evaluation of an educational intervention to address risky beliefs held by midwives and nurses working in maternity areas and new mothers about therapeutic sun exposure<br>To evaluate whether the intervention would increase midwives' and nurses' knowledge and confidence in talking to mothers about sunlight exposure | Midwives and nurses (hospital)                            | 39 post-intervention, 42 at follow-up   |
| Dobbins (2008) <sup>59</sup>   | Cross-sectional telephone interviews<br><br>+  | To examine trends over time in sun-protective behaviours of residents of Melbourne, Australia, and the effect of SunSmart-paid television media on skin cancer prevention attitudes and behaviours in the context of a long-term health promotion programme.   | One person per household was interviewed, (aged 14 to 69) | 11,589  |
| Lee (2013) <sup>60</sup>       | Pre- and post-survey<br><br>+  | To evaluate changes in beliefs and attitudes toward sun protection behaviours before and after implementation of the evidence-based "Sun Solutions" educational module among operating engineers.  | Outdoor workers   | 232   |

### **5.2.2 Quality Assessment**

The overall quality of methodological reporting in the 28 included studies (two SRs, 22 RCTs and four observational studies) is provided in Table 5.1 and

Table 5.2. Detailed quality assessment is provided in Appendix D.

### 5.2.2.1 Systematic reviews

Of the two included SRs, one fulfilled seven of the AMSTAR criteria and was considered moderate quality [+]<sup>37</sup>, while the other fulfilled only four criteria and was considered low quality [-]. Poor methodology (as reported) was an issue for both reviews, and one review showed a lack of clarity with at least two criteria reported as unclear<sup>16</sup>.

Both reviews adequately reported characteristics of primary studies and used appropriate methods to combine the findings of the primary studies. Only one review used an a priori design; reported the involvement of two independent reviewers in both the study selection and data extraction processes; listed included and excluded studies; assessed the quality of the included primary studies; and assessed of publication bias. Neither review reported adequate searches nor disclosed conflicts of interest.

### 5.2.2.2 Randomized controlled trials

The quality of the 22 included RCTs ranged from good [++] to poor [-]. Only one RCT was considered to be good quality [++] for the overall quality assessment; the majority of trials (13) were graded [-]. The main quality assessment criteria (randomisation, allocation concealment, blinding and use of intention-to-treat analysis) were not well reported across the included trials. The comparability of intervention and control groups in terms of baseline characteristics and dropout from the study were also poorly reported.

Specifically, fewer than half (six) of the included trials used appropriate randomisation methods; only two trials reported allocation concealment methods; blinding of the investigators, participants and outcome assessors was poorly reported; fewer than half (six) of the included trials reported similar baseline characteristics between the intervention and control groups; imbalances in dropouts between treatment and control groups were poorly reported and only one trial reported using an intention-to-treat analysis.

### 5.2.3 Sun Protection Policies

A poor quality [-] comparative observational study<sup>15</sup> investigated whether mandatory sun protection for outdoor workers in tropical regions (North Queensland) is associated with reduced sun damage by comparing 26 employees working under mandatory sun protection policy (mean age 42 years (SD ± 11); 89% male) with 21 employees working under a voluntary sun protection policy (mean age 44 years (SD ± 16); 100% male). 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 the risk of skin cancer (p=0.046), were more likely to believe that they were susceptible to developing skin cancer (p=0.019), and were more likely to believe that long-sleeved shirts were more hot and uncomfortable than short-sleeved shirts (p=0.049). Results are presented in detail in the Appendices.

**Evidence statement 2.1**

There is inconclusive evidence from one poor quality [-] comparative observational study<sup>15</sup> conducted in Australia investigating whether mandatory sun protection policy for outdoor workers in tropical regions reduced sun damage compared with a voluntary policy. 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 the risk of skin cancer ( $p=0.046$ ), were more likely to believe that they were susceptible to developing skin cancer ( $p=0.019$ ), and were more likely to believe that long-sleeved shirts were more hot and uncomfortable than short-sleeved shirts ( $p=0.049$ ).

<sup>15</sup>Woolley et al. 2008 [-]

## 5.2.4 Motivational Interventions

### 5.2.4.1 UV photographs with or without photoaging

There were two studies (one SR and one RCT) investigating change in perception when using UV photographs with or without photoaging alone. The outcomes are summarised below and reported in detail in the Appendices.

A low quality systematic review [-] <sup>16</sup> compared UV photoaging plus UV information with current information provision and found that perceived susceptibility to photoaging was significantly increased after viewing a UV photo and photoaging information (7 studies ( $n=252$ ); combined effect size,  $r=0.226$ ,  $p<0.0001$ ). Using UV photographs and/or photoaging information also had a significant effect on future sun protection intentions (8 studies ( $n=625$ ): combined effect size  $r=0.386$   $p<0.0001$ ) <sup>16</sup>.

One poor quality RCT [-] investigated the effects of UV photographs in 211 sixth, seventh and eighth-grade students in the USA <sup>17</sup>. The trial reported that although adolescents were comparatively optimistic (i.e. believed to be at lower risk than their peers) about their likelihood of developing cancer, non-tanning students given a photo computer-morphed to make a naturally fair-skinned model look more tanned were more optimistic than those given a similar unadulterated photo ( $p=0.001$ ) <sup>17</sup>.

#### Evidence Statement 2.2

There is inconclusive evidence from one poor quality [-] systematic review<sup>16</sup> and one poor quality [-] RCT<sup>17</sup> about the effectiveness of UV photographs (with or without photoaging) on participants' perceived susceptibility or vulnerability to skin cancer or sun damage

One poor quality [-] systematic review<sup>16</sup> in teenagers and adults reported that UV photographs with or without photoaging had significant effects on perceived susceptibility to photoaging (7 studies ( $n=252$ ); combined effect size,  $r=0.226$ ,  $p<0.0001$ ) and on future sun protection intentions (8 studies ( $n=625$ ): combined effect size  $r=0.386$   $p<0.0001$ ). A poor quality RCT[-] conducted in school-aged children in the US reported that although adolescents were comparatively optimistic (i.e. believed to be at lower risk than their peers) about their likelihood of developing cancer, non-tanning students given a photo computer-morphed to make a naturally fair-skinned model look more tanned were more optimistic than those given a similar unadulterated photo ( $p=0.001$ )<sup>17</sup>.

<sup>16</sup>Williams et al. 2013 [-]

<sup>17</sup>Roberts et al, 2011 [-]

#### 5.2.4.2 UV photographs with or without photoaging in combination with other interventions

Twelve trials reported changes in perceived susceptibility or vulnerability to skin cancer in participants receiving UV photographs with or without photoaging in combination with at least one other intervention. The other interventions most often included general skin cancer or sun protection information. The outcomes are summarised below and reported in detail in the Appendices.

One poor quality trial [-] in German school children <sup>22</sup> used an interactive presentation providing general information on the effects of sun exposure plus a personal UV photo. The intervention was predicted to result in considerable changes in risk perceptions of getting skin cancer compared with a similar intervention focused on interdental hygiene ( $p < 0.001$ ) in 253 high school students aged 13 to 19 years from seven schools <sup>22</sup>.

Five trials reported interventions in addition to UV photographs or photoaging in university or college students. All five trials reported higher perceived susceptibility or vulnerability to photoaging or skin cancer. Two trials were of moderate quality. One moderate quality trial [+] <sup>18</sup> noted no statistically significant differences, but found a trend towards higher perceived susceptibility to photoaging and skin cancer in 677 female UK students from secondary schools and universities (aged 16 to 23 years) given efficacy information as part of a risk message compared with those given a self-affirmation task alone or no intervention. The other moderate quality trial [+] <sup>19</sup>, of 126 US college students containing a high proportion of females (77%), found that those who received a combination of their UV photo and photoaging information, with or without additional photos of others with more or less skin damage than their own, reported greater perceived susceptibility to photoaging ( $d = 0.74$ ) than those receiving no intervention. However, there were no differences between the intervention groups, suggesting that additional photos of skin damage did not impact on perceptions <sup>19</sup>.

Three poor quality trials reported similar results <sup>23-25</sup>. The first trial <sup>23</sup> assessed to be of poor quality [-] recruited 90 US freshman student nurses from a community college and investigated the change in perceptions of acquiring skin cancer using UV filtered photography treatment in addition to a skin cancer lecture. The two study groups included a skin cancer lecture or no intervention. Significant difference were reported between pre and post values ( $t = -2.69$ ,  $p < 0.005$ ) for the intervention group, but not for the lecture and control group <sup>23</sup>. In the second poor quality trial [-] <sup>24</sup>, 179 US male psychology undergraduates were assigned to either a personal UV photo depicting skin damage, in addition to a regular black and white photo and information on UV exposure and sunscreen protection, or a black and white photo alone. Those that viewed the UV photo showed a higher perceived vulnerability of skin cancer than those who only saw the black and white photo ( $p = 0.04$ ) <sup>24</sup>. A third poor quality trial [-] <sup>25</sup> investigated the effects of a combined intervention, using graphic images of photoaging and skin cancer to elicit a strong emotional response plus details of how to use sunscreen effectively, in 352 US undergraduate females aged from 18 to 49 years <sup>25</sup>.



Both the combined group and the self-efficacy group (i.e. no emotional arousal component) showed increased perceived susceptibility to photoaging. Differences from baseline responses were significant compared with the control group who received stress management ( $p < 0.01$  and  $p = 0.02$ , respectively), but not between the intervention groups <sup>25</sup>.

There were three trials conducted in the USA of people thought to be at high risk of developing skin cancer: one in outdoor road workers <sup>20</sup> and two in people with multiple risk factors <sup>26, 27</sup>. A moderate quality trial [+] <sup>20</sup> reporting perceptions of skin damage examined the impact of UV photography interventions (UV photo or no photo plus educational video on photoaging or skin cancer) in 148 US male outdoor road workers. Men who saw their UV photo reported more skin damage from the sun than did those who did not view their UV photo ( $F(1, 146) = 5.0$ ,  $p < 0.03$ ,  $d = 0.41$ , means of 5.45 vs. 4.93). In addition, men in each UV group reported significantly higher estimates than those receiving no UV photo and no educational video <sup>20</sup>.

There were two RCTs of people with multiple risk factors <sup>26, 27</sup>, such as a family history of skin cancer and behavioural risks (e.g. sunbathing, indoor tanning and low sunscreen use). Both trials, by the same author, reported greater perceived susceptibility to photoaging with the intervention <sup>26, 27</sup>. One poor quality trial [-] <sup>26</sup> examined whether the efficacy of an appearance-based sun protection intervention (personal UV photo plus photoaging information) could be enhanced by the addition of social norms information in 125 predominantly female (83.2%) university undergraduates in the USA who were considered to be a high exposure group (36% spent  $\geq 1$  hour sunbathing; 91.4% with  $\geq 1$  hour incidental sun exposure per week; 28.8% with  $\geq 1$  tanning salon visit in past year); 32% described themselves as Asian <sup>26</sup>. The social norms information comprised written/visual information on how to prevent photoaging (injunctive norms) and oral information on the number of their peers who currently use regular sun protection plus an audiotape of a researcher-moderated discussion of sun protection trends (descriptive norms). All four combinations of photoaging/norms information resulted in significantly greater perceived susceptibility ( $M = 3.92$ ) relative to the control group, which received no photoaging or norms information ( $M = 0.39$ ), ( $t(120) = 3.19$ ,  $p < 0.001$ , effect size  $d = 0.73$ ), but there was no difference between them <sup>26</sup>.

The other poor quality trial [-] <sup>27</sup> compared the efficacy of two appearance-based sun protection interventions in a similarly high-risk population of undergraduates recruited from two universities located in the Midwest and Southwest USA (60% spent  $\geq 1$  hour per week sunbathing; 94.1% with  $\geq 3$  hours incidental sun exposure per week during last summer; 14% with  $\geq 1$  tanning salon visit in past month) <sup>27</sup>. A total of 442 students (62.7% female) were recruited; Iowa students were predominantly White (92.0% versus 42.3% of California students). Students were assigned to either receive photoaging information (video), have a UV photo taken, both receive photoaging information and have a UV photo taken, or to receive neither intervention. There was a significantly greater feeling of susceptibility in those viewing a photoaging video compared with those who did not ( $p = 0.001$ ) and in those seeing a UV photo compared with those who did not ( $p = 0.004$ ) <sup>27</sup>.

Two additional trials investigated the use of UV photographs, one in mothers of school-aged children and one in the general population<sup>21,28</sup>. One poor quality trial [-]<sup>28</sup> found that neither messages of different levels of persuasion nor UV photos had a significant effect on perceived vulnerability to the negative consequences of UV exposure in 151 mothers of elementary and middle-school aged children in the USA receiving a multicomponent UV intervention<sup>28</sup>. One moderate quality trial [+]<sup>21</sup> examined whether a self-affirmation task could elicit defensive responses to a personal UV photo showing skin damage in 266 people (adults and children) visiting a public science event in Germany. Subsequent analysis showed that high-risk people who were asked to rate their own personal strengths and values (self-affirmation task) reported a slight increase in risk perception compared with those not given the chance to self-affirm (difference not significant)<sup>21</sup>.

### **Evidence Statement 2.3**

There is weak, consistent evidence from four moderate quality [+] RCTs<sup>18-21</sup> and seven poor quality [-] RCTs<sup>22-28</sup> that UV photographs (with or without photoaging) plus additional interventions (mostly information provision) enhanced participants' perceived susceptibility or vulnerability to skin cancer.

There is weak evidence from one poor quality [-] RCT<sup>22</sup> in 253 German high school students aged 13 to 19 years that an interactive presentation providing general information on the effects of sun exposure plus a personal UV photos was predicted to result in considerable changes in risk perceptions of getting skin cancer compared with a similar intervention focused on interdental hygiene ( $p < 0.001$ ) in 253 high school students aged 13 to 19 years from seven schools<sup>22</sup>.

There is weak, consistent evidence from two good quality<sup>18,19</sup> and five poor quality RCTs<sup>23-27</sup> most of which were conducted in US colleges, that UV photographs (with or without photoaging) plus additional interventions (mostly information provision) enhanced participants' perceived susceptibility or vulnerability to skin cancer. One study conducted in UK reported no statistically significant differences, but found a trend towards higher perceived susceptibility to photoaging and skin cancer in 677 female students from secondary schools and universities (aged 16 to 23 years) given efficacy information as part of a risk message compared with those given a self-affirmation task alone or no intervention.

There is weak evidence from one moderate quality RCT [+]<sup>20</sup> investigating the impact of UV photography interventions (UV photo or no photo plus educational video on photoaging or skin cancer) in 148 US male outdoor road workers. Men who saw their UV photo reported more skin damage from the sun than did those who did not view their UV photo ( $F(1, 146) = 5.0, p < 0.03, d = 0.41$ , means of 5.45 vs. 4.93). In addition, men in each UV group reported significantly higher estimates of damage than those receiving no UV photo and no educational video.

There is inconclusive evidence from two additional RCTs. One poor quality RCT [-]<sup>28</sup> found that neither messages of different levels of persuasion nor UV photos had a significant effect on perceived vulnerability to the negative consequences of UV exposure in 151 mothers of elementary and middle-school aged children in the USA receiving a multicomponent UV intervention<sup>28</sup>. One moderate quality RCT [+]<sup>21</sup> reported that in 266 high-risk people (adults and children) visiting a public science event in Germany, those who were asked to rate their own personal strengths and values (self-affirmation task) reported a slight increase in risk perception to a personal UV photo compared with those not given the chance to self-affirm (difference not significant)<sup>21</sup>.

While it appeared that UV photographs (with or without photoaging) plus other interventions were effective in enhancing participants' perceived susceptibility or vulnerability to skin cancer, it was not

possible to determine which specific features of the additional interventions were the most effective. Most of the included studies used additional education interventions (videos, lectures, written information) in varying population groups (children, university students, high risk groups and the general population.

<sup>22</sup>Schuz et al. 2013 [-]

<sup>18</sup>Good et al. 2011 [+]

<sup>19</sup>Mahler et al. 2010 [+]

<sup>29</sup>Siegel et al. 2010 [-]

<sup>30</sup>Walsh et al. 2012 [-]

<sup>25</sup>Moser et al. 2012 [-]

<sup>20</sup>Stock et al. 2009 [+]

<sup>26</sup>Mahler et al. 2008 [-]

<sup>27</sup>Mahler et al. 2013 [-]

<sup>28</sup>Dykstra et al. 2008 [-]

<sup>21</sup>Schuz et al. 2013 [+]

### 5.2.4.3 Message framing

Four studies investigated changes in perceived susceptibility or vulnerability to skin cancer in terms of message framing. Two trials were of moderate quality [+]<sup>31, 32</sup> and two of poor quality [-]<sup>33, 34</sup>. The outcomes are summarised below and reported in detail in the Appendices.

One moderate quality paper [+]<sup>31</sup> reported on an RCT conducted in 390 individuals aged 16 to 26 years from various settings in the Republic of Ireland (universities, colleges, sports clubs and railway stations), and found health messages framed as either a loss (emphasizing the risks of sun exposure) or a gain (emphasizing the beneficial effects of sun protection) both resulted in a higher perceived threat and severity of skin cancer post-message. This paper reported that although perceived threat difference scores were higher for the appearance-focused message (gain frame), the difference between groups was not significant<sup>31</sup>.

A second moderate quality RCT [+]<sup>32</sup> was conducted in 219 adolescents aged 12 to 18 years (mean 15.7 years) who were members of Young Farmers of America in the rural US Midwest. The trial evaluated the impact of perceived susceptibility to skin cancer and the impact of perceived effectiveness of sun protection on the persuasiveness of either gain-framed or loss-framed sun safety messages and did not report any significant differences between groups. A gain-framed message was more effective when perceived effectiveness was high than when it was low; this effect was non-significant. Participants' preference for the loss-framed message over the gain-framed message generally increased as the level of perceived susceptibility increased; this effect was non-significant<sup>32</sup>.

Mixed results were reported for the two poor quality trials. One poor quality trial [-] <sup>33</sup> of 152 US undergraduates reported the effect of combined interventions using induced mood changes and framed messages on persuasion, in the context of promoting sun protection behaviours. Participants undertook a written exercise following the recall of a happy or sad incident and were then randomized to framed messages emphasizing the beneficial (gain frame) or harmful (loss frame) effects of sun exposure, delivered via a public service announcement. Loss-framed messages led to greater perceived susceptibility in happy participants than gain-framed messages, but no such differences were observed in sad participants <sup>33</sup>. A second poor quality trial [-] <sup>34</sup> conducted in young adults aged 18 to 29 years enrolled in introductory film and speech classes at a large urban university in the USA investigated the effect of news articles about skin cancer that used gain- or loss-framed messages and a personal exemplar about sunscreen use compared with an article about nutrition. Framing was not found to be a significant predictor of personal risk ( $p>0.05$ ) <sup>34</sup>.

#### **Evidence Statement 2.4**

There is weak, consistent evidence from two moderate quality [+] RCTs from Ireland<sup>31</sup> and the USA<sup>32</sup> and two poor quality [-] RCTs from the US <sup>33, 34</sup> that message framing is not effective in changing young adults perceived susceptibility or vulnerability to skin cancer. The included RCTs investigated health messages framed as either a loss (emphasizing the risks of sun exposure) or a gain (emphasizing the beneficial effects of sun protection). RCTs reported no significant differences between gain- or loss-framed messages for sun protection or skin cancer messages.

<sup>31</sup>Thomas et al. (2011) [+]

<sup>32</sup>Hwang et al. (2012) [+]

<sup>33</sup>Nan et al. (2011) [-]

<sup>34</sup>Hoffner et al. (2009) [-]

#### **5.2.4.4 Other motivational interventions**

Two poor quality trials investigated the effect of other motivational interventions on the perceived susceptibility or vulnerability of skin cancer or sun damage <sup>35, 36</sup>. The outcomes are summarised below and reported in detail in the Appendices.

One poor quality trial [-] <sup>35</sup> of beach goers in the UK compared the efficacy of three self-affirmation manipulations for changing beliefs in the effectiveness of using sunscreen to reduce skin cancer in a sample of 162 white female sunbathers. The self-affirmation task, which was incorporated into a leaflet presenting health risk information, required them to write a written statement about why a personal value is important to them. Results showed a significant effect of condition on response-efficacy ( $F(3, 158)=6.90, p<0.001$ ), with all three affirmation groups reporting higher levels than the control group (health promotion leaflet alone) ( $t(49.41)=3.44, p=0.001, d=0.80$ ) <sup>35</sup>.

Another poor quality trial [-] <sup>36</sup>, conducted in Dutch female sunbed users attending a spring fair, investigated the perception of vulnerability to skin cancer. Three interventions were implemented: 1) a narrative message (i.e., personal testimonial); 2) a non-narrative cognitive message (i.e., factual risk information using cognitive-laden words); or 3) a non-narrative affective message (i.e., factual risk information using affective-laden words). Narrative information evoked more feelings of risk than non-narrative cognitive information ( $p = 0.020$ ) and non-narrative affective information ( $p = 0.001$ ) immediately post-intervention. No significant difference was found between the narrative condition and non-narrative conditions on feelings of risk at follow-up. Overall, the results indicated that there were positive short-term effects of the narrative condition on feelings of risk <sup>36</sup>.

#### **Evidence Statement 2.5**

There is inconclusive, inconsistent evidence from two poor quality [-] RCTs from Northern Europe <sup>35, 36</sup> about the effect of motivational interventions on participants' perceived susceptibility or vulnerability to skin cancer or sun damage.

One poor quality RCT<sup>35</sup> reported that a self-affirmation task, which was incorporated into a leaflet presenting health risk information to 162 white female sunbathers, showed a significant improvement in perceived susceptibility or vulnerability of skin cancer or sun damage ( $p < 0.0001$ ). The second poor quality RCT<sup>36</sup> in Dutch sunbed users reported that personal testimony evoked more feelings of risk than factual risk information using cognitive-laden ( $p = 0.02$ ) or affective-laden words ( $p = 0.001$ ) immediately following the intervention. No significant differences in perceived susceptibility or vulnerability to skin cancer or sun damage were found between any of the interventions at follow up three weeks later.

<sup>35</sup>Jessop et al. (2009) [-]

<sup>36</sup>Janssen et al. (2013) [-]

#### **5.2.4.5 Multi-component interventions**

One moderate quality systematic review <sup>37</sup> reported increased perceived susceptibility/vulnerability to skin cancer from studies of university students (18 studies). The outcomes are summarised below and reported in detail in the Appendices.

The moderate quality systematic review [+]<sup>37</sup> included studies investigating various methods of communicating messages (verbal advice, mass media, printed material, web-based resources) in children and adults from a variety of settings. Three studies showed increased perceived susceptibility or vulnerability to skin cancer while two studies reported significant improvements in risk perceptions between intervention and control groups <sup>37</sup>. However, very few primary studies provided sufficient detail of the content of the interventions, or were not designed to enable comparison of different components or content, precluding any evaluation of what intervention components were most effective.

### **Evidence Statement 2.6**

There is inconclusive, inconsistent evidence from one moderate quality systematic review [+] <sup>37</sup> about the effect of multi-component interventions on participants' perceived susceptibility or vulnerability to skin cancer. The included studies reported a variety of different interventions (for example verbal advice, mass media, printed material, web-based resources) and it was not possible to determine which specific features of the interventions were the most effective.

Although the systematic review was considered moderate quality, this has been downgraded to inconclusive because the majority of the included primary studies did not provide sufficient detail of their interventions.

<sup>37</sup>Eagle et al. (2009) [+]

## **5.2.5 Educational Interventions**

### **5.2.5.1 Information provision**

One moderate quality study [+] <sup>38</sup> in US school-aged children found no differences between educational newsletters about skin cancer sun protection (mailed to parents and children) and an annual invitation to attend a data collection session in the parents' perception of their child's risk for melanoma or non-melanoma skin cancer over a three-year period. The study details are reported in the Appendices.

### **Evidence Statement**

There is weak evidence from one moderate quality [+] RCT conducted in the US <sup>38</sup> that written information provision does not enhance perceived susceptibility or vulnerability to skin cancer in children or their parents. No further information was reported.

<sup>38</sup>Crane et al. (2012) [+]

### **5.2.5.2 Tailored interventions**

Three trials, one of good quality [++] <sup>14</sup> and two of poor quality [-] <sup>39,40</sup> investigated the effect of tailored interventions on the perceived susceptibility or vulnerability to skin cancer or sun damage. The studies are summarised here and more details are reported in the Appendices.

One good quality trial [++] <sup>14</sup> evaluated four strategies (education only; education plus biometric feedback; education plus dermatologist skin examination; or education plus biometric feedback and dermatologist skin examination) in 593 high-risk beachgoers in the USA aged 18 years and older. A decrease in perceived risk of skin cancer from baseline was observed in all but the feedback plus dermatology examination group: for those reporting a higher than average perceived risk, odds ratios (ORs) were 0.53 for feedback, 1.20 for dermatologist examination, and 1.59 for the combined intervention. The same trial suggested that the intervention had no effect on perceptions of skin damage: for those reporting moderate/a lot of perceived damage, the ORs were 1.55 and 1.89 for feedback alone and with dermatology examination, respectively <sup>14</sup>.

One poor quality trial [-] <sup>39</sup> found no statistically significant difference in individuals' perceptions of risk of skin cancer in 316 Swedish adults registered at a health centre who were given general sun protection advice and different forms of personalized feedback over a three-year period. The trial evaluated three strategies using general sun protection advice with different personalized feedback: (1) A standard letter + personalized risk assessment + other information; (2) personal GP consultation + adjusted information + other info; (3) the same intervention as (2) but including a phototest. There were no significant differences reported between groups for attitudes to the risks of sunbathing or the risks of skin cancer. In terms of severity, photoaging was perceived as less terrible to develop than skin cancer <sup>39</sup>.

A third poor quality trial [-] <sup>40</sup> compared an interactive tailored computer session (adapted SunSmart programme) generating tailored feedback reports with a computerised intervention promoting physical activity and healthy eating behaviour (based on Social Cognitive Theory and the Transtheoretical Model) in 819 adolescents (aged 10-16 years) from private health care clinics in the USA. The change in decisional balance between exposure versus protection behaviours mediated the effects of the SunSmart intervention. The study concluded that decisional balance, that is the balance of pros and cons for both exposure and protection, is an important mediator of intervention effects <sup>40</sup>.

#### **Evidence Statement 2.8**

There is moderate, consistent evidence from one good quality [++] RCT <sup>14</sup> and two poor quality RCTs [-] <sup>39,40</sup> that tailored interventions do not increase the perception of skin cancer risk in high risk adults.

One good quality RCT [++] conducted in 593 US beachgoers <sup>14</sup> investigating different combinations of biometric feedback, education and dermatologist skin examinations reported a decrease in perceived risk of skin cancer from baseline in all but the feedback plus dermatology examination group: for those reporting a higher than average perceived risk, odds ratios (ORs) were 0.53 for feedback, 1.20 for dermatologist examination, and 1.59 for the combined intervention. a decrease in perceived risk of skin cancer. There was no effect on participants' perceptions of skin damage.

Two poor quality RCTs in 819 US adolescents (aged 10-16 years) and 316 Swedish adults investigated different forms of personalized feedback (combinations of standard letter, personalised risk assessment, GP consultation and photo-tests) <sup>39</sup> and tailored feedback reports as part of a SunSmart campaign <sup>40</sup> and found no differences between intervention and control groups. No further details were reported.

<sup>14</sup>Emmons et al. (2011) [++]

<sup>39</sup>Falk et al. (2011) [-]

<sup>40</sup>Adams et al. (2009) [-]

### 5.2.5.3 Active participation education sessions

Three observational studies, two of moderate quality <sup>6, 41</sup> and one of poor quality <sup>42</sup>, investigated the effect of active participation educational interventions on the perceived susceptibility or vulnerability of skin cancer or sun damage. The studies are summarised here and more details are reported in the Appendices.

A poor quality [-] comparative observational study <sup>42</sup> used a before and after study design to provide a preliminary test of a theory of planned behaviour (TPB) belief-based intervention to increase sun protective behaviours in a high risk area in Australia among adolescents aged 13 to 16 years (mean 14.53 (SD 0.69) years) attending one of two secondary schools (one government, one private). The intervention comprised three, one hour in-school sessions facilitated by Cancer Council Queensland employees with sessions covering the belief basis of the TPB (i.e. behavioural, normative, and control [barrier and motivator] sun-safe beliefs). Students completed questionnaires assessing sun-safety beliefs, intentions, and behaviour pre- and post-intervention. Students completing the intervention reported stronger sun-safe normative and motivator beliefs and intentions across time than those in the control condition <sup>42</sup>.

A moderate quality [+] comparative observational survey <sup>41</sup> aimed to determine whether entertainment-education strategies could be combined in a creative communication campaign to improve sun protection behaviours among 1,588 Australian 14 to 25 year olds. The intervention involved a music video showing five recommended forms of sun protection (using sunscreen, wearing sunglasses and hats, getting under shade, and covering up with clothing) that were communicated both visually and lyrically in the video. There was a significant difference in perceived personal risk of getting skin cancer between the two groups. The intervention group had greater confidence in their perceived ability to protect themselves from skin cancer by using sun protection methods. There were no significant differences in peer perceptions of tanning <sup>41</sup>.

A moderate quality [+] non-comparative observational questionnaire <sup>6</sup> was administered before and after SolSano (a sun safety programme) conducted in 1522 children with a mean age of 6.6 (SD not reported) from 215 Aragonese primary schools in Spain. The percentage of children who desired to be tanned reduced slightly by 4.5%, from 48.3% to 43.8% following the intervention <sup>6</sup>.

#### **Evidence statement 2.9**

There is inconclusive, consistent evidence from two of moderate quality observational studies <sup>6, 41</sup> and one poor quality observational study <sup>42</sup>, that active participation educational interventions may improve the perceived susceptibility or vulnerability of skin cancer or sun damage.

Two comparative observational studies were conducted in Australian adolescents; one moderate quality [+] study reported stronger sun safe beliefs and intentions following a belief based intervention comprised three, one hour in-school sessions facilitated by Cancer Council Queensland employees <sup>42</sup>, while the other poor quality [-] study reported that the 1588 participants had greater confidence in their perceived ability to protect themselves from skin cancer following an intervention involved a music video showing five recommended forms of sun protection (using sunscreen, wearing sunglasses and hats, getting under shade, and covering up with clothing) that were communicated both visually and lyrically <sup>41</sup>.



A moderate quality [+] non-comparative observational questionnaire<sup>6</sup> was administered before and after SolSano (a sun safety programme) conducted in 1522 children from 215 Spanish primary schools. The percentage of children who desired to be tanned reduced slightly from 48.3% to 43.8% following the intervention. No further details were reported

<sup>42</sup>White et al. (2010) [+]

<sup>41</sup>Potente et al. (2011) [-]

<sup>6</sup>Gilaberte et al. (2008) [+]

The following summaries represent groups that are thought to be at higher risk of sun damage and skin cancer. The studies are summarised here and more details are reported in the Appendices.

#### 5.2.5.4 School-aged children

There were four RCTs relating to children of school age (ranging from  $\geq 6$  years to high school)<sup>17, 22, 38, 40</sup>. One moderate quality trial [+] <sup>38</sup> found no differences between educational newsletters about skin cancer sun protection (mailed to US parents and their children) and an annual invitation to attend a data collection session in the parents' perception of their child's risk for melanoma or non-melanoma skin cancer over a three-year period.

A second poor quality trial [-] <sup>17</sup> of 211 sixth, seventh and eighth-grade students in the USA found that although adolescents were comparatively optimistic (i.e. believed to be at lower risk than their peers) about their likelihood of developing cancer, non-tanning students given a photo computer-morphed to make a naturally fair-skinned model look more tanned were more optimistic than those given a similar unadulterated photo ( $p=0.001$ ).

A third poor quality [-] trial <sup>22</sup> reported an interactive presentation providing general information on the effects of sun exposure plus a personal UV photo. The presentation was predicted to result in considerable changes in risk perceptions of getting skin cancer compared with a similar intervention focused on interdental hygiene ( $p<0.001$ ) in 253 German high school students aged 13 to 19 years from seven schools <sup>22</sup>.

A fourth trial of poor quality [-] <sup>40</sup> compared an interactive tailored computer session (adapted SunSmart programme) generating tailored feedback reports with a computerised intervention promoting physical activity and healthy eating behaviour (based on Social Cognitive Theory and the Transtheoretical Model) in 819 adolescents (aged 10-16 years) from private health care clinics in the USA. The change in decisional balance between exposure versus protection behaviours mediated the effects of the SunSmart intervention. The study concluded that decisional balance, that is, the balance of pros and cons for both exposure and protection, is an important mediator of intervention effects <sup>40</sup>.

### Evidence Statement 3.1

There is weak, inconsistent evidence from one moderate quality [+] RCT<sup>38</sup> and one poor quality RCT<sup>40</sup> both conducted in children in the US, which found that educational newsletters and interactive tailored computer sessions were not beneficial in changing perceptions in school-aged children.

There is inconclusive evidence from two poor quality RCTs [-] in children from the US<sup>17</sup> and Germany<sup>22</sup> about the effectiveness of UV photographs to change perceptions of school-aged children.

<sup>38</sup>Crane et al. (2012)

<sup>17</sup>Roberts et al. (2011)

<sup>22</sup>Schuz et al. (2013)

#### 5.2.5.5 Outdoor workers and lifestyle/leisure-associated risks

There were five RCTs of participants whose occupation or leisure pursuits can cause excessive UV exposure. Two trials recruited populations at occupational risk of skin cancer including US Department of Transport road workers<sup>20</sup> and high school students who were members of Young Farmers of America<sup>32</sup>, while three trials recruited individuals seeking tans, including beach goers<sup>14, 35</sup> and sunbed users<sup>36</sup>.

One moderate quality trial [+] <sup>20</sup> reporting perceptions of skin damage examined the impact of UV photography interventions (UV photo or no photo plus educational video on photoaging or skin cancer) in 148 male US outdoor road workers. Men in each UV group reported significantly higher estimates of skin damage than those receiving no UV photo and no educational video<sup>20</sup>. A second moderate quality RCT [+] <sup>32</sup> was conducted in 219 adolescents aged 12 to 18 years (mean 15.7 years) who were members of Young Farmers of America in the rural US Midwest. Gain-framed messages were found to be more effective when perceived effectiveness was high than when it was low; this effect was non-significant. Participants' preference for the loss-framed message over the gain-framed message generally increased as the level of perceived susceptibility increased, this effect was non-significant<sup>32</sup>.

One good quality trial [++] <sup>14</sup> evaluated four strategies (education only; education plus biometric feedback; education plus dermatologist skin examination; or education plus biometric feedback and dermatologist skin examination) in 593 high-risk US beach goers aged 18 years and older. A decrease in perceived risk of skin cancer from baseline was observed in most groups and there was no effect on perceptions of skin damage<sup>14</sup>. The second poor quality trial [-] <sup>35</sup> of UK beach goers compared the efficacy of three self-affirmation manipulations for changing beliefs in the effectiveness of using sunscreen to reduce skin cancer in a sample of 162 white female sunbathers. The self-affirmation task, which was incorporated into a leaflet presenting health risk information, required them to write a written statement about why a personal value is important to them. Results showed a significant effect of condition on response-efficacy ( $F(3, 158) = 6.90, p < 0.001$ ), with all three affirmation groups reporting higher levels than the control group (health promotion leaflet alone) ( $t(49.41) = 3.44, p = 0.001, d = 0.80$ )<sup>35</sup>.

A poor quality trial [-] <sup>35</sup>, which was conducted in Dutch female sunbed users who were attending a spring fair, investigated perceptions of vulnerability to skin cancer. Three interventions were implemented: 1) a narrative message (i.e., personal testimonial); 2) a non-narrative cognitive message (i.e., factual risk information using cognitive-laden words); or 3) a non-narrative affective message (i.e., factual risk information using affective-laden words). Overall, the results indicated that there were positive short-term effects of the narrative condition on feelings of risk <sup>35</sup>.

### **Evidence Statement 3.2**

There is weak, inconsistent evidence from two moderate quality [+] RCTs<sup>20, 32</sup> (investigating different interventions) about the effect of interventions to improve outdoor workers' perceived susceptibility or vulnerability to skin cancer.

One [+] study<sup>20</sup> conducted in US Department of Transport road workers examined the impact of UV photography interventions (UV photo or no photo plus educational video on photoaging or skin cancer) in 148 men. Men in each UV group reported significantly higher estimates of skin damage than those receiving no UV photo and no educational video. A second [+] RCT <sup>32</sup> was conducted in 219 adolescents aged 12 to 18 years (mean 15.7 years) who were members of Young Farmers of America in the rural US Midwest. Gain-framed messages were found to be more effective when perceived effectiveness was high than when it was low; this effect was non-significant. Participants' preference for the loss-framed message over the gain-framed message generally increased as the level of perceived susceptibility increased, this effect was non-significant.

<sup>20</sup>Stock et al. (2009) [+]

<sup>32</sup>Hwang et al. (2012) [+]

#### **5.2.5.6 Populations with multiple risk factors**

There were two RCTs of people with multiple risk in the USA, such as a family history of skin cancer and behavioural risks (e.g. sunbathing, indoor tanning and low sunscreen use). Both trials, by the same author, reported greater perceived susceptibility to photoaging with the intervention <sup>26, 27</sup>.

One poor quality trial [-] <sup>26</sup> examined whether the efficacy of an appearance-based sun protection intervention (personal UV photo plus photoaging information) could be enhanced by the addition of social norms information in 125 predominantly female (83.2%) university undergraduates in the USA who were considered to be a high exposure group (36% spent  $\geq 1$  hour sunbathing; 91.4% with  $\geq 1$  hour incidental sun exposure per week; 28.8% with  $\geq 1$  tanning salon visit in past year); 32% described themselves as Asian. The social norms information comprised written/visual information on how to prevent photoaging (injunctive norms) and oral information on the number of their peers who currently use regular sun protection plus an audiotape of a researcher-moderated discussion of sun protection trends (descriptive norms). All four combinations of photoaging/norms information resulted in significantly greater perceived susceptibility ( $M=3.92$ ) relative to the control group, which received no photoaging or norms information ( $M = 0.39$ ), ( $t(120) = 3.19$ ,  $p < 0.001$ , effect size  $d = 0.73$ ), but there was no difference between them <sup>26</sup>.

The other poor quality trial [-] <sup>27</sup> compared the efficacy of two appearance-based sun protections interventions in a similarly high-risk population of undergraduates recruited from two universities located in the Midwest and Southwest USA (60% spent  $\geq 1$  hour per week sunbathing; 94.1% with  $\geq 3$  hours incidental sun exposure per week during last summer; 14% with  $\geq 1$  tanning salon visit in past month). A total of 442 students (62.7% female) were recruited; Iowa students were predominantly White (92.0% versus 42.3% of California students). Students were assigned to either receive photoaging information (video), have a UV photo taken, both receive photoaging information and have a UV photo taken, or to receive neither intervention. There was a significantly greater feeling of susceptibility in those viewing a photoaging video compared with those who did not ( $p=0.001$ ) and in those seeing a UV photo compared with those who did not ( $p=0.004$ ) <sup>27</sup>.

### Evidence Statement 3.3

There is inconclusive, consistent evidence from two poor quality [-] RCTs<sup>26, 27</sup> reporting that UV photographs with or without photoaging resulted in significantly greater perceived susceptibility to skin cancer.

<sup>26</sup>Mahler et al. (2008) [-]

<sup>27</sup> Mahler et al. (2013) [-]

## 5.2.6 Summary of Evidence on Perception Change

There is limited evidence for interventions that change people's perceptions of their risk of sun damage or skin cancer; two interventions reported evidence that was assessed to be weak, but consistent across studies. The first was for the most common intervention, the use of UV photographs with or without photoaging plus an additional intervention, which was reported in 11 studies. Although the evidence appeared to be consistent, the additional interventions varied across the studies and the contribution of the additional intervention to the UV photographs with or without photoaging was unclear in most studies. The second was for message framing, which was reported in four studies. The evidence showed that message framing did not make a difference to sun protection messages. The evidence for several interventions was inconclusive either because of the lack of studies and/or the poor quality of trials identified.

### Summary Evidence Statements

There is weak, consistent evidence from four moderate quality [+] studies <sup>18-21</sup> and seven poor quality [-] studies <sup>22-28</sup> that UV photographs (with or without photoaging) plus additional interventions (mostly information provision) enhanced participants' perceived susceptibility or vulnerability to skin cancer. There is inconclusive evidence about which of the additional interventions were efficacious.

There is weak, consistent evidence from two moderate quality trials [+] <sup>31, 32</sup> and two poor quality [-] trials <sup>33, 34</sup> that message framing is not effective in promoting sun protection. Trials reported no significant differences between gain- or loss-framed messages for sun protection or skin cancer messages.

There was inconclusive evidence about the use of UV photographs alone, multicomponent interventions and some motivational interventions (intervention content eliciting strong emotional responses, self-affirmation manipulations and different types of narrative message).

## **5.3 ATTITUDES TO THE RISKS AND BENEFITS OF SUN EXPOSURE**

### **5.3.1.1 Systematic reviews**

Of the four included SRs, one fulfilled seven of the ASMTAR criteria and was considered moderate quality [+] <sup>53</sup>, while the others fulfilled only four criteria at most and were considered low quality [-] <sup>12, 16, 44</sup>. Poor methodology (as reported) was an issue in all four of these reviews: all three had at least two criteria reported as unclear, showing a lack of clarity.

Specifically, one of the four SRs <sup>53</sup> used an a priori design; provided lists of both the included and excluded studies <sup>44</sup>; adequately reported the characteristics of the included primary studies <sup>16</sup>; and assessed publication bias <sup>16</sup>. Two of the four reviews assessed the quality of the included primary studies <sup>12, 53</sup>; reported adequate searches <sup>12, 53</sup>; and used appropriate methods to combine the findings of the primary studies <sup>53, 16</sup>. None of the four reviews reported the involvement of two independent reviewers in both the study selection and data extraction processes, or disclosed conflicts of interest.

### **5.3.1.2 Randomized controlled trials**

The quality of the 36 included RCTs ranged from good [++] to poor [-]. Three RCTs were graded good quality [++] for the overall quality assessment; the majority of trials (21) were graded poor quality [-]. The main quality assessment criteria (randomization, allocation concealment, blinding and use of intention-to-treat analysis) were not well reported across the included trials. Specifically, fewer than half of the included trials used appropriate randomisation methods; only two trials reported allocation concealment methods; two trials reported that researchers or assessors conducting the follow-up were blinded and five trials used an intention-to-treat analysis.

The comparability of the intervention and control groups in terms of dropouts from the study was also poorly reported. In addition, half of the included trials reported similar baseline characteristics between the intervention and control groups; eight trials did not report any imbalances between groups; and seven trials analysed fewer participants than were initially randomized.

## **5.3.2 Motivational Interventions**

There were 23 studies (two SRs, 19 RCTs and two observational studies) of motivational interventions. These typically aimed to encourage individuals to change their attitudes towards sun exposure and intentions to adopt protective behaviours, primarily through the use of UV-filtered photographs (six studies), message frames (six studies), threat/fear scenarios (four studies), and other approaches (five studies).

### 5.3.3 UV photos with or without photoaging

There were seven studies (one SR, five RCTs and one comparative observational study) that evaluated the use of UV-filtered photos, which depict the underlying skin damage caused by sun exposure, with or without the provision of additional information on photoaging and/or skin cancer<sup>16, 19, 20, 24, 26, 27, 43</sup>. Two trials combined these with photos of others depicting less or more skin damage (upward/downward condition)<sup>19</sup> and social norms information<sup>26</sup>. The outcomes reported in these studies are summarised here and presented in more detail in the Appendices.

The most frequently reported outcomes were those relating to changes in intentions to engage in sun protection behaviour, reported in five studies (one SR and four RCTs).

A low quality SR [-] (15) that compared UV photoaging plus UV information with current information provision found that that intentions to use sun protection were significantly increased after viewing a UV photo and photoaging information (8 studies (n=625); combined effect size,  $r=0.386$ ,  $p\leq 0.0001$ ).

One poor quality trial [-]<sup>24</sup> examined the impact of a personal UV photo depicting skin damage, in addition to a regular black and white photo and information on UV exposure and sunscreen, compared with a black and white photo alone, in 152 male US undergraduate psychology students. A marginally higher willingness to engage in sun protection behaviour was found in those who saw the UV photo than in those who only saw a black and white photo (beta = 0.11,  $t = 1.92$ ,  $p < 0.06$ ). This positive effect was stronger in more masculine men (beta = 0.27,  $t = 3.27$ ,  $p = 0.001$ ) than in less masculine men ( $p = 0.60$ ), where masculinity was based on responses to the Conformity to Masculine Norms Inventory. Similar results were observed in relation to skin examinations, with more masculine men having greater intentions to undertake an exam (beta = 0.35,  $t = 4.06$ ,  $p < 0.001$ ). The UV photo condition was also associated with higher sun protection attitudes among more masculine men (beta = 0.22,  $t = 2.03$ ,  $p = 0.04$ ), but not less masculine men ( $p = 0.22$ )<sup>24</sup>.

One poor quality trial [-]<sup>27</sup> compared the efficacy of two appearance-based sun protections interventions in a high-risk population of undergraduates recruited from two universities located in climatologically different regions of the USA: the Midwest and Southwest (60% spent  $\geq 1$  hour per week sunbathing; 94.1% with  $\geq 3$  hours incidental sun exposure per week during last summer; 14% with  $\geq 1$  tanning salon visit in past month). A total of 442 students (62.7% female) were recruited; Iowa students were predominantly White (92.0% versus 42.3% of California students). Significantly greater intentions to use sun protection were found in participants who viewed the photoaging video compared with those who did not ( $F(1, 425) = 33.40$ ,  $p < 0.001$ ,  $\eta^2 = 0.27$ ); marginally greater intentions were found in those who viewed their UV photo ( $F(1, 425) = 3.52$ ,  $p = 0.06$ ,  $\eta^2 = 0.09$ ). Participants seeing the photoaging video also felt slightly greater self-efficacy for engaging in regular sunscreen use ( $p = 0.06$ ), whereas there was no significant difference between those who did and did not see their UV photo ( $p > 0.20$ ). However, the trial also found a significant effect of location, with students in Iowa having significantly lower future sun protection intentions ( $F(1, 425) = 7.98$ ,  $p < 0.01$ ,  $\eta^2 = 0.1$ ) and lower self-efficacy for sunscreen use ( $F(1, 425) = 6.42$ ,  $p = 0.01$ ,  $\eta^2 = 0.12$ ) than their counterparts in California<sup>27</sup>.

The same author reported a further two trials <sup>19, 26</sup> from the USA, one graded moderate quality and the other poor quality, that evaluated whether the efficacy of an appearance-based sun protection intervention could be enhanced by the addition of social comparison information and social norms.

In the moderate quality trial [+]<sup>19</sup>, the impact of adding social comparison information to appearance-based sun protection interventions was examined in 126 predominantly female (77%) US undergraduate students aged 18 to 34 years. The three intervention groups received a personal UV photo and photoaging information, either alone (basic intervention) or in conjunction with a photo of others that showed less (downward condition) or more (upward condition) skin damage than their own. Students receiving the basic UV intervention had greater intentions to sun protect ( $d=1.32$ ) than the control group who received no intervention and also lower tanning cognitions ( $d=0.44$ ). However, photos of others depicting either less (upward condition) or more (downward condition) skin damage had no impact: there were no differences in sun protection intentions or tanning cognitions between the three intervention groups (all  $p>0.18$  and all  $d<0.21$ )<sup>19</sup>.

In the other poor quality trial [-]<sup>26</sup>, the addition of social norms information to an appearance-based sun protection intervention (personal UV photo plus photoaging information) was evaluated in 125 predominantly female (83.2%) undergraduates in the USA aged 18 to 38 years, who were considered to be a high exposure group (36% spent  $\geq 1$  hour sunbathing; 91.4% with  $\geq 1$  hour incidental sun exposure per week; 28.8% with  $\geq 1$  tanning salon visit in past year); 32% described themselves as Asian. The social norms information comprised written/visual information on how to prevent photoaging (injunctive norms) and oral information on the number of their peers who currently use regular sun protection plus an audiotape of a researcher-moderated discussion of sun protection trends (descriptive norms). Significantly stronger intentions to use sun protection were found in students receiving the UV photo/photoaging information (basic) intervention relative to the control (no intervention) ( $M=3.28$  vs  $M=2.80$ ,  $p<0.01$ ,  $d=0.66$ ), and for students receiving any norms information compared with those receiving the basic intervention ( $M=3.37$  vs  $M=3.01$ ,  $p<0.05$ ,  $d=0.43$ ). However, there was no significant difference in sun protection intentions between the norm conditions<sup>26</sup>.

An additional moderate quality trial [+]<sup>20</sup> reporting attitudes towards sun protection examined the impact of UV photography interventions (UV photo or no photo plus educational video on photoaging or skin cancer) in 148 male US outdoor road workers (mean age 46.5 years), the majority (90%) of whom spent at least 5 to 6 hours in the sun each day. Overall, men who saw their UV photo and/or the educational video reported more positive attitudes towards sun protection than those in the control group who saw neither a UV photo nor educational video ( $M=3.6$  vs  $M=3.1$ ;  $F(1, 146)=11.49$ ,  $p=0.001$ ,  $d=0.86$ ). Although all four interventions were significantly different from the control group (all  $p<0.01$ ; all  $d>0.81$ ), there was no significant difference between interventions (all  $p>0.4$ )<sup>20</sup>.

A moderate quality [+] comparative study<sup>43</sup> undertaken in the UK investigated the impact of a facial-aging intervention in 70 female university students aged 18 to 34 years (mean 23.7 (SD 5.03) years). The students' sun protection attitudes and behavioural intentions were compared to a health literature intervention. Participants in the facial-aging intervention condition scored significantly higher following the facial aging intervention regarding their intentions, negative attitudes and perceived sun damage susceptibility, compared to those in the health literature intervention<sup>43</sup>.

#### **Evidence Statement 4.1**

There is weak, consistent evidence from one poor quality [-] systematic review<sup>16</sup>, one moderate quality [+] RCT<sup>19</sup> three poor quality [-] RCTs<sup>24, 26, 27</sup> and one comparative observational study<sup>43</sup> that UV photographs (with or without photoaging) plus additional interventions (additional information or photos of others) increase participants' intentions to adopt sun protection measures. The interventions used UV-filtered photos, which depict the underlying skin damage caused by sun exposure, with or without the provision of additional information on photoaging and/or skin cancer. Two trials combined these with photos of others depicting less or more skin damage (upward/downward condition)<sup>19</sup> and social norms information<sup>26</sup>. There is inconclusive evidence about which of the additional interventions were efficacious.

There is inconclusive evidence from one moderate quality trial [+] <sup>20</sup> reporting attitudes towards sun protection by examining the impact of UV photography interventions (UV photo or no photo plus educational video on photoaging or skin cancer) in 148 male US outdoor road workers (mean age 46.5 years), the majority (90%) of whom spent at least 5 to 6 hours in the sun each day. Overall, men who saw their UV photo and/or the educational video reported more positive attitudes towards sun protection than those in the control group who saw neither a UV photo nor educational video (M=3.6 vs M=3.1; F (1, 146)=11.49, p=0.001, d=0.86). Although all four interventions were significantly different from the control group (all p<0.01; all d>0.81), there was no significant difference between interventions (all p>0.4)<sup>20</sup>.

<sup>16</sup>Williams et al. (2013) [-]

<sup>19</sup>Mahler et al. (2010) [+]

<sup>24</sup>Walsh et al. (2012) [-]

<sup>27</sup>Mahler et al. (2013) [-]

<sup>26</sup>Mahler et al. (2008) [-]

<sup>43</sup>Williams et al. (2013) [+]

<sup>20</sup>Stock et al. (2009) [+]

#### **5.3.4 Message Framing**

Six studies (one SR and five RCTs) evaluated the use of framing messages to emphasize either the positive or beneficial effects of engaging in protective behaviours, i.e. a gain frame (e.g. using sunscreen keeps skin healthy), or the negative or detrimental effects of not adopting such behaviours, i.e. a loss frame (e.g. risks of sun exposure)<sup>31, 33, 34, 44-46</sup>. Three of the five trials also explored interactions with additional variables, such as the focus of the message<sup>45</sup>, incidental affect (impact of emotional recall)<sup>33</sup>, and the level of efficacy of behaviours described within the message. The outcomes reported in these studies are summarised here and presented in detail in the Appendices.



The most frequently reported outcomes were those relating to behavioural intentions, or more specifically sun protection behaviour, in populations of predominantly young adults or students. These were reported in five papers (one moderate quality [+] and four poor quality [-]) discussing RCTs, with two of the papers discussing the same RCT.

The moderate quality trial [+] <sup>31</sup> examined the behavioural intentions of 390 young adults in the Republic of Ireland (aged 16 to 26 years) through framed health messages embedded in a questionnaire concerning beliefs about skin cancer and body consciousness. Each message contained factual information and was followed by a framing manipulation that focused on the consequences of using/not using sun protection on one's appearance or health. Results showed an increase in the composite intention score (intention to use sunscreen, protective clothing and sunbeds) pre- to post-message for both gain- and loss-framed messages ( $M=16.29$  vs  $M=15.12$ ,  $p<0.025$ ,  $d=0.08$ ), with intentions to perform different skin protection behaviours greatest for loss-framed messages ( $M=1.55$  vs  $M=0.82$ ,  $F(1,385) = 5.02$ ,  $p<0.05$ , partial  $\eta^2 = 0.01$ ). The findings held when individual differences in body consciousness were controlled for <sup>31</sup>.

The second publication (poor quality [-], <sup>45</sup>) reporting on this RCT also discussed finding mixed results with messages about skin cancer that not only differed in frame (gain or loss) but also in focus (health or appearance). Of the 390 participants, all were members of the general public in the Republic of Ireland aged 16 to 26 years, predominantly university students; with 11% having had a family member diagnosed with skin cancer. Results showed no significant difference in intentions to use sunscreen or a sunbed after reading a gain- or loss-framed message, or after reading a health or appearance focused message. However, gain-framed health messages had a significant effect on sunscreen use intentions for those high in body consciousness, compared with those low in body consciousness ( $F(1, 382) = 4.22$ ,  $p < 0.01$ , partial  $\eta^2 = 0.03$ ). The failure to find any effect on sunbed use was thought to be due to the very low levels of sunbed use reported <sup>45</sup>.

One poor quality trial [-] <sup>34</sup> also reported the finding of positive effects of message framing in 191 young adults in the USA (aged 18 to 29 years), of mixed ethnic origin (White 41.4%, Black 36.6%, Asian Pacific Islander 8.4%, Hispanic 4.2%, Native American 0.5%) who were enrolled in introductory film and speech classes at a large urban university. The impact of news articles about skin cancer risk and prevention presented as either a gain frame or loss frame and along with a personal example, were compared to a control group which read an article about nutrition. Compared with the control group, both frames increased intentions to use sunscreen but there was no difference between them. Analysis showed a significant effect of gender, with greater intended sunscreen use among women than men ( $M=4.07$  vs  $M=3.69$ ,  $F(1,183) = 4.29$ ,  $p<0.05$ ,  $h^2=0.02$ ). The trial also reported no difference between the framing and control group in terms of the choice of sunscreen (higher SPF) for future use

<sup>34</sup>.

A poor quality trial [-] <sup>33</sup> also found no significant effect of messages frame as a gain or loss and incidental effect on a composite measure of behavioural intentions, including intention to adopt sun protection. The participants (152 US undergraduate students) were given a self-reflective writing task (to make them happy or sad) and then presented with a loss- or gain-framed message relating to sun protection. Neither incidental affect nor message frame were shown to have an independent or interactive effect on intentions to adopt sun protection behaviours <sup>33</sup>.

A further poor quality trial [-] <sup>46</sup> investigated variables that affect compliance with framed messages in two distinct groups of women in the USA: younger (aged 18 to 30 years) and older (aged >60 years). This trial assessed the impact of four messages framed as either a gain or loss and in terms of the efficacy (high or low) of the skin cancer detection and prevention behaviours described therein in 136 women, 23% and 11% of whom had a diagnosis of cancer or skin cancer, respectively, at some point. Message framing was not found to be a significant predictor of intention to adopt prevention behaviours and also had no significant effect on intentions to engage in skin cancer detection behaviours <sup>46</sup>.

An additional low quality systematic review [-] <sup>44</sup> explored the relative persuasiveness of gain-framed and loss-framed messages for encouraging skin cancer preventive behaviours. From the 33 primary studies included it found no so significant persuasive advantage for one frame over the other: the combined data for all attitude, behavioural intention, behaviour and related measures assessed in the primary studies produced a random effects weighted mean correlation of -0.020 (95% CI: -0.060 to 0.019; Z = -1.002, p=0.316; 33 studies). Further analyses demonstrated that the relative persuasiveness of framed appeals was not affected by the focus of the message: mean r of -0.013 and -0.023 for messages advocating sunscreen use (12 studies) and other or multiple behaviours (21 studies), respectively <sup>44</sup>.

#### **Evidence Statement 4.2**

There is inconclusive, consistent evidence from one poor quality [-] systematic review<sup>44</sup> (including 33 primary studies) one moderate quality [+] RCT conducted in Ireland<sup>31</sup> and four poor quality RCTs from Ireland<sup>45</sup> and the US<sup>33, 34, 46</sup> that the use of framing messages does not encourage people to engage in protective behaviours.

Gain-framed messages emphasize positive or beneficial effects of engaging in protective behaviours (e.g. using sunscreen keeps skin healthy), while loss framed messages emphasize the negative or detrimental effects of not adopting such behaviours (e.g. risks of sun exposure). Three of the five trials also explored interactions with additional variables, such as the focus of the message <sup>45</sup>, incidental affect (impact of emotional recall) <sup>33</sup>, and the level of efficacy of behaviours described within the message. The systematic review<sup>44</sup> and RCTs <sup>31, 33, 34, 45, 46</sup> reported no significant difference between gain or loss framed messages.

<sup>44</sup>O'Keefe et al. (2012) [-]

<sup>31</sup>Thomas et al. (2011) [+]

<sup>45</sup>Hevey et al. (2008) [-]

<sup>34</sup>Hoffner et al. (2009) [-]

<sup>33</sup>Nan et al (2011) [-]

<sup>46</sup>Stoner et al. (2009) [-]

### 5.3.5 Threat/Fear Scenarios

Four RCTs evaluated the impact of manipulating the level of physical threat or fear within a health message, for example by highlighting the detrimental or positive effects of the sun or sun exposure, to promote adaptive behaviour<sup>47-50</sup>. All four studies reported behaviour-related outcomes in people whose lifestyle could cause excessive UV exposure. The studies are summarised here and more detail is provided in the Appendices.

One moderate quality trial [+] <sup>47</sup> explored how the level of threat and coping information impacted on behavioural change in 254 Caucasian female undergraduates in the USA who had previously intentionally sought a tan, using the stage of change model and protection motivation theory to create brief persuasive appeals to promote healthy sun practice. High and low threat essays, respectively, emphasized and minimized concerns in relation to sun exposure, whilst high and low coping essays focused on the effectiveness and inconvenience, respectively, of the recommended measures. Both the high threat and high coping appraisal information elicited significantly higher intentions to use sun protection than their low equivalents ( $F=92.32$ ,  $p<0.001$  and  $F=5.84$ ,  $p<0.02$ ), respectively. Threat appraisal information also promoted transition from the pre-contemplation stage (i.e. no intention of changing behaviour) to the contemplation stage (intend to change). It was suggested that the brief message format commonly encountered in daily life is unlikely to trigger immediate action in most people

One poor quality trial [-] <sup>48</sup> examined whether fear appeals that make death thought conscious have any impact on messages designed to manipulate health behaviour by highlighting the effectiveness or ineffectiveness of sun protection behaviours. Results obtained in 147 US beach goers (mean age 24.5) showed that when fear appeals consciously primed death, sun protection intentions were decreased for behaviours considered ineffective compared with those considered effective (sun protection scores 3.36 vs 5.45,  $p=0.02$ ). However, when death is no longer a conscious thought, the framing of the effectiveness of sun protection behaviours has no effect<sup>48</sup>.

In a second poor quality trial [-] <sup>49</sup>, 40 Australian undergraduates, predominantly female (77.5%), with mid-range anxiety levels and low to average melanoma worry, were trained to adopt either a positive or negative interpretation bias using physical threat scenarios, then asked to view a health campaign warning against melanoma skin cancer. There was no significant difference between training groups for both outcome measures (proportion of sun expenditure and behavioural intentions). However, the more participants increased in melanoma worry because of the video, and as a consequence of the induced interpretation bias, the more they spent on sun protection in the lost-luggage game ( $t(39)=0.42$ ,  $p<0.01$ ). Results suggested that higher levels of worry promote adaptive behaviour<sup>49</sup>.

A third poor quality trial [-] <sup>50</sup> evaluated the effect of magazine articles primed to manipulate the appeal of pale skin in 53 Caucasian women (mean age 22.98) recruited from a beach in the USA. Participants in the trial answered questions about their mortality (fear threat) or a control topic, and were presented with a fashion article highlighting the attractiveness of pale or natural-looking (neutral) skin. Compared with the control group, reminders of death increased sunscreen intentions in participants reading an article about the attractiveness of fair skin ( $F(1, 49) = 4.64, p = 0.04, d = 0.56$ ) and decreased sunscreen intentions in those reading a similar article focusing on natural looking skin (i.e. no reference to skin tone) ( $F(1, 49) = 4.36, p = 0.04, d = 0.54$ ). When participants were asked what sunscreen product they would like to receive as a gift for participation, participants reminded of death and exposed to the fair skin prime chose products with a higher SPF level than those in the control group ( $F(1, 48) = 7.92, p = .01, d = 0.78$ ); no such differences were found for those exposed to the neutral article <sup>50</sup>.

#### **Evidence Statement 4.3**

There is weak, consistent evidence from one moderate quality [+] RCT<sup>47</sup> and three poor [-] quality RCTs<sup>48-50</sup> that health messages manipulated to invoke a sense of fear or increase worry are effective in promoting behavioural change (sun protection practices). Three trials<sup>47, 48, 50</sup> were conducted in the US and one in Australia<sup>49</sup>. The majority of participants were young women (university aged) who were seeking to tan.

<sup>47</sup>Prentice-Dunn et al. (2009) [+]

<sup>48</sup>Cooper et al. (2014) [-]

<sup>49</sup>Notebaert et al. (2014) [-]

<sup>50</sup>Cox et al. (2009) [-]

### **5.3.6 Other Motivational Interventions**

Five RCTs and one observational study evaluated a range of other motivational interventions, including dissonance induction <sup>51</sup>, instructions on how to view videos presenting health information <sup>9</sup>, self-affirmation tasks <sup>35</sup>, social support <sup>52</sup> and computer-morphed photos <sup>17</sup>. The studies are summarised here and more detail is provided in the Appendices.

The most frequently reported outcomes (reported in four trials) concerned changes in intentions to use either sun protection or sunscreen or to wear a protective hat.

One moderate quality trial [+]<sup>51</sup> investigated whether a dissonance induction strategy would successfully change UV-related behaviour in 260 female US psychology undergraduate students (90% non-Hispanic) who reported frequent indoor/outdoor tanning ( $\geq 6$  times in the past year). The dissonance induction strategy, which comprising an interactive participation session focusing on the negative aspects of the 'ideal tan' – tanning group, was compared with a similar dissonance strategy in healthy living controls and a psycho-educational control focused on tanning. Results showed a decrease in intentions to tan indoors and an increase in intentions to use sunscreen for dissonance induction in the tanning group, compared with a similar strategy for healthy living controls. However, compared with the psycho-educational control, both groups were similarly successful and unsuccessful in different behavioural measures<sup>51</sup>.

In one poor quality trial [-]<sup>9</sup> investigating how age-related changes in attention to negative information can impact on health behaviour, younger (aged 18 to 25) and older (aged 60 to 92) adults from the USA viewed health-related videos with the instruction to control emotions, absorb information, or watch as though it was television at home (control group). Intentions to adopt more sun protective behaviours were measured by the selection of sun protection items. Adults in the information-focused instruction group were significantly more likely to choose a high SPF sunscreen than either the emotion-focused or control groups ( $p=0.01$ ). In addition, older adults showed significantly greater intentions to adopt more protective behaviours than did younger adults: they chose more give-away sun protection items than younger adults ( $M=3$  vs  $M=2$ ,  $F(1, 148) = 16.31$ ,  $p < 0.001$ ), and were more likely to choose high SPF (30 or 50) sunscreen ( $\chi^2(1, N = 154) = 3.81$ ,  $p = 0.05$ )<sup>9</sup>.

Two poor quality trials [-] found the intervention had no effect on intentions to use sun protective measures. The first poor quality trial [-]<sup>52</sup>, conducted in 59 US Caucasian females aged 18 to 24 years, found that social support had no impact on the relationship between worry and health decision-making. The women were assigned to one of four groups: worry induction condition (information provided plus participant asked to imagine impact of cancer); no worry condition (information only); social support condition (viewing information on a website followed by Q&A session and the provision of contact details for further enquiries); and no support condition (as for social support but no contact details). No significant differences in intentions to use sunscreen or to wear a hat were found either immediately post-intervention, or after 30 days' follow-up, between women assigned to any of the four groups<sup>52</sup>.

The second poor quality trial [-]<sup>35</sup> examined the efficacy of a self-affirmation manipulation in instigating behaviour change in response to information about the health risks of sunbathing in 163 female sunbathers in the UK aged 18 to 92 years (mean 33.33). The self-affirmation task, which involved writing a statement about why a personal value is important to you, was attached to the questionnaire and health promotion leaflet that all participants received. Compared with the leaflet alone, there was no effect on subsequent intentions to use sunscreen ( $F(3, 158)=1.95$ ,  $p=0.12$ , partial eta squared=0.04). However, participants in all three affirmation conditions reported higher levels of self-efficacy, i.e. their beliefs about the ability to use sunscreen, than those that received the health promotion leaflet alone ( $t(50.15)=3.24$ ,  $p<0.01$ ,  $d=0.76$ ), and also expressed more positive attitudes towards the use of sunscreen ( $t(57.13)=2.55$ ,  $p<0.05$ ,  $d=0.53$ )<sup>35</sup>.

An additional poor quality trial [-] <sup>17</sup> studied the effects of tanning appearance in photos given to 211 public school students in the USA, aged 11 to 14 years. Students viewed photos of either naturally fair-skinned models (pale target) or photos that had been computer-morphed to make the model look more tanned (tan target). Results showed that although adolescent females were significantly more likely to rate the photo of a tanned model as more attractive than their male counterparts ( $F(1, 194) = 3.99, p=0.05, \text{partial } \eta^2=0.02$ ), the effects of student age (early vs mid adolescent), student behaviour (tanner vs non-tanner) and target photo (pale vs tan) were not significant. Analyses also indicated that target photo had a significant effect on the comparative optimism (i.e. belief to be at lower risk of developing cancer than their peers) of mid-adolescent non-tanning students ( $F(1, 50) = 13.27, p=0.001, \eta^2=0.21$ ), but not mid or early adolescent tanning students or early adolescent non-tanning students (all  $p>0.23$ ). Perceived attractiveness was not significantly associated with comparative optimism ( $p = 0.33$ ) <sup>17</sup>.

A poor quality [-] comparative survey <sup>123</sup> evaluated the effects of the ABC intervention in 60 adult US patients (75% women) who were scheduled to receive a skin examination in a secondary care setting to determine if this technique is associated with improvement in patient satisfaction and immediate intentions to enhance their sun-protective behaviours. The ABC intervention is a 2- to 3-minute conversational tool used to enhance patients' sunscreen use and sun protective behaviours. Following the interventions, those in the ABC group were significantly more likely to intend to increase their sunscreen use (mean 5.14 (SD 1.30) vs. mean 3.17 (SD 1.83),  $p < 0.001$ ) and their intention to use sunscreen before outdoor activities (mean 5.59 (SD 1.21) vs mean 4.38 (SD 1.76),  $p=0.004$ ) <sup>123</sup>.

#### **Evidence Statement 4.4**

There is weak, inconsistent evidence from five RCTs regarding the effect of motivational interventions on individuals' intentions to adopt more sun protective behaviours, or the effectiveness of individual components. One moderate quality [+] RCT investigated dissonance induction in 260 female US psychology undergraduate students (90% non-Hispanic) and showed no differences between groups.<sup>51</sup> Four poor [-] quality RCTs were also identified; one investigating instructions on how to view videos presenting health information in younger (aged 18-25) and older (aged 60 -92) US adults reporting that adults showed significantly greater intentions to adopt more protective behaviours than did younger adults <sup>9</sup>; one investigating self-affirmation tasks in 163 female sunbathers in the UK aged 18 to 92 years reporting no differences in participants intentions to use sunscreen<sup>35</sup>; one investigating social support in 59 US Caucasian females aged 18 to 24 years <sup>52</sup> and computer-morphed photos given to 211 public school students in the USA, aged 11 to 14 years <sup>17</sup>.

<sup>51</sup>Chait et al. (2011) [+]

<sup>9</sup>Isaacowitz et al. (2012) [-]

<sup>52</sup>Midboe et al. (2011) [-]

<sup>35</sup>Jessop et al. (2009) [-]

<sup>17</sup>Roberts et al. (2011) [-]

### 5.3.7 Educational Interventions

There were 24 studies (two SRs, 17 RCTs and five observational studies) of educational interventions. These typically aimed to encourage individuals to change their attitudes towards sun exposure and intentions to adopt protective behaviours, primarily through media campaigns (one study), text messages (one study), tailored education (four studies), active participation (four studies), information provision only (three studies) and other multi-component approaches (six studies).

#### 5.3.7.1 Health promotion programmes based on the UV index

One moderate quality [+] SR<sup>53</sup> was identified that assessed studies using the UV index as a health promotion instrument via media campaigns, programmes aimed at specific settings (e.g. childcare, high radiation), programmes delivered through health care providers, programmes using general or personalized information, or a combination of approaches. This review, which included 25 studies (number of participants not reported), found only one study that assessed attitudes towards sun protection and/or intentions to use sun protective behaviours. The primary study, an RCT conducted in Sweden, evaluated four different information packages, two of which contained a UV meter. Although the study found an improvement in attitude with all four information packs, there was no real difference between them<sup>53</sup>.

#### Evidence Statement 4.5

There is inconclusive evidence from one moderate quality [+] systematic review<sup>53</sup> about the effective of health care programmes based on the UV index in changing individuals' attitudes towards tanning and the risk of skin cancer. The review identified one RCT conducted in Sweden evaluating four different information packages, two of which contained a UV meter. No significant differences were found between the information packages.

<sup>53</sup>Italia et al. (2012) [+]

#### 5.3.7.2 Text messages

One poor quality Australian trial [-]<sup>54</sup> was identified that evaluated the use of mobile phones to send health promotion messages on changing individuals' attitudes towards the risks and benefits of sun exposure. The results of this trial, specifically attitudes towards tanning and risk of skin cancer, are presented in detail in the Appendices. The trial found no significant differences between subscribers to a mobile advertising service (aged 16 to 29 years; 5% born with dark skin) who were randomized to receive fortnightly text messages promoting sun safety or safe sex. The odds ratios were 1.1 95% CI: 0.6–2.4, p=0.72) and 1.0 (95% CI: 0.6–1.5, p=0.98), respectively, for attitudes towards a tan (preference for a dark tan) and attitudes towards the risk of skin cancer (believe about risk of skin cancer)<sup>54</sup>.

#### Evidence Statement 4.6

There is inconclusive evidence from one poor quality [-] RCT<sup>54</sup> that text messages are ineffective in changing individuals' attitudes towards tanning and the risk of skin cancer. The trial found no significant differences between subscribers to a mobile advertising service (aged 16 to 29 years; 5% born with dark skin) who were randomized to receive fortnightly text messages promoting sun safety or safe sex. The odds ratios were 1.1 (95% CI: 0.6–2.4,  $p=0.72$ ) and 1.0 (95% CI: 0.6–1.5,  $p=0.98$ ), respectively, for attitudes towards a tan (preference for a dark tan) and attitudes towards the risk of skin cancer (believe about risk of skin cancer).

<sup>54</sup>Gold et al. (2011) [-]

#### 5.3.7.3 Tailored educational interventions

There were four RCTs that evaluated the use of educational interventions tailored to the individual or incorporating personalized feedback<sup>13, 39, 55, 56</sup>. The outcomes reported in these studies are summarised here and presented in more detail in the Appendices.

The most frequently reported outcomes were changes in intentions relating to sunbathing and use of sun protection, which were reported in three trials<sup>39, 55, 56</sup>.

One moderate quality French trial [+] <sup>13</sup> assessed the effect of a targeted intervention, aimed at reducing the risk and increasing early detection of melanoma, on 173 predominantly female (77%) patients (mean ages 43.6 and 42.8 years) identified as being at elevated risk for melanoma. Twenty general practitioners (GPs), from 20 participating surgeries, delivered either the targeted screening and education intervention or a conventional information-based campaign. GPs in the intervention group identified patients at elevated risk for melanoma with a validated assessment tool, the Self-Assessment Melanoma Risk Score (SAMScore), examined their skin, and provided counselling and information, whereas GPs in the control group displayed a poster and the leaflets in their waiting room and performed skin examinations at their discretion. Intervention patients were more likely to worry about developing melanoma than the control group, but the difference was not significant ( $M=28\%$  vs  $18.4\%$ ,  $p=0.16$ ). Similarly, intervention patients were more likely to consult their GP again to discuss the disease ( $M=15.5\%$  vs  $9.2\%$ ,  $p=0.23$ )<sup>13</sup>.

One poor quality trial [-] <sup>39</sup> reported mixed results for the effect of different approaches to providing sun protection advice in a sample of 316 Swedish adults of varying age ( $\geq 18$  to over 65) registering at a health care clinic with no abnormal UV sensitivity, current intake of UV sensitizing medication or cognitive disorders. All three groups received the same general advice but questionnaire feedback was delivered by three different methods: through a standard letter with a personalized risk assessment, and a personal GP consultation plus individualized information, with or without a phototest (the result of which was returned by mail). Readiness to increase sun protection was based on the Transtheoretical Model of Behaviour Change. After 3 years, results showed no significant difference in stage of change related to giving up sunbathing, use of sunscreen and use of protective clothing. However, a significant difference in terms of staying in the shade was observed between groups assigned to GP consultation, with those not having a phototest showing more readiness to change their behaviour ( $p<0.05$ ). There were no significant differences between the groups in relation to changes in attitudes towards tanning and sunbathing<sup>39</sup>.



One poor quality trial [-] <sup>56</sup> assessed the addition of personalized normative feedback to standard of care in 316 US women under 75 (actual range 36 to 79), 22% of whom had a personal diagnosis of skin cancer. Participants were assigned to either information (standard of care) plus personalized normative feedback (in the form of true injunctive norms observed amongst the sample and the participant's own perceptions of the same norms) or information alone. Compared with information alone, the provision of personalized normalized feedback significantly increased intentions to adopt sun protection measures both immediately post-test and at follow-up (M=4.64 vs M=4.38, d=0.35 at 4 weeks, p-value not reported). However, there was no significant effect on intention to sunbathe, either immediately post-test or at the 4-week follow-up (M=2.70 vs M=2.33, d=0.13) <sup>56</sup>. It was unclear whether a second moderate quality trial [+] <sup>55</sup> reported by the same author was conducted on a US subsample from the 'original' study. This second moderate quality [+] trial assessed the same interventions but in a sample of 189 community-residing women aged 37 to 77 years (94% non-Hispanic White). It reported a similar effect on sun protection intentions at both post-test and 4-week follow-up, but a moderate to large influence of personalized normative feedback on changes in injunctive norms. Participants in the feedback group believed the injunctive norms favouring sun protection to be stronger than those in the control group (post-test means 4.64 and 4.21, respectively) <sup>55</sup>.

#### **Evidence Statement 4.7**

There is weak, inconsistent evidence from one moderate quality [+] RCT conducted in France<sup>55</sup> and two poor quality [-] RCTs conducted in Sweden and the US<sup>39, 56</sup> that tailored interventions improve individuals' intentions to adopt sun protection behaviours for adults.

One moderate quality [+] trial<sup>55</sup> in 316 US women under 75, 22% of whom had a personal diagnosis of skin cancer, compared provision of personalized normalized feedback with information alone and reported significantly increased intentions to adopt sun protection measures both immediately post-test and at follow-up (M=4.64 vs M=4.38, d=0.35 at 4 weeks, p-value not reported). A second poor [-] quality trial <sup>39</sup> in 316 Swedish adults compared a standard letter with a personalized risk assessment with a personal GP consultation plus individualized information, with or without a phototest. After 3 years, no significant differences in giving up sunbathing, use of sunscreen and use of protective clothing. <sup>39</sup>.

There is weak, consistent evidence from two moderate quality [+] RCTs<sup>13, 55</sup> that tailored interventions are not effective in changing attitudes in relation to the risks of sun exposure and sun protection behaviours.

One moderate quality [+] French trial<sup>13</sup> in 173 predominantly female adults identified as being at elevated risk for melanoma compared a targeted screening and education intervention or a conventional information-based campaign in 20 GP practices. There were no significant differences between groups. A second poor quality [-] trial<sup>55</sup> assessed the addition of personalized normative feedback to standard of care in 316 US women under 75, 22% of whom had a personal diagnosis of skin cancer. There was no significant effect on intention to sunbathe, either immediately post-test or at the 4-week follow-up (M=2.70 vs M=2.33, d=0.13).

<sup>55</sup>Reid et al. (2013) [+]

<sup>39</sup>Falk et al. (2011) [-]

<sup>56</sup>Reid et al. (2011) [-]

#### 5.3.7.4 Active participation education sessions

Four RCTs and three observational studies assessed the impact of active participation education sessions on changing the attitudes of individuals towards sun exposure and protection. The outcomes reported in these studies are summarised here and presented in detail in the Appendices.

Three trials, ranging in quality from good [++] to poor [-], reported changes in attitudes, specifically attitudes towards sun prevention, tanning and sunbed use.

One good quality trial [++] <sup>4</sup> evaluated the impact of the 'Living with the Sun' (LWS) programme, a sun safety education programme aimed at improving children's knowledge and modifying their behaviour and attitudes towards sun safety through a series of classroom activities. The trial, which compared the LWS programme with no LWS programme, was conducted in 1365 French school children aged 9 to 12 year from 70 classes in participating primary schools; 57.7% to 58.7% of the children had pale white to cream white skin (skin type I + II + III on Fitzpatrick scale). Both groups showed positive changes in attitudes immediately after completion of the programme, with significant differences observed between groups for questions on whether tan offers protection from sunburn (35.4% vs. 48.6%,  $p < 0.04$ ), when sun protection is necessary (when walking: 69.2% vs 76.7%,  $p < 0.04$ ; in the mountains: 60.0% vs 79.1%,  $p < 0.04$ ), the need for sun protection (sunscreen use helps avoid later skin damage: 20.5% vs. 27.6%,  $p < 0.04$ ) and approach to sun protection (best protection is a combination of behaviours: 59.6% vs. 67.0%,  $p < 0.04$ ). Although differences between the groups decreased throughout the year, they remained significant <sup>4</sup>.

One moderate quality trial [+] <sup>57</sup> evaluated two versions of the Pool Cool programme for preventing skin cancer in 3014 US lifeguards (mean age 18.6 years) recruited from 400 participating outdoor pools. The basic version comprised a toolkit, training session and container of sunscreen, whilst the enhanced version contained additional sun safety items and environmental supports, such as sun signs and the opportunity to be involved in an incentive points system. Participation in either the basic or enhanced versions of the programme had no effect on tanning attitudes, as assessed through responses to two items: "People are more attractive if they have a tan" and "It helps to have a good base tan". There were no differences between groups for both items, either at baseline or follow-up. Results showed that baseline tanning attitude was an important predictor of future attitudes towards tanning <sup>57</sup>.

No effects were also observed in one poor quality trial [-] <sup>58</sup> examining an education intervention on sunbed use (e-magazine and educational exercises) in Danish teenagers (aged 14 to 17) at continuation schools which had either strong or weak smoking policies, i.e. smoking prohibited or allowed for both staff and pupils. A total of 2351 pupils from 33 randomized schools received either the intervention, partly through classroom sessions, or no intervention. Although the intervention had no significant effect on the attitudes of either girls or boys towards sunbed use or on intentions to use sunbeds, the analyses revealed a significant impact of the school on attitudes (intraclass correlation coefficient estimates of 6.0% and 7.8% for girls and boys, respectively) <sup>58</sup>.

An additional poor quality trial [-],<sup>22</sup> conducted in German school children, reported changes in outcome expectancies (for avoiding over exposure), self-efficacy (convincing friends to seek shade), health-related time perspectives and appearance motives (for tanning) and the predicted impact on intentions and exposure behaviour. In this trial, an interactive presentation providing general information on the effects of sun exposure plus a personal UV photo was compared with a similar intervention focused on interdental hygiene in 253 high school students aged 13 to 19 years from seven schools. Being in the intervention group predicted significant changes in outcome expectancies (beta = 0.30 [SE 0.06],  $p < 0.001$ ), health-related time perspectives (beta = 0.12 [SE 0.05],  $p < 0.01$ ), and appearance motives (beta = -0.12 [SE 0.05],  $p < 0.01$ ), but not self-efficacy (efficacy (beta = -0.03 [SE 0.06])<sup>22</sup>.

A moderate quality [+] non-comparative observational study<sup>5</sup> used a questionnaire before and after a 'SunPass' project conducted in 5424 children attending 55 kindergartens in Germany. The SunPass project involved an interventional lecture, site inspections and certification of nursery schools. Children were aged between 0 and 12 years (mean 3.8 years). Encouragement of headgear use for staff members by their institution increased significantly from 20.8% at baseline to 36.7% following the intervention ( $p < 0.001$ ), however children were not encouraged more after the intervention to put sunscreen on themselves ( $p = 0.425$ )<sup>5</sup>.

A moderate quality [+] non-comparative observational study<sup>59</sup> sought to examine trends over time in sun-protective behaviours of Australians and the effect of SunSmart-paid television media on skin cancer prevention attitudes and behaviours in the context of a long-term health promotion programme. The study interviewed 11589 adults over the telephone using age and gender quotas to ensure generalisability of the sample. There was an improvement over time; 41.9% of people in 1987-88 said "no" to "Do you like to get a tan?" compared with 59.3% in 2001-2 ( $p < 0.001$ )<sup>59</sup>.

A moderate quality [+] non-comparative observational study<sup>60</sup> in 232 outdoor workers in Michigan, USA (mean age of 45.6) evaluated changes in beliefs and attitudes toward sun protection behaviours before and after implementation of the evidence-based "Sun Solutions" educational module among operating engineers, 89.6% of whom were male. Following the intervention, 84% of participants reported their intentions to use sunscreen<sup>60</sup>.

#### Evidence Statement 4.8

There is moderate, inconsistent evidence from one good quality [++] RCT conducted in French school children<sup>4</sup>, one moderate quality [+] RCT conducted in US lifeguards<sup>57</sup> and one poor quality [-] RCT conducted in Danish teenagers<sup>58</sup> about the effectiveness of active participation education sessions in changing individuals' attitudes towards sun exposure and protection.

Two trials<sup>4, 22</sup> reported the active participation sessions were effective. One trial evaluated the impact of the 'Living with the Sun' (LWS) programme<sup>4</sup> - a sun safety education programme aimed at improving children's knowledge and modifying their behaviour and attitudes towards sun safety through a series of classroom activities. 1365 French school children aged 9 to 12 years showed positive changes in attitudes immediately after completion of the programme, with significant differences observed between groups for questions on whether tan offers protection from sunburn (35.4% vs. 48.6%,  $p < 0.04$ ), when sun protection is necessary (when walking: 69.2% vs 76.7%,  $p < 0.04$ ; in the mountains: 60.0% vs 79.1%,  $p < 0.04$ ), the need for sun protection (sunscreen use helps avoid later skin damage: 20.5% vs. 27.6%,  $p < 0.04$ ) and approach to sun protection (best protection is a combination of behaviours: 59.6% vs. 67.0%,  $p < 0.04$ ).<sup>4</sup> An additional poor quality trial [-],<sup>22</sup> conducted in German school children used an interactive presentation providing general information on the effects of sun exposure plus a personal UV photo compared with a similar intervention focused on interdental hygiene in 253 high school students aged 13 to 19 years. Being in the intervention group predicted significant changes in outcome expectancies (beta = 0.30 [SE 0.06],  $p < 0.001$ ), health-related time perspectives (beta = 0.12 [SE 0.05],  $p < 0.01$ ), and appearance motives (beta = -0.12 [SE 0.05],  $p < 0.01$ ), but not self-efficacy (efficacy (beta = -0.03 [SE 0.06])

Two trials reported no effect of active participation sessions. One moderate quality [+] trial<sup>57</sup> investigated the Pool Cool programme for preventing skin cancer in 3014 US lifeguards and one poor quality and one poor quality trial [-]<sup>58</sup> examined an education intervention on sunbed use (e-magazine and educational exercises) in Danish teenagers (aged 14 to 17).

Three moderate quality [+] non-comparative observational study reported mixed results, two studies showed improvements<sup>59, 60</sup>, while one study reported no differences.<sup>5</sup>

<sup>4</sup>Sancho-Garnier et al. (2012) [++]

<sup>57</sup>Hiemstra et al. (2012) [+]

<sup>58</sup>Aarestrup et al. (2014) [-]

<sup>22</sup>Schuz et al. (2013) [-]

<sup>59</sup>Dobbinson et al. (2008) [+]

<sup>60</sup>Lee et al. (2013) [+]

<sup>5</sup>Stover et al. (2012) [+]

#### 5.3.7.5 Information provision only

Three RCTs, of varying quality, and two observational studies assessed alternative means of communicating information with the overall aim of promoting healthy sun behaviour. There were no outcomes common to all of these studies.

One good quality trial [++] <sup>61</sup> evaluated the effects of a brief appearance-focused intervention based on decision-theoretical models of health behaviour in 430 female university students in the USA (mean age 19 years) with prior indoor tanning or with future intentions to tan. Compared with the control (no intervention), the appearance-focused booklet significantly reduced both intentions to indoor tan ( $F(df = 1400) = 15.64; p < 0.001$ , 2-tailed) and attitudes towards indoor tanning ( $p < 0.01$ ) at the long-term follow-up (6 months), despite follow-up being conducted from February through April during the heaviest period of sunbed use <sup>61</sup>.

One moderate quality trial [+] <sup>62</sup> conducted in 121 British university students and staff (aged 14 to 61) recruited from an outdoor setting and who liked to tan examined the impact of temporal framing of messages providing information about the use of sunscreen in the prevention of skin cancer, according to health behaviour. The messages were presented in information booklets and were framed as long-term positive and short-term negative consequences, or vice versa, while participants were categorized as either high or low responders, based on responses to the Future Consequences Scale (CRC). High responders exhibited more positive intentions to use sunscreen than low responders ( $F(1, 117) = 7.13, p < 0.01$ ), but the main effect of temporal frame was not significant. When considering both future consequence and temporal frame, high responders were more likely to endorse sunscreen use when information was presented as the short-term negative and long-term positive manipulation, whereas low responders were more likely to endorse sunscreen use than high responders for information presented as the short-term positive and long-term negative manipulation <sup>62</sup>.

Communications promoting sun protection use and sun avoidance through the use of tailored and non-tailored material were found to have no effect on self-efficacy for sun protection use in one poor quality US trial [-] <sup>63</sup>. This trial compared a summer programme of newsletters aimed at adolescents (Summer Raze) and parents (Sun Scoop) with no summer programme in 599 high school students aged 11 to 15 years and their parents. The authors reported that there was no evidence of a significant difference between those who did and did not receive the summer programme in either parents or their children (data not reported) <sup>63</sup>.

One moderate quality [+] comparative observational study <sup>64</sup> used a before and after study design to investigate the effectiveness of a maternity hospital-based education programme (midwife teaching intervention) to discourage mothers from exposing themselves and their infants to sunlight for therapeutic reasons in an intense UV radiation environment. 106 pre- and 203 post-intervention women were recruited from an Australian maternity hospital. Women were aged 27.4 (SD 5.65) years and the majority were Caucasian. Following the intervention, significantly fewer women reported their intention to 'sun' their baby if they suspected jaundice in their newborns (28.8% vs. 13.3%;  $p < 0.001$ ); intentionally expose their babies to help their skin adapt to sunlight (10.5% vs. 2.5%;  $p = 0.003$ ); or use sunlight for the treatment of sore or cracked nipples (7.6% vs. 2%;  $p = 0.026$ ). There were no differences in women's intentions to 'sun' their baby to obtain adequate vitamin D, to treat nappy rash, or as a treatment for acne <sup>64</sup>.

A moderate quality [+] non-comparative observational study<sup>65</sup> using questionnaires aimed to evaluate whether the development, implementation and evaluation of an educational intervention would increase midwives' and nurses' knowledge and confidence in talking to mothers about sunlight exposure in a hospital in Queensland, Australia. 39 women were included post intervention, and 42 at follow-up. The educational intervention was considered successful in developing the knowledge of midwives and nurses to provide sound advice to new mothers about therapeutic sun exposure<sup>65</sup>.

#### **Evidence statement 4.9**

There is moderate, inconsistent evidence from one good quality [++] RCT conducted in US university students<sup>61</sup>, one moderate quality [+] RCT conducted in British university students<sup>62</sup> and one poor quality [-] RCT conducted in US high school students<sup>63</sup> and two observational studies<sup>64, 65</sup> that information provision alone is effective in changing individuals' attitudes and beliefs towards the use of sun protection.

One good quality trial [++]<sup>61</sup> evaluated the effects of a brief appearance-focused intervention in 430 female university students in the USA with prior indoor tanning or with future intentions to tan. Compared with the control (no intervention), the appearance-focused booklet significantly reduced both intentions to indoor tan ( $F(df = 1400) = 15.64; p < 0.001$ , 2-tailed) and attitudes towards indoor tanning ( $p < 0.01$ ) at the long-term follow-up (6 months).

No effect of information provision was found in one moderate quality trial [+] <sup>62</sup> conducted in 121 British university students and staff (aged 14 to 61) recruited from an outdoor setting and who liked to tan, examining the impact of temporal framing of messages providing information about the use of sunscreen, or from a poor quality [-] US trial<sup>63</sup> comparing a summer programme of newsletters aimed at adolescents (Summer Raze) and parents (Sun Scoop) with no summer programme in 599 high school students aged 11 to 15 years and their parents

Two observational studies compared information interventions to investigate the effectiveness of educational interventions; one study<sup>64</sup> discouraged mothers from exposing themselves and their infants to sunlight for therapeutic reasons and was found to be ineffective, while the other study<sup>65</sup> aimed to increase midwives' and nurses' knowledge and confidence in talking to mothers about sunlight exposure and was thought to be successful.

<sup>61</sup>Hillhouse et al. (2008) [++]

<sup>62</sup>Orbell et al. (2008) [+]

<sup>63</sup>Reynolds et al. (2008) [-]

<sup>64</sup>Harrison et al. (2013) [+]

<sup>65</sup>Devine et al. (2008) [+]

### 5.3.7.6 Multi-component interventions

There were six studies (one SR and five RCTs) that evaluated the impact of multi-component interventions in changing individuals' attitudes towards the risks and benefits of sun exposure<sup>11, 12, 18, 28, 34, 44, 66, 67</sup>. Individual components of the interventions in the included studies comprised various approaches to presenting and delivering health information (text formats, videos, photos, lectures, posters, mail, and information campaigns), medical examinations, interactive tasks, persuasive messages, and interviews, counselling sessions, self-affirmation tasks and personalized feedback. The outcomes reported in these studies are summarised here and presented in more detail in the Appendices.

The main outcome reported was changes in individuals' intentions to use sun protection, reported in four RCTs<sup>11, 18, 28, 66</sup>.

Two studies employed motivational techniques as part of their intervention<sup>11, 66</sup>. In one good quality trial [++]<sup>11</sup>, 494 adult siblings (age 18 to >51) of recently diagnosed (<1 month) melanoma patients in the USA received either a multi-component intervention (comprising a motivational and goal-setting session, individually tailored feedback, telephone counselling, mailed information and links to free screening) or the suggestion to notify family members and encourage screening (i.e. usual care). After 12 months, there was no difference between the two groups in terms of intentions to use sunscreen, but participants receiving the multi-component intervention reported greater intentions to see a dermatologist than those receiving usual care (69.9% vs 65.2%; OR 1.68, 95% CI: 1.16 to 2.44), and also greater confidence in seeing a dermatologist (61.2% vs 53.3%; OR 2.14, 95% CI: 1.2 to 3.7)<sup>11</sup>. In a poor quality trial [-]<sup>66</sup>, stage of change for use of sun protection was significantly affected by the addition of photos and/or a motivational interviewing counselling session to educational material in 197 university psychology students in the USA (aged 18 to 24) with at least one risk factor for skin cancer. The use of photos was significantly more effective in improving stage of change compared with education (OR 2.58, 95% CI: 1.06 to 6.28, p=0.04), while motivational interviewing was marginally more effective than education (OR 2.20, 95% CI: 0.91 to 5.31; p=0.08). It was unclear why the effects of the multi-component intervention did not differ significantly from the control (education)<sup>66</sup>.

One moderate quality trial [+] <sup>18</sup> compared the effects of a combination of self-efficacy information and self-affirmation (a written task on the importance of personal values) with no intervention or either of the intervention components alone, in 677 female UK students (aged 16 to 23) in their final year of secondary school or enrolled on a university psychology course. When presented with a message evoking the threat of skin cancer, students who received the efficacy information showed significantly greater intentions to use sun protection than those who did not (M=6.15 vs M=5.68, p=0.03); no such difference was observed when the message related to photoaging (M=5.93 vs M=5.89, p=0.87). In addition, a marginally significant effect on age-based denial was observed, with less age-based denial seen amongst those who received efficacy information compared with those who did not<sup>18</sup>

One poor quality trial [-] <sup>28</sup> found the addition of persuasive messages and UV photos depicting skin damage to have no effect on intentions to use sun protection. In this trial, 151 US mothers (mean age 43.1 years) of elementary and middle-school aged children received a multi-component information intervention (brochures, photos, sunscreen) with or without a UV photo, in conjunction with either a forcefully persuasive message, an open-ended dialogue (subtle persuasion) or without persuasion. No significant differences between groups (UV photo/no UV photo or persuasion condition) were also found for the mothers' willingness and intentions to seek UV exposure, their intention to protect themselves, and their willingness and intentions to protect their children and allow their children to be exposed to UV <sup>28</sup>.

Two additional studies were conducted in individuals whose occupation or leisure pursuits could cause excessive UV exposure. The first, a moderate quality trial [+] <sup>67</sup>, evaluated a community-based informational campaign with or without a cognitive-behavioural small group intervention in 61 white, predominantly female (73%) undergraduates from the USA who were intending to have a spring holiday at <35° latitude (i.e. subtropics). There was no significant difference between groups in terms of their attitudes and beliefs towards sunscreen use, sun protection in general, and sun exposure <sup>67</sup>.

The second study, a low quality SR [-] <sup>12</sup>, evaluated the effectiveness of multi-component sun-safety education programmes in outdoor occupational settings. The review identified eight interventional studies that reported attitudes towards skin cancer, sun protection and suntan, but provided little detail in the way of results. One of the included primary studies reported a significant positive short-term effect of an education programme <sup>12</sup>.

#### **Evidence Statement 4.10**

There is moderate, inconsistent evidence from one good quality [++] RCT conducted in adult siblings of melanoma patients from the US<sup>11</sup>, one moderate quality [+] RCT conducted in British female students (high school and university)<sup>18</sup>, and two poor quality [-] RCTs conducted in US university students and US mothers<sup>28, 66</sup> about the effectiveness of multi-component educational interventions in changing individuals' intentions to use sun protection.

Two studies employed motivational techniques as part of their intervention <sup>11, 66</sup>. In one good quality [++] trial<sup>11</sup>, 494 adult siblings (age 18 to >51) of recently diagnosed melanoma patients in the US received either a multi-component intervention (comprising a motivational and goal-setting session, individually tailored feedback, telephone counselling, mailed information and links to free screening) or the suggestion to notify family members and encourage screening (i.e. usual care). After 12 months, there was no difference between the two groups in terms of intentions to use sunscreen, but participants receiving the multi-component intervention reported greater intentions to see a dermatologist than those receiving usual care (69.9% vs 65.2%; OR 1.68, 95% CI: 1.16 to 2.44), and also greater confidence in seeing a dermatologist (61.2% vs 53.3%; OR 2.14, 95% CI: 1.2 to 3.7) <sup>11</sup>. In a poor quality trial [-] <sup>66</sup>, the use of sun protection was significantly affected by the addition of photos and/or a motivational interviewing counselling session to educational material in 197 university psychology students in the USA (aged 18 to 24) with at least one risk factor for skin cancer. The use of photos was significantly more effective in improving stage of change compared with education (OR 2.58, 95% CI: 1.06 to 6.28, p=0.04), while motivational interviewing was marginally more effective than education (OR 2.20, 95% CI: 0.91 to 5.31; p=0.08). It was unclear why the effects of the multi-component intervention did not differ significantly from the control (education) <sup>66</sup>.



One moderate quality trial [+] <sup>18</sup> compared the effects of a combination of self-efficacy information and self-affirmation (a written task on the importance of personal values) with no intervention or either of the intervention components alone, in 677 female UK students (aged 16 to 23) in their final year of secondary school or enrolled on a university psychology course. When presented with a message evoking the threat of skin cancer, students who received the efficacy information showed significantly greater intentions to use sun protection than those who did not (M=6.15 vs M=5.68, p=0.03); no such difference was observed when the message related to photoaging (M=5.93 vs M=5.89, p=0.87). <sup>18</sup>

One poor quality trial [-] <sup>28</sup> found the addition of persuasive messages and UV photos depicting skin damage to have no effect on intentions to use sun protection. in 151 US mothers of elementary and middle-school aged children.

There is weak, consistent evidence from one moderate quality RCT [+] conducted in US university students<sup>67</sup> and one poor quality systematic review [-] including eight primary studies<sup>12</sup> that multi-component interventions are not effective in changing attitudes towards sunscreen use and sun exposure in people whose occupational or leisure pursuits could cause excessive sun exposure.

<sup>11</sup>Geller et al. (2006) [++]

<sup>18</sup>Good et al. (2011) [+]

<sup>66</sup>Heckman et al. (2013) [-]

<sup>28</sup>Dykstra et al. (2008) [-]

<sup>67</sup>Roberts et al. (2009) [+]

<sup>12</sup>Reinart et al. (2013) [-]

### 5.3.8 Results in Different Population Groups

The following summaries represent groups that are thought to be at higher risk of sun damage and skin cancer.

#### 5.3.8.1 School-aged children

There were five RCTs relating to children of school age (ranging from 9 years to high school) <sup>4, 17, 22, 58, 63</sup>.

One good quality trial [++] <sup>4</sup> evaluated the impact of the 'Living with the Sun' (LWS) programme, a sun safety education programme delivered through classroom sessions, in 1365 French school children aged 9 to 12 years; 57.7% to 58.7% of the children had pale white to cream white skin (skin type I + II + III on Fitzpatrick scale. Children in the LWS and no LWS groups both showed positive changes in attitudes immediately after completion of the programme. Significant between-group differences (p<0.02) were observed for questions relating to whether tan offers protection from sunburn and sun protection behaviours; these differences decreased throughout the year but remained significant <sup>4</sup>.

The other four trials were of a poor quality [-]. One poor quality trial [-] <sup>58</sup> examined an education intervention on sunbed use (e-magazine and educational exercises), delivered partly through classroom sessions, to 2351 pupils aged 14 to 17 years from continuation schools in Denmark with strong or weak smoking policies (i.e. either allowed or prohibited smoking for both staff and pupils). Neither group (intervention or no intervention) demonstrated an effect on the attitudes of either girls or boys towards sunbed use or on intentions to use sunbeds <sup>58</sup>.

A second poor quality trial [-] <sup>63</sup> compared tailored communications (Summer Raze and Sun Scoop newsletters aimed at adolescents and parents, respectively) and non-tailored communications promoting sun protection and sun avoidance in 599 US high school students aged 11 to 15 years and their parents. There was no evidence of a significant difference in self-efficacy for sunscreen protection between those who did and did not receive the summer programme in either parents or children (data not reported) <sup>63</sup>.

The third poor quality trial [-] <sup>22</sup> compared an interactive presentation providing general information on the effects of sun exposure plus a personal UV photo with a similar intervention focused on interdental hygiene in 253 German high school students aged 13 to 19 years from seven schools. Being in the intervention group predicted significant changes in outcome expectancies (beta = 0.30 [SE 0.06], p<0.001), health-related time perspectives (beta = 0.12[SE 0.05], p<0.01), and appearance motives (beta = -0.12[SE0.05], p<0.01), but not self-efficacy (efficacy (beta = -0.03[SE 0.06]) <sup>22</sup>.

The fourth poor quality trial [-] <sup>17</sup> studied the effects of tanning appearance in photos given to 211 public school students in the USA, aged 11 to 14 years. Female students were significantly more likely to rate a photo computer-morphed to make a naturally fair-skinned model look more tanned as more attractive than their male counterparts (p=0.05), but student age, student tanning behaviour and target photo (unadulterated vs tanned) had no significant effects. Target photo, however, had a significant effect on the comparative optimism for likelihood of developing cancer (i.e. belief of being at lower risk than their peers) but only in the group of mid-adolescent non-tanning students (F1, 50) =13.27, p=0.001, eta-squared=0.21). Perceived attractiveness was not significantly associated with comparative optimism (p =0.33) <sup>17</sup>.

#### **Evidence Statement 5.1**

There is moderate, inconsistent evidence from five RCTs<sup>4, 17, 22, 58, 63</sup> relating to children of school age (ranging from 9 years to high school) about the effectiveness of interventions to change attitudes of school-aged children.

One good quality [++] trial <sup>4</sup> evaluated the impact of the 'Living with the Sun' (LWS) programme, a sun safety education programme delivered through classroom sessions, in 1365 French school children aged 9 to 12 years; significant between-group differences (p<0.02) were observed for questions relating to whether tan offers protection from sunburn and sun protection behaviours; these differences decreased throughout the year but remained significant <sup>4</sup>.

There were no significant effects of an education intervention on sunbed use (e-magazine and educational exercises), delivered partly through classroom sessions, to 2351 pupils aged 14 to 17 years from continuation schools in Denmark<sup>58</sup>; between those who did and did not receive a tailored newsletter summer programme in 599 high school students or their parents<sup>63</sup>. A poor quality trial [-] <sup>22</sup> reported significant changes in outcome expectancies (beta = 0.30 [SE 0.06], p<0.001), health-related time perspectives (beta = 0.12[SE 0.05], p<0.01), and appearance motives (beta = -0.12[SE0.05], p<0.01), but not self-efficacy (efficacy (beta = -0.03[SE 0.06]) in 253 German high school students aged 13 to 19 years receiving general information on the effects of sun exposure plus a personal UV photo compared with a similar intervention focused on interdental hygiene<sup>22</sup>. A second poor quality [-] trial<sup>17</sup> reported that female students were significantly more likely to rate a photo computer-morphed to make a naturally fair-skinned model look more tanned as more attractive than their male

counterparts ( $p=0.05$ ) studied the effects of tanning appearance in photos given to 211 public school students in the USA, aged 11 to 14 years.

<sup>58</sup>Aarestrup et al. (2014) [-]

<sup>22</sup>Schuz et al. (2013) [-]

<sup>4</sup>Sancho-Garnier et al. (2012) [++]

<sup>17</sup>Roberts et al. (2011) [-]

<sup>63</sup>Reynolds et al. (2008) [-]

### 5.3.8.2 Outdoor workers

There were 3 studies (one SR and two RCTs) of participants whose occupation was considered to cause excessive UV exposure including US Department of Transport road workers<sup>20</sup> and US lifeguards<sup>57</sup> or evaluated programmes in outdoor occupational settings<sup>12</sup>.

In one poor quality SR [-]<sup>12</sup> only one of the eight included primary studies reported a significant positive short-term effect of an education programme conducted in outdoor occupational settings on attitudes towards skin cancer and sun behaviours ( $p$ -value not reported). One moderate quality trial [+] <sup>20</sup> reporting attitudes towards sun protection examined the impact of UV photography interventions (UV photo or no photo plus educational video on photoaging or skin cancer) in 148 male US outdoor road workers (mean age 46.5 years), the majority (90%) of whom spent at least 5 to 6 hours in the sun each day. Overall, men who saw their UV photo and/or the educational video reported more positive attitudes toward sun protection than the control group (no UV photo and no educational video) ( $M=3.6$  vs  $M=3.1$ ;  $F(1, 146) = 11.49$ ,  $p=0.001$ ,  $d=0.86$ ). All four interventions were significantly different from the control (all  $p<0.01$ ; all  $d>0.81$ ), but not each other (all  $p>0.4$ )<sup>20</sup>. One moderate quality trial [+] <sup>57</sup> evaluated basic and enhanced versions of the Pool Cool programme for preventing skin cancer and found no effect on the attitudes of 3014 US lifeguards (mean age 18.6 years) from 400 participating pools, as assessed through responses to: "People are more attractive if they have a tan" and "It helps to have a good base tan". Baseline tanning attitude was an important predictor of future attitudes towards tanning<sup>57</sup>.

#### Evidence Statement 5.2

There is weak, inconsistent evidence from one poor quality systematic review [-] including eight primary studies<sup>12</sup> and two moderate quality [+] RCTs about the effectiveness of interventions to change the attitudes of people at risk of occupational skin cancer.

In one poor quality SR [-]<sup>12</sup> only one of the eight included primary studies reported a significant positive short-term effect of an education programme conducted in outdoor occupational settings on attitudes towards skin cancer and sun behaviours ( $p$ -value not reported). One RCT<sup>20</sup> investigating UV photographs in 148 male outdoor road workers reported that men who saw their UV photo and/or the educational video reported more positive attitudes toward sun protection than the control group (no UV photo and no educational video) ( $M=3.6$  vs  $M=3.1$ ;  $F(1, 146) = 11.49$ ,  $p=0.001$ ,  $d=0.86$ ). A second RCT<sup>57</sup> found no effect of basic and enhanced versions of an active participation education programme in 3014 US lifeguards.

<sup>12</sup>Reinau et al. (2013) [-]

<sup>20</sup>Stock et al. (2009) [++]

<sup>57</sup>Hiemstra et al. (2012) [++]

### 5.3.8.3 Lifestyle/leisure-associated risks

There were 10 studies (one SR and nine RCTs) of participants whose occupation or leisure pursuits were considered to cause excessive UV exposure. Three studies (one SR and two RCTs) recruited populations at occupational risk of skin cancer, including US Department of Transport road workers<sup>20</sup> and US lifeguards<sup>57</sup> or evaluated programmes in outdoor occupational settings<sup>12</sup>. Five trials recruited individuals seeking tans on the beach or in an outdoor area<sup>48, 50, 62</sup>, or with prior indoor/outdoor tanning or intentions to tan<sup>47, 51, 61</sup>, and one trial recruited US students intending to holiday in a subtropical region<sup>67</sup>.

One moderate quality trial [+] <sup>62</sup> examined the impact of temporal framing of information messages in 121 British university students and staff (aged 14 to 61) recruited from an outdoor area and who liked to tan. The messages were framed as long-term positive and short-term negative consequences, or vice versa, while participants were categorized as either high or low responders, based on responses to the Future Consequences Scale. High responders exhibited more positive intentions to use sunscreen than low responders ( $F(1, 117) = 7.13, p < 0.01$ ), but there was no significant difference in message frame. One poor quality trial [-] conducted in 147 predominantly white (95%) US beach goers (mean age 24.5 years) examined the impact of fear appeals on messages highlighting the effectiveness or ineffectiveness of sun protection behaviours. When fear appeals consciously primed death, sun protection intentions were decreased for behaviours considered ineffective compared with those considered effective (sun protection scores 3.36 vs 5.45,  $p = 0.02$ ); the framing of the message had no effect when death was no longer a conscious thought<sup>48</sup>.

A second poor quality trial [-] <sup>50</sup> evaluated the effect of magazine articles primed to manipulate the appeal of pale skin in 53 Caucasian women in the USA (mean age 22.98) recruited from a beach. Reminders of death increased sunscreen intentions in participants reading an article about the attractiveness of fair skin ( $F(1, 49) = 4.64, p = 0.04, d = 0.56$ ), but decreased sunscreen intentions in the control group who read a similar article focusing on natural looking skin (i.e. no reference to skin tone) ( $F(1, 49) = 4.36, p = 0.04, d = 0.54$ ). Participants reminded of death and exposed to the fair skin prime also chose products with a higher SPF level as a gift than participants in the control group ( $F(1, 48) = 7.92, p = .01, d = 0.78$ ); no such differences were found for those exposed to the neutral article<sup>50</sup>.

One good quality trial [++] <sup>61</sup> found that a brief appearance-focused intervention based on decision-theoretical models of health behaviour significantly reduced both intentions to indoor tan ( $F(df = 1400) = 15.64; p < 0.001, 2$ -tailed) and attitudes towards indoor tanning ( $p < 0.01$ ) at 6 months, relative to no intervention, in 430 female university students in the USA (mean age 19 years) with prior indoor tanning or with future intentions to tan. One moderate quality trial [+] <sup>51</sup> investigated whether a dissonance induction strategy would successfully change UV-related behaviour in 260 female US psychology undergraduate students (90% non-Hispanic) who reported frequent indoor/outdoor tanning ( $\geq 6$  times in the past year). The dissonance induction strategy, which comprised an interactive participation session focusing on the negative aspects of the 'ideal tan' – tanning group, was compared with a similar dissonance strategy in healthy living controls and a psycho-educational control focused on tanning. The dissonance induction tanning group showed decreased intentions to tan indoors and increased intentions to use sunscreen relative to the healthy living controls, but similar behaviour to the psycho-educational controls<sup>51</sup>.

In a second moderate quality trial [+] <sup>47</sup>, 254 Caucasian female undergraduates in the USA who had previously sought a tan read one of four essays that manipulated the level of threat and coping information. High and low threat essays, respectively, emphasized and minimized concerns in relation to sun exposure, whilst high and low coping essays focused on the effectiveness and inconvenience, respectively, of the recommended measures. Both the high threat and high coping appraisal information elicited significantly higher intentions to use sun protection than their low equivalents ( $F=92.32$ ,  $p<0.001$  and  $F=5.84$ ,  $p<0.02$ ), respectively <sup>47</sup>. A third moderate quality trial [+] <sup>67</sup> found no significant effect between a community-based informational campaign with or without a cognitive-behavioural small group intervention on sun-related attitudes and beliefs of 61 white, predominantly female (73%) US undergraduate students who were intending to have a spring holiday at  $<35^\circ$  latitude (i.e. subtropics).

### Evidence statement 5.3

There is weak, inconsistent evidence from one moderate quality [+] RCT investigating the impact of temporal framing of information messages in British university students and staff<sup>62</sup> and two poor quality [-] RCTs, one investigating impact of fear appeals on messages in US beach going adults<sup>48</sup> and one investigating magazine articles to manipulate the appeal of pale skin in US women <sup>50</sup>, on the effectiveness of interventions to increase intentions to use sun protection in people who seek to tan.

One moderate quality trial [+] <sup>62</sup> examined the impact of temporal framing of information messages in 121 British university students and staff (aged 14 to 61) recruited from an outdoor area and who liked to tan. The messages were framed as long-term positive and short-term negative consequences, or vice versa, while participants were categorized as either high or low responders, based on responses to the Future Consequences Scale. High responders exhibited more positive intentions to use sunscreen than low responders ( $F(1, 117) = 7.13$ ,  $p<0.01$ ), but there was no significant difference in message frame. One poor quality [-] trial<sup>48</sup> conducted in 147 predominantly white (95%) US beach goers (mean age 24.5 years) examined the impact of fear appeals on messages highlighting the effectiveness or ineffectiveness of sun protection behaviours. When fear appeals consciously primed death, sun protection intentions were decreased for behaviours considered ineffective compared with those considered effective (sun protection scores 3.36 vs 5.45,  $p=0.02$ ); the framing of the message had no effect when death was no longer a conscious thought. A second poor quality [-] trial<sup>50</sup> evaluated the effect of magazine articles primed to manipulate the appeal of pale skin in 53 Caucasian women in the USA (mean age 22.98) recruited from a beach. Reminders of death increased sunscreen intentions in participants reading an article about the attractiveness of fair skin ( $F(1, 49) = 4.64$ ,  $p=0.04$ ,  $d=0.56$ ), but decreased sunscreen intentions in the control group who read a similar article focusing on natural looking skin (i.e. no reference to skin tone) ( $F(1, 49) = 4.36$ ,  $p=0.04$ ,  $d=0.54$ ). Participants reminded of death and exposed to the fair skin prime also chose products with a higher SPF level as a gift than participants in the control group ( $F(1, 48) = 7.92$ ,  $p = .01$ ,  $d = 0.78$ ); no such differences were found for those exposed to the neutral article <sup>50</sup>.

There is moderate, inconsistent evidence from one good quality [++] RCT investigating an appearance-focused intervention based on decision-theoretical models of health behaviour in US university students<sup>61</sup> and three moderate quality [+] RCTs (all conducted in US university students) investigating either adissonance induction strategy<sup>51</sup>, essays that manipulate the level of threat and coping information <sup>47</sup>, or a community-based informational campaign with or without a cognitive-behavioural small group intervention, about the effectiveness of interventions to change the attitudes of people with intentions to tan.

One good quality trial [++] <sup>61</sup> found that a brief appearance-focused intervention based on decision-theoretical models of health behaviour significantly reduced both intentions to indoor tan ( $F$  ( $df = 1400$ ) = 15.64;  $p < 0.001$ , 2-tailed) and attitudes towards indoor tanning ( $p < 0.01$ ) at 6 months, relative to no intervention, in 430 female university students in the USA (mean age 19 years) with prior indoor tanning or with future intentions to tan. One moderate quality trial [+] <sup>51</sup> investigated whether a dissonance induction strategy would successfully change UV-related behaviour in 260 female US psychology undergraduate students (90% non-Hispanic) who reported frequent indoor/outdoor tanning ( $\geq 6$  times in the past year). The dissonance induction strategy, which comprised an interactive participation session focusing on the negative aspects of the 'ideal tan' – tanning group, was compared with a similar dissonance strategy in healthy living controls and a psycho-educational control focused on tanning. The dissonance induction tanning group showed decreased intentions to tan indoors and increased intentions to use sunscreen relative to the healthy living controls, but similar behaviour to the psycho-educational controls <sup>51</sup>. In a second moderate quality trial [+] <sup>47</sup>, 254 Caucasian female undergraduates in the USA who had previously sought a tan read one of four essays that manipulated the level of threat and coping information. High and low threat essays, respectively, emphasized and minimized concerns in relation to sun exposure, whilst high and low coping essays focused on the effectiveness and inconvenience, respectively, of the recommended measures. Both the high threat and high coping appraisal information elicited significantly higher intentions to use sun protection than their low equivalents ( $F=92.32$ ,  $p < 0.001$  and  $F=5.84$ ,  $p < 0.02$ ), respectively <sup>47</sup>. A third moderate quality trial [+] <sup>67</sup> found no significant effect between a community-based informational campaign with or without a cognitive-behavioural small group intervention on sun-related attitudes and beliefs of 61 white, predominantly female (73%) US undergraduate students who were intending to have a spring holiday at  $< 35^\circ$  latitude (i.e. subtropics).

<sup>50</sup>Cox et al. (2009) [+]

<sup>48</sup>Cooper et al. (2014) [-]

<sup>62</sup>Orbell et al. (2008) [-]

<sup>51</sup>Chait et al. (2011) [+]

<sup>47</sup>Prentice-Dunn et al. (2009)

<sup>61</sup>Hillhouse et al. (2008) [++]

<sup>67</sup>Roberts et al. (2009) [+]

#### 5.3.8.4 Older people (age 65 and older)

There were two RCTs which each reported specifically recruiting two distinct adult age groups: younger and older (903) <sup>46</sup>.

The first poor quality trial [-] investigated how age-related changes in attention to negative information can impact on the health behaviour of younger and older adults <sup>9</sup>. US adults viewed health-related videos with the instruction to control emotions, absorb information, or watch as though it was television at home (control group). The subgroup of older people (age 60 to 92) had a mean age 71.6 years and was predominantly female (81.8%). Older adults showed significantly greater intentions to adopt more protective behaviours than did younger adults: they chose more give-away sun protection items ( $M = 3$  vs  $M = 2$ ,  $F(1, 148) = 16.31$ ,  $p < 0.001$ ), and a higher SPF (30 or 50) sunscreen ( $\chi^2(1, N = 154) = 3.81$ ,  $p = 0.05$ ). Significantly greater selection of a high SPF sunscreen was observed in the information-instruction group overall relative to the emotion-focused and control groups overall ( $p = 0.01$ ), but was not reported according to age group <sup>9</sup>.

The second poor quality trial [-] <sup>46</sup> assessed the impact of four messages framed as either a gain or loss and in terms of the efficacy (high or low) of the skin cancer detection and prevention behaviours described therein in younger and older women in the US. The subgroup of older women comprised 68 women aged 60 and older (mean age 73.95 years), some with a prior diagnosis of cancer or skin cancer (23% and 11%, respectively across the overall population). Older adults reacted similarly to younger adults following exposure to framed messages and endorsed stronger intentions than younger adults to engage in prevention behaviours  $M=4.5$ ,  $SD=1.13$  vs  $M=2.85$ ,  $SD=1.18$ ), regardless of message frame ( $F(1, 132) = 66.02$ ,  $p < 0.001$ ) <sup>46</sup>.

#### **Evidence Statement 5.4**

There is inconclusive evidence from two poor quality [-] RCTs (investigating different interventions) <sup>9, 46</sup> of the effectiveness of interventions to change behavioural intentions in older people (age 65 and older).

One trial <sup>9</sup> investigated how age-related changes in attention to negative information can impact on the health behaviour of younger (18-25 year old) and older adults (60-92 year old) US adults who viewed health-related videos. Older adults showed significantly greater intentions to adopt more protective behaviours than did younger adults: they chose more give-away sun protection items ( $M=3$  vs  $M=2$ ,  $F(1, 148) = 16.31$ ,  $p < 0.001$ ), and a higher SPF (30 or 50) sunscreen ( $\chi^2(1, N = 154) = 3.81$ ,  $p = 0.05$ ). Significantly greater selection of a high SPF sunscreen was observed in the information-instruction group overall relative to the emotion-focused and control groups overall ( $p=0.01$ ), but was not reported according to age group. The second trial <sup>46</sup> assessed the impact of four messages framed as either a gain or loss and in terms of the efficacy (high or low) of the skin cancer detection and prevention behaviours described therein in younger and older women in the US. The subgroup of older women comprised 68 women aged 60 and older (mean age 73.95 years), some with a prior diagnosis of cancer or skin cancer (23% and 11%, respectively across the overall population). Older adults reacted similarly to younger adults following exposure to framed messages and endorsed stronger intentions than younger adults to engage in prevention behaviours  $M=4.5$ ,  $SD=1.13$  vs  $M=2.85$ ,  $SD=1.18$ ), regardless of message frame ( $F(1, 132) = 66.02$ ,  $p < 0.001$ ) <sup>46</sup>.

<sup>9</sup>Isaacowitz et al. (2012) [-]

<sup>46</sup>Stoner et al. (2009) [-]

#### **5.3.8.5 Individuals with a family history of cancer**

There was one RCT of people with a family history of cancer <sup>11</sup>.

One good quality trial [++] <sup>11</sup> randomized 494 adult siblings (aged 18 to >51 years; 81.3 to 88.0% fair skin type) of recently diagnosed (<1 month) melanoma patients in the USA to receive either a multi-component intervention (comprising a motivational and goal-setting session, individually tailored feedback, telephone counselling, mailed information and links to free screening) or usual care (suggestion to notify family members and encourage screening). After 12 months, there was no difference between the two groups in terms of intentions to use sunscreen. However, participants receiving the multi-component intervention reported greater intentions to see a dermatologist (69.9% vs 65.2%; OR 1.68, 95% CI: 1.16 to 2.44) and greater confidence in seeing a dermatologist (61.2% vs 53.3%; OR 2.14, 95% CI: 1.2 to 3.7) than those receiving usual care <sup>11</sup>.

### Evidence Statement 5.5

There is moderate evidence from one good quality [++] RCT conducted in 494 adult siblings of US melanoma patients<sup>11</sup>. After 12 months, there was no difference between a multi-component intervention (comprising a motivational and goal-setting session, individually tailored feedback, telephone counselling, mailed information and links to free screening) or usual care (suggestion to notify family members and encourage screening) in terms of intentions to use sunscreen, however, participants receiving the multi-component intervention reported greater intentions to see a dermatologist and greater confidence in seeing a dermatologist than those receiving usual care.

<sup>11</sup>Geller et al. (2006) [++]

#### 5.3.8.6 Populations with multiple risk factors

There were four RCTs of people with multiple risk, such as those with a family history of skin cancer and behavioural risks (e.g. sunbathing, indoor tanning and low sunscreen use)<sup>13, 26, 27, 66</sup>.

Two poor quality trials [-] trials by the same author studied undergraduate students considered to represent high-risk populations. The first poor quality trial [-]<sup>26</sup> examined whether the efficacy of an appearance-based sun protection intervention (personal UV photo plus photoaging information) could be enhanced by the addition of social norms information in 125 predominantly female (83.2%) university undergraduates in the USA aged 18 to 38 years with high sun exposure (36% spent  $\geq 1$  hour sunbathing; 91.4% with  $\geq 1$  hour incidental sun exposure per week; 28.8% with  $\geq 1$  tanning salon visit in past year); 32% described themselves as Asian. The social norms information comprised written/visual information on how to prevent photoaging (injunctive norms) and oral information on the number of their peers who currently use regular sun protection plus an audiotape of a researcher-moderated discussion of sun protection trends (descriptive norms).

Significantly stronger intentions to use sun protection were found for UV photo/photoaging information relative to the control (no intervention) ( $M=3.28$  vs  $M=2.80$ ,  $p<0.01$ ,  $d=0.66$ ), and for any norms information relative to UV photo/photoaging information ( $M=3.37$  vs  $M=3.01$ ,  $p<0.05$ ,  $d=0.43$ ), but there was no significant difference between the norm conditions<sup>26</sup>.

The second poor quality trial [-]<sup>27</sup> compared the efficacy of two appearance-based sun protection interventions in a similarly high-risk population of US undergraduates (60% spent  $\geq 1$  hour per week sunbathing; 94.1% with  $\geq 3$  hours incidental sun exposure per week during last summer; 14% with  $\geq 1$  tanning salon visit in past month). A total of 442 students (62.7% female) were recruited from two universities located in climatologically different regions of the USA; Iowa students were predominantly White (92.0%) compared with California students (42.3%). Students were assigned to either receive photoaging information (video), have a UV photo taken, both receive photoaging information and have a UV photo taken, or to receive neither intervention. Participants who viewed the photoaging video reported significantly greater intentions to use sun protection than those who did not ( $F(1, 425) = 33.40$ ,  $p<0.001$ ,  $\eta^2=0.27$ ) and slightly greater feelings of self-efficacy for engaging in regular sunscreen use ( $p=0.06$ ). There were marginally greater intentions for sun protection use ( $F(1, 425) = 3.52$ ,  $p=0.06$ ,  $\eta^2=0.09$ ), but no significant difference in self-efficacy ( $p>0.20$ ) in those seeing a UV photo compared with those who did not<sup>27</sup>.



One moderate quality trial [+]<sup>13</sup> assessed the effect of a targeted screening and education intervention in 173 predominantly female (77%) French patients (mean ages 43.6 and 42.8 years) identified as being at elevated risk for melanoma, from 20 participating surgeries. GPs in the intervention group identified patients at elevated risk for melanoma with a validated assessment tool, the Self-Assessment Melanoma Risk Score (SAMScore), examined their skin, and provided counselling and information, whereas GPs in the control group (conventional information-based campaign) displayed a poster and the leaflets in their waiting room and performed skin examinations at their discretion. Intervention patients were more likely to worry about developing melanoma (M=28% vs M=18.4% for the control, p=0.16) and more likely to consult their GP again to discuss the disease (M=15.5% vs M=9.2%, p=0.23), but not significantly so<sup>13</sup>.

One poor quality trial [-]<sup>66</sup> found stage of change for use of sun protection was significantly affected by the addition of photos and/or motivational interviewing counselling to educational material in 197 university psychology students in the USA (aged 18 to 24) with at least one risk factor for skin cancer (sunbathing 95%; indoor tanning 58%; low sunscreen use 66%; or family history of skin cancer 37%). Photos were significantly more effective in improving stage of change compared with education (OR 2.58, 95% CI: 1.06 to 6.28, p=0.04), while motivational interviewing was marginally more effective than education (OR 2.20, 95% CI: 0.91 to 5.31; p=0.08). The effects of the multi-component intervention did not differ significantly from the control (education)<sup>66</sup>.

#### **Evidence Statement 5.6**

There is weak, consistent evidence from three poor quality [-] RCTs<sup>26, 27, 66</sup> that UV photos and/or photoaging information, with or without additional interventions, are effective in increasing intentions to use sun protection in people with multiple risk factors.

Two poor quality trials [-] trials by the same author studied undergraduate students considered to represent high-risk populations. The first poor quality [-] trial<sup>26</sup> examined whether the efficacy of an appearance-based sun protection intervention (personal UV photo plus photoaging information) could be enhanced by the addition of social norms information in 125 predominantly female (83.2%) university undergraduates in the USA aged 18 to 38 years. Significantly stronger intentions to use sun protection were found for UV photo/photoaging information relative to the control (no intervention) (M=3.28 vs M=2.80, p<0.01, d=0.66), and for any norms information relative to UV photo/photoaging information (M=3.37 vs M=3.01, p<0.05, d=0.43), but there was no significant difference between the norm conditions. The second poor quality [-] trial<sup>27</sup> compared the efficacy of two appearance-based sun protections interventions in a similarly high-risk population of 442 US undergraduates recruited from two universities located in climatologically in different regions of the USA. Participants who viewed a photoaging video reported significantly greater intentions to use sun protection than those who did not (F (1, 425) = 33.40, p<0.001,  $\eta$  =0.27) and slightly greater feelings of self-efficacy for engaging in regular sunscreen use (p=0.06). There were marginally greater intentions for sun protection use (F (1, 425) = 3.52, p=0.06,  $\eta$  =0.09), but no significant difference in self-efficacy (p>0.20) in those seeing a UV photo compared with those who did not. One moderate quality [+] trial<sup>13</sup> assessed the effect of a targeted screening and education intervention in 173 predominantly female (77%) French patients (mean ages 43.6 and 42.8 years) identified as being at elevated risk for melanoma. GPs in the intervention group identified patients at elevated risk for melanoma with a validated assessment tool, the Self-Assessment Melanoma Risk Score (SAMScore), examined their skin, and provided counselling and information, whereas GPs in the control group (conventional information-based campaign) displayed a poster and the leaflets in their waiting room and performed skin examinations at their discretion. Intervention patients were more likely to worry about developing melanoma (M=28% vs M=18.4% for the control, p=0.16) and more likely to consult their GP again to discuss the disease (M=15.5% vs M=9.2%, p=0.23), but not significantly so<sup>13</sup>. One poor quality [-] trial<sup>66</sup> reported that the use of sun protection was significantly affected by the addition of photos and/or motivational interviewing counselling to educational material in 197 university psychology

students in the USA (aged 18 to 24) with at least one risk factor for skin cancer (sunbathing 95%; indoor tanning 58%; low sunscreen use 66%; or family history of skin cancer 37%). Photos were significantly more effective in improving stage of change compared with education (OR 2.58, 95% CI: 1.06 to 6.28,  $p=0.04$ ), while motivational interviewing was marginally more effective than education (OR 2.20, 95% CI: 0.91 to 5.31;  $p=0.08$ ). The effects of the multi-component intervention did not differ significantly from the control (education)<sup>66</sup>.

<sup>26</sup>Mahler et al. (2008)

<sup>27</sup>Mahler et al. (2013)

<sup>66</sup>Heckman et al. (2013)

<sup>13</sup>Rat et al. (2014)

## 5.4 SUMMARY OF EVIDENCE

There is limited evidence for interventions that change people's attitudes and behavioural intentions in relation to sun exposure, sun protection and skin cancer. Two interventions reported evidence that was assessed to be weak, but consistent across studies. The first was for the most common intervention, the use of UV photographs with or without photoaging plus an additional intervention, as reported in five studies. Although the evidence appeared to be consistent, the additional interventions varied across the studies and the contribution of the additional intervention to the UV photographs with or without photoaging was unclear in most studies. The second was for threat/fear scenarios, as reported in four studies. The evidence showed that health messages that increase worry and install fear promote adaptive sun protection behaviours. The evidence for several interventions was inconclusive either because of the lack of studies and/or the poor quality of trials identified.

### Summary of Evidence Statements

There is weak, consistent evidence from one poor quality systematic review [-]<sup>16</sup>, one moderate quality [+] study<sup>19</sup>, and three poor quality [-] studies<sup>24, 26, 27</sup> that UV photographs (with or without photoaging) plus additional interventions (additional information, norms information, educational videos, regular black and white photos, or photos of others) increase participants' intentions to adopt sun protection measures. There is inconclusive evidence about which of the additional interventions were efficacious.

There is weak, consistent evidence from one moderate quality [+] trial<sup>47</sup> and three poor quality [-] trials<sup>48-50</sup> that health messages manipulated to invoke a sense of fear or increase worry are effective in promoting behavioural change in relation to sun protection practices.

There was inconclusive evidence about the use of message framing, some motivational interventions (interactive participation sessions, intervention content eliciting strong emotional responses, self-affirmation manipulations, and different types of narrative message), health promotion programmes based on the UV index, text messages, tailored education, active participation education sessions, information provision and multi-component interventions.

## **Section 6: Changes in Individuals' Knowledge and/or Awareness of Diseases Related to Over- or Under-Exposure to Sunlight**

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The studies reviewed in this section reported changes in individuals' knowledge and/or awareness of diseases related to sun exposure (either under- or over-exposure) including non-melanoma and malignant melanoma skin cancer and sunburn.

### **6.1 OVERVIEW OF INCLUDED STUDIES**

#### **6.1.1 Characteristics of the Included Studies**

Eight studies reported changes in individuals' knowledge and/or awareness of diseases related to sun exposure; this included non-melanoma and malignant melanoma skin cancer and sunburn. The majority of studies were concerned with measuring knowledge of skin cancer, and the groups assessed included secondary school adolescents, university students, adults in the community (young and elderly), parents of young children, and health professionals (student nurses). Summary characteristics of the studies are presented in Table 6.1 and further details are provided in the Appendices.

Four of the eight studies explicitly focused on or included at-risk groups (four in children and one in workers at occupational risk). The four other studies included adolescents (one study), students (two studies), adults and the elderly (18 to 25 years and 60 to 92 years in one study). All assessed knowledge of skin cancer.

One systematic review (SR)<sup>53</sup> was identified that assessed studies using the UV index as a health promotion instrument via media campaigns, programmes aimed at specific settings (e.g. childcare, high radiation), programmes delivered through health care providers, programmes using general or personalized information, or a combination of approaches<sup>53</sup>.

A second<sup>37</sup> considered a wide range of interventions including verbal advice; mass media; mixed methods (lecture + supporting visual material; video + printed material; verbal advice + website; verbal advice + supporting visual/printed material; lesson-based including verbal advice, videos and printed material); new media (the Internet including social networking sites, e-media and text messaging), and printed material. All age groups were eligible for inclusion.

One RCT<sup>68</sup> was identified which used an Internet-based system within Spanish schools to improve the knowledge and behaviour of 1290 adolescents in relation to sun exposure in secondary school children aged 12 to 16 years. Participants in the intervention group accessed a website for at least one hour in the presence of their teachers at the end of the school year (June) and were able to access the webpage throughout the summer. The webpage was structured in six sections by dermatologists, epidemiologists and specialists in education: (i) the sun and its characteristics; (ii) sun without danger; (iii) seven sun commandments; (iv) games; (v) visits to other websites; and (vi) Who are we? The control group received no intervention.

A second RCT<sup>38</sup> investigated the effectiveness of a partially tailored mailed intervention based on the Precaution Adoption Process Model, delivered to 677 white American children who were considered to be at high risk of skin cancer and who were 6 years old at baseline. The intervention group received three sets of educational newsletters each year in the spring (at approximately two-week intervals) about skin cancer and sun protection, and related sun protection resources such as a swim shirt, sun hat, sunscreen, and backpack. The control group received a letter each spring inviting them to complete data collection. All participants who attended skin exams during a given summer (both study groups) received a letter informing them of the average nevus count among children examined in that year and the nevus count for their child<sup>38</sup>.

A third RCT<sup>9</sup> investigated how age-related changes in attention to negative information can impact on the health behaviour of younger and older adults in the USA. Two groups of participants were recruited, one group aged 18 to 25 years (n=78) and another group aged 60 to 92 years (n=77). The intervention groups viewed health-related videos with the instruction to control emotions (“avoid feeling bad as much as you can), or to absorb information (“be as thorough as you can in collecting information so that you can act later based on what you have learned”). The control group was instructed to watch the video as though it was watching television at home<sup>9</sup>.

A fourth RCT<sup>69</sup> conducted in the USA assessed the effect of a multi-component intervention on parental knowledge, sun avoidance behaviours, and sun protection practices in 197 parents and their children who were aged between 3 and 10 years. The intervention group received a brief presentation and brochure for the parent and educational video and sun protection incentives for the child. The brochure addressed topics which included the epidemic of skin cancer, its relationship to the sun, and the importance of the three key sun protection practices (i.e. shirt, sunscreen, hat use, also known as Slip! Slop! Slap!). The control group received no intervention<sup>69</sup>.

A fifth RCT<sup>67</sup> evaluated the efficacy of two interventions to reduce UV exposure in 61 white, predominantly female (73%) US undergraduates, prior to an opportunity for high-intensity UV exposure during a spring holiday at <35° latitude (i.e. subtropics). The interventions were a community-based information campaign alone, or a combination of the campaign and a cognitive-behavioural small group intervention)<sup>67</sup>.

The sixth RCT<sup>23</sup> aimed to assess effectiveness of UV filtered photography on knowledge of skin cancer in 90 US first year student nurses. The trial compared UV filtered photography treatment plus a skin cancer lecture with the skin cancer lecture alone and a control group who received no intervention<sup>23</sup>.

**Table 6.1: Characteristics of the included studies**

| Reference                      | Study design and quality | Country  | Objectives  | Population                          | Sample size (Number analysed)        |
|--------------------------------|--------------------------|--|---|-------------------------------------|--------------------------------------|
| Crane (2012) <sup>38</sup>     | RCT<br>Moderate [+]      | USA  | To test the effectiveness of a partially tailored mailed intervention based on the Precaution Adoption Process Model, delivered in the spring over 3 years to parents and children.   | Parents and primary school children | 677                                  |
| Eagle (2009) <sup>37</sup>     | SR<br>Moderate [+]       | Australia, Canada, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden, UK, and the USA.       | To assess the effective and cost-effective ways of providing information on skin cancer prevention to change people's knowledge, awareness and behaviour.<br>To investigate what content effective and cost-effective primary prevention messages contain and what is the most effective and cost-effective content.  | Children and adults                 | 84 studies                           |
| Eisman (2013) <sup>68</sup>    | RCT<br>Poor [-]          | Spain  | To determine the knowledge and behaviour of a Spanish adolescent population in relation to sun exposure through an Internet-based system, and to describe the use of an Internet-based school intervention programme to improve sun exposure knowledge and behaviour of adolescents.  | Children of 12 to 16 years of age   | Intervention: 730<br>Control: 560    |
| Glasser (2010) <sup>69</sup>   | RCT<br>Moderate [+]      | USA  | To assess the effect of a multicomponent intervention on parental knowledge, sun avoidance behaviours, and sun protection practices in children aged 3-10 years.  | English speaking parent-child pairs | 197 parent/caregiver and child pairs |
| Isaacowitz (2012) <sup>9</sup> | RCT<br>Poor [-]          | USA  | To investigate how age related changes in attention to negative but relevant information about skin cancer risk reduction influenced both subsequent health behaviour and mood regulation.<br>To investigate how age- related changes in attention to negative but relevant information about skin cancer risk reduction influenced both subsequent health behaviour and mood regulation. | Adults                              | 155                                  |
| Italia (2012) <sup>53</sup>    | SR<br>Moderate [+]       | Australia, New Zealand, the UK, Sweden, Germany, Italy, Switzerland, Finland, the USA, Canada and Columbia | To review the effectiveness of the UV Index as a health promotion instrument.   | Adults and children                 | 27 studies                           |

| Reference            | Study design and quality | Country | Objectives  | Population                                       | Sample size (Number analysed) |
|----------------------|--------------------------|---------|---|--|-------------------------------|
| Roberts (2009)<br>67 | RCT<br><br>Moderate [+]  | USA     | To evaluate the efficacy of two interventions to reduce UV exposure in college students prior to an opportunity for high-intensity exposure: a community-based informational campaign with or without a cognitive-behavioural small group intervention. | Undergraduates                                   | 61                            |
| Siegel 2010<br>23    | RCT<br><br>Poor [-]      | USA     | To assess the effectiveness of ultraviolet filtered photography on knowledge of skin cancer, sun protective behaviours, perceptions of acquiring skin cancer, and health promotion in skin cancer prevention in freshman student nurses                 | Freshman student nurses from a community college | 90                            |

### 6.1.2 Quality Assessment

The two SR <sup>37, 53</sup> were assessed to be of moderate quality [+]. Of six RCTs, three were of moderate quality [+] and three were of poor quality [-] <sup>9, 23, 38, 67-69</sup>. The overall quality assessment of the included studies is presented in Table 6.1 with further details provided in the Appendices.

Of the two SRs, two were assessed as being of moderate quality <sup>37, 53</sup>, having adequately reported five to seven AMSTAR criteria. Specifically, both of the SRs used an a priori design; reported adequate searches; provided lists of both the included and excluded studies; adequately reported the characteristics of the included primary studies; assessed the quality of the included primary studies; and used appropriate methods to combine the findings of the primary studies. Neither of the two reviews reported the involvement of two independent reviewers in both the study selection and data extraction processes, assessed publication bias, or disclosed conflicts of interest.

Four of the RCTs were assessed as being of good [++] quality, five were assessed <sup>4, 11, 14, 61, 124</sup> as being of moderate [+] quality, and the remainder were assessed as being of poor [-] quality <sup>13, 18-21, 31, 32, 38, 47, 51, 55, 57, 62, 67</sup>. Issues that affected the validity of the included RCTs included inadequate reporting of research methods, in particular with regard to method of randomization, allocation concealment, blinding and use of intention-to-treat analysis, and comparability of the treatment groups in terms of baseline characteristics and dropouts from the study.

## 6.2 MOTIVATIONAL INTERVENTIONS

Two poor quality trials investigated motivational interventions to change individuals' knowledge and/or awareness of diseases related to sun exposure <sup>9, 23</sup>. The results of the included studies are summarised here and detailed study data are provided in the Appendices.

The first poor quality trial [-] investigated how age-related changes in attention to negative information can impact on the health behaviour of younger and older adults in the USA <sup>9</sup>. Adults viewed health-related videos with the instruction to control emotions, absorb information, or watch as though it was television at home (control group). Although there were no significant effects between groups, there was a significant interaction effect with age. Older adults had significantly greater knowledge before the trial than younger adults (mean score 12.1 vs 10.5), however, they learned less following the trial compared to younger adults (mean score 16.7 vs 17.6) <sup>9</sup>.

The second poor quality trial [-] <sup>23</sup> compared UV filtered photography treatment plus skin cancer lecture with the skin cancer lecture alone and a control group who received no intervention in 90 US student nurses. Significant differences were reported between pre- and post-intervention scores in the lecture group (mean difference -3.10 (SD 3.93),  $p < 0.0001$ ) and in the UV photo plus lecture group (mean difference -3.32 (SD 4.47),  $p = 0.001$ ). There was no evidence of a significant difference between pre- and post- values in the control group (mean difference -0.29 (SD 4.93),  $p = 0.76$ ) <sup>23</sup>.

#### **Evidence statement 6.1**

There is inconclusive, inconsistent evidence from two poor quality [-] RCTs, both conducted in the USA<sup>9, 23</sup>, about the effectiveness of motivational interventions to improve individuals' knowledge and/or awareness of diseases related to sun exposure.

The first poor quality trial [-] investigated how age-related changes in attention to negative information can impact on the health behaviour of younger (18-25 years) and older adults (60-92 year) in the USA<sup>9</sup>. Although there were no significant effects between groups, there was a significant interaction effect with age. Older adults had significantly greater knowledge before the trial than younger adults (mean score 12.1 vs 10.5), however, they learned less following the trial compared to younger adults (mean score 16.7 vs 17.6)<sup>9</sup>. The second poor quality trial [-] <sup>23</sup> compared UV filtered photography treatment plus skin cancer lecture with the skin cancer lecture alone and a control group who received no intervention in 90 US student nurses. Significant differences were reported between pre- and post-intervention scores in the lecture group (mean difference -3.10 (SD 3.93),  $p < 0.0001$ ) and in the UV photo plus lecture group (mean difference -3.32 (SD 4.47),  $p = 0.001$ ). There was no evidence of a significant difference between pre- and post- values in the control group (mean difference -0.29 (SD 4.93),  $p = 0.76$ ) <sup>23</sup>.

<sup>9</sup>Isaacowitz et al. (2012) [-]

<sup>23</sup>Siegel et al. (2010) [-]

### **6.3 EDUCATIONAL INTERVENTIONS**

Two moderate quality trials and one poor quality trial investigated educational interventions to change individuals' knowledge and/or awareness of diseases related to sun exposure <sup>38, 67, 68</sup>.

One moderate quality trial [+] <sup>67</sup> found no significant differences between a community-based information campaign with or without a cognitive-behavioural small group intervention on the skin cancer knowledge of 61 white, predominantly female (73%) US undergraduates who were intending to have a spring holiday at  $< 35^\circ$  latitude (i.e. subtropics). For the combined intervention group, the mean baseline knowledge score was 106.7 (SD 10.4) compared to 115.6 (SD 7.9) following the intervention. For the information only group, the mean baseline knowledge score was 107.9 (SD 10.7) compared to 106.8 (SD 14.8) post-intervention <sup>67</sup>.



One moderate quality trial [+] <sup>38</sup> in school-aged children in the USA assessed a partially tailored mailed intervention including educational newsletters about skin cancer sun protection (mailed to parents and children) and an annual invitation to attend a data collection session. Compared to the control group, participants in the intervention group were more aware of skin cancer risk factors <sup>38</sup>.

One poor quality trial [-] <sup>68</sup> was identified which used an Internet-based system within Spanish schools to improve the knowledge and behaviour of 1290 adolescents aged 12 to 16 years in relation to sun exposure; 62.2% of the participants were female. The Internet-based intervention did not improve sun exposure knowledge compared to the control group who received no intervention. There were no significant differences in a high or excellent knowledge score relative to a reference category of null, low or medium score for the intervention compared with the control group (OR 0.515 (95%CI: 0.156–1.699), p=0.240) <sup>68</sup>.

#### **Evidence statement 6.2**

There is weak evidence from one moderate quality [+] RCT<sup>67</sup> and one poor quality [-] trial<sup>68</sup> that the addition of cognitive behavioural therapy to a community-based information campaign in 61 white, predominantly female (73%) US undergraduates who were intending to have a spring holiday at <35° latitude (i.e. subtropics) and an Internet-based system within Spanish schools to improve the knowledge and behaviour of 1290 adolescents aged 12 to 16 years in relation to sun exposure had no significant impact on individuals' knowledge and/or awareness of diseases related to sun exposure.

There is weak evidence from one moderate quality [+] RCT<sup>38</sup> that a partially tailored mailed intervention may increase awareness of skin cancer risk compared to an annual invitation to attend a data collection session in school-aged children in the US.

<sup>67</sup>Roberts et al. (2009) [+]

<sup>68</sup>Buendia Eisman et al. (2013) [-]

<sup>38</sup>Crane et al. (2012) [+]

## **6.4 MULTI-COMPONENT INTERVENTIONS**

Two moderate quality SRs <sup>37, 53</sup>, and one moderate quality trial <sup>69</sup> investigated multiple or multi-component interventions. The results of these studies are summarized here and further details of the studies are provided in the Appendices.

One moderate quality [+] SR <sup>53</sup> assessed studies using the UV index as a health promotion instrument via media campaigns, programmes aimed at specific settings (e.g. childcare, high radiation), programmes delivered through health care providers, programmes using general or personalized information, or a combination of approaches. Only three studies investigated the effect of the UV index on people's knowledge; all three reported that the UV index had no effect on participants' knowledge <sup>53</sup>.

A second moderate quality [+] SR <sup>37</sup> considered a wide range of interventions including: verbal advice; mass media; mixed methods (lecture + supporting visual material; video + printed material; verbal advice + website; verbal advice + supporting visual/printed material; lesson-based including verbal advice, videos and printed material); new media (the Internet including social networking sites, e-media and text messaging), and printed material. The review found mixed results. Among university students, they identified 15 RCTs, one controlled before-and-after study and two before-and-after studies (using mass media, mixed methods, new media, print material); four studies reported increases in knowledge of risk of skin cancer or tanning, three of which were statistically significant (all using printed material). Among secondary schoolchildren, there were four RCTs and three before-and-after studies (using mixed methods); all reported significant increases in self-reported knowledge of skin cancer risk/ symptoms at follow-up (one week to 5 months). In workplace settings, one RCT was identified (printed media + information on self-examination); this found a significant increase in self-reported knowledge of skin cancer risk in male employees of a mining company at follow-up (10 and 20 weeks) <sup>37</sup>.

A moderate quality trial [+] <sup>69</sup> assessed the effect of a multi-component intervention on parental knowledge, sun avoidance behaviours, and sun protection practices in 197 parents in the USA and their children who were aged between 3 and 10 years. Although knowledge in both groups significantly improved following the intervention, the intervention group showed a more significant increase than the control group. The intervention group, in which the parent received a brief presentation and a brochure and the child received an educational video and sun protection incentives, scored 2.8 (SD 1.3) out of five points on a questionnaire at baseline and significantly improved following the intervention (score 3.6 (SD 1.1),  $p=0.0004$ ). The control group, which received a brochure containing information on topics such as the epidemic of skin cancer, its relationship to the sun, and the importance of the three key sun protection practices (i.e. shirt, sunscreen, hat use), also significantly improved from 2.4 (SD 1.3) at baseline to 2.8 (SD 1.2) <sup>69</sup>.

### **Evidence statement 6.3**

There is weak, inconsistent evidence from two moderate quality [+] systematic reviews; one review <sup>53</sup> (including three RCTs) reported no significant impact of using the UV Index as a health promotion instrument as part of several different interventions on participants' knowledge about skin cancer, while the other <sup>37</sup> reported that multi-component interventions are effective in increasing knowledge of the risk of skin cancer or which components were most effective. Although the systematic review was considered moderate quality, the included primary studies investigated a variety of methods of communicating messages and the majority did not provide sufficient detail of these interventions.

An additional moderate quality trial [+] <sup>69</sup> assessed the effect of a multi-component intervention on parental knowledge, sun avoidance behaviours, and sun protection practices in 197 parents in the USA and their children who were aged between 3 and 10 years. Although knowledge in both groups significantly improved following the intervention, the intervention group showed a more significant increase than the control group. The intervention group, in which the parent received a brief presentation and a brochure and the child received an educational video and sun protection incentives, scored 2.8 (SD 1.3) out of five points on a questionnaire at baseline and significantly improved following the intervention (score 3.6 (SD 1.1),  $p=0.0004$ ). The control group, which received a brochure containing information on topics such as the epidemic of skin cancer, its relationship to the

sun, and the importance of the three key sun protection practices (i.e. shirt, sunscreen, hat use), also significantly improved from 2.4 (SD 1.3) at baseline to 2.8 (SD 1.2).

<sup>53</sup>Italia et al. (2012) [+]

<sup>37</sup>Eagle et al. (2009) [+]

<sup>69</sup>Glasser et al. (2010) [+]

# Section 7: Changes in Individuals' Knowledge and/or Awareness of Practices that Protect Against Over- or Under-exposure to Sunlight

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The studies reviewed in this section report changes in individuals' knowledge and/or awareness of practices that protect against sun exposure e.g. wearing sunscreen, wearing hats, and avoiding sunlight in the middle of the day.

## 7.1 OVERVIEW OF INCLUDED STUDIES

### 7.1.1 Characteristics of Included Studies

Eight studies investigated changes in individuals' knowledge and/or awareness of practices that protect against sun exposure. There was one systematic review (SR) <sup>37</sup>, four randomised controlled trials <sup>23, 71-73</sup>, and three observational studies <sup>6, 15, 70</sup>.

The SR <sup>37</sup> considered a wide range of interventions including verbal advice; mass media; mixed methods (lecture + supporting visual material; video + printed material; verbal advice + website; verbal advice + supporting visual/printed material; lesson-based including verbal advice, videos and printed material); new media (the Internet including social networking sites, e-media and text messaging), and printed material. All age groups were eligible for inclusion.

The first RCT <sup>72</sup> compared an environmental intervention plus a cognitive-behavioural intervention with the environmental intervention only in four German nursery schools with children aged 3 to 6 years (mean 4.3 years). In the environmental intervention, parents and nursery nurses received a German cancer aid brochure on sun protection for parents of young children in July 2011. In the cognitive behavioural intervention, the theatre play "Clown Zitzewitz and sun protection" was performed for the children.

The second RCT <sup>71</sup> was conducted in the USA and investigated the efficacy of online videos as an educational medium, compared to an informational pamphlet, to improve sunscreen behavioural outcomes and sunscreen application knowledge in 94 adults (aged over 18 years). The online video addressed how sunscreens work to protect skin, different types of sunscreens, importance of sunscreen use, and proper application, and was compared with a pamphlet which contained educational content identical to the video but delivered in a written format.

The third RCT <sup>73</sup> used a combination computer program with teacher-led presentation in 1033 school children from kindergarten to grade 5 in 12 elementary schools in the USA. The computer programs were tailored with age-appropriate sun safety education for children in primary schools derived from the Sunny Days, Healthy Ways (SDHW) sun safety curriculum. The teacher-led presentation was also based on the same program and facilitated discussion and hands-on learning activities (with worksheets). This was compared with either the computer program alone or teacher-led presentation alone.

The fourth RCT <sup>23</sup> aimed to assess the effectiveness of UV filtered photography on knowledge of skin cancer in 90 US first year student nurses. The study compared UV filtered photography plus a skin cancer lecture with the skin cancer lecture alone and a control group who received no intervention.

Summary characteristics of the included studies are presented in Table 7.1 and Table 7.2, with further details provided in the Appendices.

**Table 7.1: Characteristics of the included systematic reviews and randomized controlled trials**

| Reference                    | Study design and quality | Country  | Objectives   | Population  | Sample size (Number analysed)  |
|------------------------------|--------------------------|--|--|---|--|
| Eagle (2009) <sup>37</sup>   | SR moderate              | Australia, Canada, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden, UK, and the USA. | To assess the effective and cost-effective ways of providing information on skin cancer prevention to change people's knowledge, awareness and behaviour.<br>To investigate what content effective and cost-effective primary prevention messages contain and what is the most effective and cost-effective content.                   | Children and adults                                 | 84 studies   |
| Seidel 2013 <sup>72</sup>    | RCT -                    | Germany  | To estimate the effectiveness of a combined environmental intervention (EI, addressing parents, teachers, and nursery nurses) and cognitive-behavioural intervention (BI, for children) in enhancing children's knowledge about sun protection compared to the sole EI   | Nursery school children                             | 184 parents (intervention group: 94, control group: 90) received consent forms, of which 115 (63 %; intervention group: 61, control group: 54) gave informed consent. Overall, 34 children of the intervention group and 46 of the control group completed the pretest, received the intervention, and were present at the posttest. |
| Armstrong 2011 <sup>71</sup> | RCT +                    | USA  | To assess the efficacy of online videos as an educational medium compared to an informational pamphlet to improve sunscreen behavioural outcomes and sunscreen application knowledge.  | Adults >18 years of age.                            | 94 (47 in each group)  |
| Buller 2008 <sup>73</sup>    | RCT -                    | USA  | To assess (1) whether changes in outcome expectations (knowledge and attitudes) and self-reported sun protection behaviour produced by the computer program were different from those produced by the presentation, and (2) whether combined presentation of the computer program and teacher presentation produced superior outcomes. | School children enrolled in kindergarten to grade 5 | 1033 students from 12 elementary schools   |

| Reference                 | Study design and quality | Country | Objectives  | Population                                       | Sample size (Number analysed) |
|---------------------------|--------------------------|---------|---|--|-------------------------------|
| Siegel 2010 <sup>23</sup> | RCT<br>-                 | USA     | To assess the effectiveness of ultraviolet filtered photography on knowledge of skin cancer, sun protective behaviours, perceptions of acquiring skin cancer, and health promotion in skin cancer prevention in freshman student nurses | Freshman student nurses from a community college | 90                            |

**Table 7.2: Characteristics of the included observational studies**

| Reference                                    | Study design and quality   | Objectives  | Population                                    | Sample size (number analysed)                                    |
|--|--|---|---|--|
| <b>Comparative observational studies</b>     |  |   |   |  |
| Woolley (2008) <sup>15</sup>                 | Survey questionnaire and measurements of current sun damage.<br>--   | 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.   | Outdoor workers                               | 69   |
| <b>Non-comparative observational studies</b> |  |   |   |  |
| Aulbert (2009) <sup>70</sup>                 | Non-randomized, before/after, intervention without control group.<br>+   | To establish a feasible certification programme for sun protection in a German child day-care centre, for a better sun protection of the children and the reduction of skin cancer incidence in the long term. Investigated the number of children wearing a hat when playing outside, the use of sunscreen and the percentage of shaded areas on the playground. | Children, parents and staff at a kindergarten | 12 staff and 46 parents were recruited (12 staff and 27 parents) |
| Gilaberte (2008) <sup>6</sup>                | Non-randomized, before/after, community intervention without control group, with schools as the unit of intervention and a questionnaire.<br>+ | To evaluate SolSano's effects on students' knowledge, attitudes and practices about sun safety.   | Elementary school children                    | 5845 children from 215 primary schools                           |

### 7.1.2 Quality Assessment of the Systematic Review

The SR <sup>37</sup> was assessed as being of moderate quality [+]. Positive features included that it had an 'a priori' design. Methods were guided by the Methods for Development of NICE Public Health Guidance 2006. A protocol was developed by the research team in conjunction with the NICE project team, detailing the key elements of the SR. It had duplicate study selection and data extraction with any discrepancies or disagreements resolved by discussion. There was a comprehensive literature search. 14 databases and five websites were searched from inception to Aug/Sept 2008; the search terms and search strategies (in appendices) were provided. In addition, references submitted by stakeholders, but not previously identified by formal searches, were added to the appropriate reference database, and reference lists of relevant SRs were checked. [Note: protocol deviation states that reference list checking of primary studies included in the evidence reviews was planned but not undertaken.] Presentation of included and excluded studies was very comprehensive. The authors provided a list of references, denoting which studies had been reported in the main WMHTAC report, which had been reported in the WMHTAC supplementary report, and before and after studies that had not been analysed in the WMHTAC report. The original report listed excluded articles with reasons for exclusion and articles that were unobtainable. Characteristics of the included studies were very comprehensive. Tables summarising characteristics of the studies (year, location, media, methodology and other relevant factors, intervention target) were provided in the appendices, with studies categorized by target population segment (i.e. setting), then by type of intervention delivery. The scientific quality of the included studies was assessed and documented. Quality assessment of studies meeting the inclusion criteria was undertaken using the appropriate assessment tool from the NICE methods manual. Each study was given a summary quality rating (++, + or -): a uniform system was adapted where if the study met at least 80% of the quality criteria it was rated as '++'; when it met 60 to 79% of the criteria it was rated as '+'; and when <60% were met it was rated '-'. Summary tables in the Synthesis Appendices reported the overall quality score for each study according to setting and intervention, and more detailed quality ratings were tabulated for studies in the original WMHTAC report (i.e. not uncontrolled before-and-after studies) (shown in Appendices of original report). The review used narrative synthesis. The authors did not specifically mention that pooling was not possible because of heterogeneity between the interventions. However, they did comment that very few studies provided sufficient detail of the content of the intervention or were not designed in such a way as to enable comparison of different components or content.



Negative features of the quality assessment were that the searches were restricted to articles published in the English language. The authors noted that a large amount of unpublished data is also likely to reside within organisations such as SunSmart. Methodological limitations of the studies were discussed and the authors commented on the lack of robust evidence; the evidence base being potentially far stronger than indicated by the available material; and how lack of detail could inhibit recommendations regarding potential transferability of studies to other populations and settings. However, study quality was not considered in the analysis of the results, nor was it explicitly stated in formulating recommendations. The likelihood of publication bias was not reported. Sources of funding were stated for each individual included study but not reported for the group undertaking the summary review. The original report states that the WMHTAC produce various reports for NICE, then mentions how NICE has been asked by the Department of Health to develop guidance on public health interventions aimed at preventing skin cancer and how this report is part of that referral. Funding sources are reported in evidence tables for RCTs and controlled before-and-after studies included in the original WMHTAC report, but are not reported for the additional before-and-after studies included in the current synthesis.

### **7.1.3 Quality Assessment of the Randomized Controlled Trials**

The first RCT <sup>72</sup> was assessed as poor quality [-]. It described the study population, but it was unclear whether the eligible population or area was representative of the source population or area, or whether the selected participants or areas represented the eligible population or area. The randomization method and allocation concealment were unclear. The interventions and comparisons were well reported. The study was not blinded. Contamination was acceptably low. Co-interventions were not reported. This study only had a 43% participation rate. The setting and interventions did not reflect normal UK practice. Only one outcome measure was reported, but it had face validity. Follow-up was 4 weeks. No significant differences in demographic characteristics between intervention and control groups were found at baseline. Intention-to-treat analysis and power calculations were not reported. The analytical methods were appropriate.

The second RCT <sup>71</sup> was assessed as moderate quality [+]. The source population and eligible population were not reported but the sample population was representative: a PRISMA diagram indicated that of 102 eligible participants, 94 agreed to participate. The randomization method, allocation concealment and potential contamination were not described but interventions and comparisons were well described and appropriate. Blinding was not possible for participants. There was 15% attrition in the pamphlet group and 9% attrition in the video group at 12 weeks follow-up. Reasons were not given but are unlikely to be based on adverse events of the intervention. Outcomes were appropriate to the aims of the study: self-report of knowledge and behaviour. Full descriptions were given of the participants at baseline, with comparability between groups. Dropouts were not included in the analyses. No power calculation was reported. Analysis methods were appropriate for the data: t tests and chi square tests for continuous and binary data respectively. The results are not necessarily generalisable as the authors noted that the participants were better educated than the general American population.

The third RCT <sup>73</sup> was assessed as poor quality [-]. There were insufficient population demographics. The eligible population comprised only those who consented so may not be representative of the source. An informative flow diagram shows the process from eligibility to selection. The study was stated as random but the methods of randomization and allocation concealment were not described. All interventions were based on a well-described sun protection programme. Blinding was not reported but was unlikely. Details of the implementation of the interventions were clearly reported with excellent fidelity. There was 16% attrition from pre- to post-test. There was insufficient detail on outcomes, and the authors acknowledged that reliability was poor. Pre-test occurred from March to May 2002 and follow-up from May to June 2002; the authors acknowledged that follow-up was short. The groups appeared comparable at baseline and covariates were used in the analyses. No power calculation was reported. Some estimates of effects were given, but no measures of variation for the means. The analyses appear appropriate: separate analyses were conducted for different grades where responses would be expected to be different. A mixed modelling approach was used so precision was not applicable for these analyses.

The fourth RCT <sup>23</sup> was assessed as poor quality [-]. The population demographics were not described. A convenience sample was used: eligibility criteria were not clear, so representativeness is unknown. The study was stated by the authors as quasi-random but the methods of randomization and allocation concealment were not described. No details of the intervention were given and it was not clear how the interventions were delivered. Blinding is not applicable. No details were provided on possible contamination between groups. Details were given of the source of the outcome measures but details on the actual survey instrument used were not given. Attrition and follow-up were not reported. Baseline comparability of groups was not reported. Power calculations and whether the authors conducted an intention-to-treat analysis were not reported. The mean difference between pre- and post-tests, together with SDs of the difference, were reported

## **7.2 SUN PROTECTION POLICIES**

A poor quality [-] comparative observational study <sup>15</sup> conducted in Australia investigated whether mandatory sun protection for outdoor workers in tropical regions is associated with reduced sun damage by comparing 26 employees working under mandatory sun protection policy (mean age 42 years (SD ± 11); 89% male) with 21 employees working under a voluntary sun protection policy (mean age 44 years (SD ± 16); 100% male). There were no significant changes in individuals' knowledge and/or awareness of practices that protect against sun exposure between groups <sup>15</sup>.

### Evidence statement 7.1

There is inconclusive evidence from one poor quality [-] comparative observational study<sup>15</sup> conducted in Australia which investigated whether mandatory sun protection for outdoor workers in tropical regions is associated with reduced sun damage by comparing 26 employees working under mandatory sun protection policy (mean age 42 years (SD ± 11); 89% male) with 21 employees working under a voluntary sun protection policy (mean age 44 years (SD ± 16); 100% male). There were no significant changes in individuals' knowledge and/or awareness of practices that protect against sun exposure between groups

<sup>15</sup>Woolley et al. (2008) [-]

## 7.3 MULTI-COMPONENT INTERVENTIONS

One moderate quality SR<sup>37</sup> and one moderate quality non-comparative observational study<sup>70</sup> investigated multi-component interventions. Study results are summarised here and presented in more detail in the Appendices.

One moderate quality [+] SR<sup>37</sup> investigated the effectiveness and cost-effectiveness of providing information on skin cancer prevention to change people's knowledge, awareness and behaviour. The review also investigated what content effective and cost-effective primary prevention messages contain and what is the most effective and cost-effective content. Interventions were required to include at least one of the following: one-to-one or group-based verbal advice, mass media campaigns, leaflets, other information or teaching resources or printed material including posters, new media (Internet, e-media or text messaging). These interventions were compared to current information provision, no intervention, or head-to-head comparisons with the other included interventions.

The review<sup>37</sup> found 95 studies for effectiveness and two economic evaluations.

- Eighteen studies were identified that assessed mass media, mixed methods, new media, and printed material in university students. Mixed results were reported: four studies reported significant improvements in sun protection knowledge; two studies found a significant decrease in post-intervention knowledge after 10 weeks and one year of follow-up. While many of these studies reported significant increases in knowledge or short-term, self-reported attitudes or behaviours, none investigated actual sustained behaviour change.
- Twenty-five studies reported outcomes in primary schoolchildren when assessing new media, lesson-based delivery, health fair, and other mixed methods. Several studies reported higher knowledge of sun protection behaviours, however, inadequate reporting of intervention delivery made it impossible to determine effects of individual delivery strategies or components within them.
- Seventeen studies involved various home (nine studies) or recreational (eight studies) based studies investigating mixed methods, print material and lesson-based interventions. Two studies using mixed methods reported significant improvements in sun protection knowledge.

- Four studies investigated mixed methods, new media and printed material in a workplace setting where there appeared to be some evidence of increased sun protection knowledge.
- Eight studies in medical practice or hospital settings also showed mixed results, with some increased knowledge and self-reported skin protection behaviours indicated with computer-based intervention but little impact found using printed material.

The review concluded that a number of studies suggested evidence of effectiveness on knowledge-related outcomes, but very few studies provided sufficient detail of the content of the intervention, or were not designed in such a way as to enable comparison of different components or content. Consequently, the review concluded that it was not possible to determine what content or component of the interventions was the most effective.

A moderate quality [+] non-comparative observational study<sup>70</sup> conducted in Germany aimed to implement a certification programme for sun protection among 12 staff and 27 parents of children aged 0 to 6 years attending a kindergarten. The intervention included the implementation of a sun protection policy, training sessions for staff and parents conducted by a dermatologist, and group discussions about personal experiences with excessive sun exposure. Following the intervention there was an increase in staff knowledge (baseline 8/14 points vs. post-intervention 12/14 points;  $p=0.002$ ) and an increase in parental knowledge (baseline 6/12 vs. post-intervention 11/12;  $p=0.001$ )<sup>70</sup>.

#### **Evidence statement 7.2**

There is weak evidence from one moderate quality [+] systematic review<sup>37</sup> reporting 25 studies in primary school children that new media, lesson-based delivery, health fair, and other mixed methods may be effective in increasing knowledge about sun protection. Several studies reported improvements in sun protection behaviours, however, inadequate reporting of interventions made it impossible to determine the effects of individual delivery strategies or components within them. An additional moderate quality [+] non-comparative observational study<sup>70</sup> conducted in Germany reported an increase in staff knowledge (baseline 8/14 points vs. post-intervention 12/14 points;  $p=0.002$ ) and an increase in parental knowledge (baseline 6/12 vs. post-intervention 11/12;  $p=0.001$ ) in a certification programme for sun protection among 12 staff and 27 parents of children aged 0 to 6 years attending a kindergarten.

<sup>37</sup>Eagle et al. (2009) [+]

<sup>70</sup>Aulbert et al. (2009) [+]

## 7.4 EDUCATIONAL INTERVENTIONS

One moderate quality trial <sup>71</sup>, two poor quality trials <sup>72, 73</sup> and one moderate quality non-comparative observational study <sup>6</sup> investigated educational interventions. Study results are summarised here and presented in more detail in the Appendices.

A moderate quality trial [+] <sup>71</sup> investigating the efficacy of online videos as an educational medium in the USA compared an online video (which addressed how sunscreens work to protect skin, different types of sunscreens, importance of sunscreen use, and proper application) with a pamphlet (which contained identical educational content to the video but delivered in a pamphlet) in 94 adults. Although the study reported a significantly greater improvement in the knowledge scores for both groups ( $p < 0.001$  for both), there was a significantly greater improvement in the video group who improved from 6.9 (SD 1.3) correct answers at baseline, to 8.8 (SD 1.4) correct answers post-intervention compared to the pamphlet group who improved from 6.5 (SD 1.4) correct answers at baseline to 7.6 (SD 1.2) correct answers post-intervention ( $p = 0.003$ ) <sup>71</sup>.

A poor quality trial [-] <sup>72</sup> conducted with 80 German children compared a combined environmental and cognitive-behavioural intervention ( $n=34$ ) with the environmental intervention alone ( $n=46$ ). The environmental intervention provided parents and nursery nurses with a cancer aid brochure on sun protection for parents of young children. The cognitive-behavioural intervention involved the children watching the play "Clown Zitzewitz and sun protection". Following the intervention, children were presented with five coloured photographs for each relevant sun protection behaviour (shirt, sunglasses, sun lotion, sunhat, and sun shade) and were instructed to indicate which one depicted the correct behaviour among incorrect behaviours. After adjustment for the pre-test score and age, knowledge of sun protection differed significantly between the intervention and control groups. The number of correct answers improved from 2.9 (SD 1.2) to 3.6 (SD 1.3,  $p < 0.05$ ) in the intervention group, compared with no change in the control group, 2.7 (1.4). Implementing a theatre play in nursery schools, in addition to an environmental intervention, led to an increase in knowledge in young children <sup>72</sup>.

The second poor quality trial [-] <sup>73</sup> used a combination of a computer program with teacher-led presentation in 1033 school children from kindergarten to grade five in 12 elementary schools in the USA. On a questionnaire, children receiving both the computer program and the teacher-led presentation (combination group) had a greater increase in knowledge following the intervention than the group receiving the computer program only ( $p=0.0101$ ) and the teacher-led presentation only ( $p=0.0229$ ). There were no differences between groups receiving the computer program alone or the teacher-led presentation alone <sup>73</sup>.

A moderate quality [+] <sup>6</sup> non-comparative observational study administered a questionnaire before and after 'SolSano', a sun safety programme conducted in 1522 children with a mean age of 6.6 (SD not reported) from 215 Aragonese primary schools in Spain. Children were scored one point for each correct drawing of a sun protection practice. The number of points scored increased following the intervention from 1.69 (SD 1.71) to 2.72 (SD 1.45);  $p < 0.001$  <sup>6</sup>.

### Evidence statement 7.3

There is weak, inconclusive evidence from one moderate quality [+] RCT<sup>71</sup>. conducted in 94 US adults, two poor quality [-] trials; one conducted in 80 German school children<sup>72</sup> and one conducted in 1033 elementary school aged children from the US<sup>73</sup> and one moderate quality [+]non-comparative observational study<sup>6</sup> conducted in 1522 Spanish children.

The trial from the US reported that an online video improved people's knowledge significantly more than print-based material<sup>71</sup>. There was a significantly greater improvement in the video group who improved from 6.9 (SD 1.3) correct answers at baseline to 8.8 (SD 1.4) correct answers post-intervention compared to the pamphlet group who improved from 6.5 (SD 1.4) correct answers at baseline to 7.6 (SD 1.2) correct answers post-intervention (p = 0.003). The trial in German school children<sup>72</sup>. reported that implementing a theatre play in nursery schools, in addition to an environmental intervention, led to an increase in knowledge in young children; the number of correct answers improved from 2.9 (SD 1.2) to 3.6 (SD 1.3, p<0.05) in the intervention group compared to no change in the comparator group. The trial in US elementary school children<sup>73</sup> reported that children receiving both the computer program and the teacher-led presentation (combination group) had a greater increase in knowledge following the intervention than the group receiving a computer program only (p=0.0101) and a teacher-led presentation only (p=0.0229). The observational study administered a questionnaire before and after 'SolSano', a sun safety programme where children were scored one point for each correct drawing of a sun protection practice. The number of points scored increased following the intervention from 1.69 (SD 1.71) to 2.72 (SD 1.45); p<0.001<sup>6</sup>.

<sup>71</sup>Armstrong et al. (2011) [+]

<sup>72</sup>Seidel et al. (2013) [-]

<sup>73</sup>Buller et al. (2008) [-]

<sup>6</sup>Gilaberte et al. (2008) [+]

## 7.5 MOTIVATIONAL INTERVENTIONS

A poor quality RCT [-] compared UV filtered photography plus a skin cancer lecture with the skin cancer lecture alone and a control group who received no intervention in 90 student nurses in the USA. There were no differences reported between baseline and post-intervention values for any group<sup>23</sup>.

## **Section 8: Effective Interventions for Achieving Changes in Sun Protection Practices and the Effects of Sun Exposure**

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The studies reviewed in this section presented outcomes for various sun protection or sun exposure behaviours, or reported on the effectiveness of interventions in terms of the number of sunburn episodes, naevi counts or other physical measures of sun exposure. Specifically, we included studies that reported the following outcomes:

- Changes in either the timing, intensity, frequency or duration of sun exposure and sun protection practices:
  - People's sun exposure (this could be an increase for people at increased risk of vitamin D deficiency and a decrease for people at increased risk of skin cancer);
  - Sun protection practices.
- Changes in quantifiable markers of health/outcomes of sun exposure, including:
  - Melanocytic naevi counts;
  - Skin colour measures;
  - Frequency of sunburn;
  - Incidence of vitamin D deficiency;
  - Prevalence of vitamin D deficiency or vitamin d deficiency morbidities;
  - Skin cancer incidence (basal cell, squamous cell, melanoma);
  - Eyelid malignancies.

### **8.1 OVERVIEW OF INCLUDED STUDIES**

#### **8.1.1 Characteristics of Included Studies**

Fifty-one studies (44 RCTs and seven SRs) met the inclusion criteria. The majority of studies were concerned with measuring various sun protection or sun exposure behaviours, either as overall composite scores or specific behaviours such as use of sunscreen, avoidance of shade, use of sun protective clothing, hours of sun exposure and indoor tanning rate, mostly in the general population. A wide variety of interventions were assessed. An additional 17 observational studies (seven comparative and 10 non-comparatives) were also identified. Summary characteristics of the studies are presented in Table 8.1.

### 8.1.1.1 Participants

Four of the seven SRs <sup>16, 37, 53, 81</sup> included studies of the general population, regardless of risk; in one of these the participants were mostly students <sup>16</sup>. The other three SRs included subgroups of participants at risk of skin cancer <sup>74</sup>, adults or children in recreational or tourism settings <sup>92</sup> and adult outdoor workers <sup>12</sup>.

The participants in the RCTs varied; about half of the studies included only adults, eight included only children, 11 included either young adults (often college students) or adolescents, and three included mixed age groups or the general public.

A number of studies focused on subgroups that were at higher risk of skin cancer: one study of the behaviour of children of melanoma survivors <sup>93</sup>, one study of patients in primary care who were considered at high risk of melanoma <sup>13</sup>, one study of relatives of melanoma patients <sup>10</sup>, one study of female netballers <sup>82</sup>, one study of university students in golf teams <sup>78</sup>, four studies of adults and children considered at moderate or high risk of skin cancer <sup>13, 74, 89, 90</sup>, two studies of outdoor workers <sup>12, 20</sup>, three studies of beach goers and sunbathers <sup>14, 35, 125</sup> one study of lifeguards at a swimming pool <sup>57</sup>, one study of university students planning to go on a spring break <sup>67</sup>, and one study of participants interested in maintaining a deep tan <sup>91</sup>. Eight studies focused solely on young children at kindergarten or primary school <sup>4, 38, 73, 75, 79, 80, 89, 94</sup>. Eleven studies exclusively recruited women and one study recruited only males; the remainder had mixed genders. The majority of participants were Caucasian.

### 8.1.1.2 Interventions

A majority of the SRs assessed a wide variety of interventions, some of which were multi-component interventions. Two SRs were more specific: one assessed the influence of employer policies, such as limiting exposure to the sun and providing sun protection <sup>74</sup> while the other compared the effect of a UV photo plus photoaging information with information on photoaging alone on indoor tanning behavior and future plans for sun exposure <sup>16</sup>.

The included RCTs investigated the effects of a variety of interventions. Five studies assessed the effects of general programmes (SunSafe, Living with the Sun, Sun Scoop, Sun Smart and Pool Cool) <sup>4, 40, 57, 63, 75</sup>.

Seven studies assessed the effects of providing sun protection: one provided easy access to sunscreen <sup>78</sup> and the others provided hats together with other sun protection interventions <sup>12, 38, 63, 79, 80, 125</sup>. Fourteen studies investigated the effects of using motivational tools such as UV photographs with or without information on photo aging, self-affirmation and self-efficacy, often combined with educational messages <sup>16, 19, 21, 23, 25-27, 35, 39, 81, 82, 84, 125, 126</sup>. Sixteen studies assessed educational and information tools delivered in a variety of ways: text messaging, newsletters, mailings, computer programs, videos, and presentations by teachers or general practitioners (GPs) <sup>10, 13, 38, 39, 54, 63, 67, 68, 71, 73, 81, 86, 88-91</sup>. Nineteen studies investigated multi-component interventions which incorporated one or more of skin examinations, counselling, education, feedback, doctor consultation, photo test, cognitive behaviour therapy, social support and provision of UV meters <sup>12-14, 20, 37, 39, 51, 52, 58, 67, 69, 80, 81, 92-94, 125, 127, 128</sup>. Three studies investigated the monitoring of sunlight exposure directly <sup>57, 63, 100</sup>.



The interventions used could be categorised as sun protection policies (often administered in schools or appropriate settings such as swimming pools), various types of education (newsletters, flyers, text messages, presentations by teachers or GPs, videos, E magazines and websites), motivational messages (UV photos and other appearance-focused interventions, self-affirmation, interventions resulting in emotional arousal, skin cancer risk and action plans) and multi-component interventions using a variety of approaches.

### 8.1.1.3 Outcomes

Most studies assessed sun protection behaviours, either as an overall composite score or in terms of individual items such as use of sunscreen and use of protective clothing. A majority of the studies assessing these behaviours relied on self-reports of the participants about various types of behaviour aimed at protecting individuals from the effects of the sun. Many studies measured both sun protection and sun exposure behaviours.

Five SRs measured sun protection behaviours, and one SR measured only sunscreen use. The majority of RCTs measured sun protection behaviours, either in composite scores or individual items. One RCT measured the change in adoption of a school protection policy among randomized school districts<sup>75</sup>. Five RCTs measured only sunscreen use<sup>71, 78, 83, 84, 86</sup>, one study (two reports) measuring use of hats<sup>80, 86</sup>, one measured uptake of an offer of sunscreen<sup>35</sup> and one other measured both hat and sunscreen use<sup>52</sup>.

Two SRs measured either sun exposure or indoor tanning exposure<sup>16, 53</sup>. Seventeen RCTs measured sunbathing or tanning outcomes. Seven of these specifically measured time spent sunbathing or tanning<sup>25-27, 38, 39, 89, 127</sup> while the remainder measured the outcomes in more general terms<sup>13, 14, 21, 51, 57, 58, 68, 90, 91, 125</sup>.

Many of the studies developed composite sun protection scores or indexes made up of individual components such as use of sunscreen, use of appropriate sun protection factor (SPF) factor in sunscreen, use of protective clothing (such as long trousers, hats, shirts, sunglasses) and avoiding the midday sun. Others studied only the use of sunscreen or hats as a response to the intervention.

Thirteen studies assessed outcomes that related to frequency of sunburn: two were SRs<sup>12, 92</sup> and eleven were RCTs<sup>13, 14, 38, 39, 57, 63, 68, 89, 93, 125, 127</sup>. All of the studies assessed the frequency of sunburns through self-reporting, either through diary entries, questionnaires or interviews.

Three studies assessed outcomes that related to naevi counts<sup>38, 80, 94</sup> conducted via expert skin examinations.

Five studies assessed changes in skin pigmentation or tanning: two SRs<sup>81, 92</sup> and three RCTs<sup>38, 67, 80</sup>. Three of the studies reported that these outcomes were assessed using skin reflectance spectrophotometry and one reported the use of skin reflectance spectrophotometry alongside other observational techniques. The fifth study failed to report both the method used and any numerical data<sup>92</sup>.

One RCT assessed changes in vitamin D levels <sup>100</sup>: serum 25 hydroxy vitamin D was measured by liquid chromatography tandem mass spectrometry.

One SR assessed changes in skin cancer outcomes <sup>37</sup> by recording the incidence of suspicious lesions excised over time.

### **8.1.2 Quality Assessment**

One SR and eight RCTs were assessed as being either of high quality (AMSTAR assessment for SRs) or of good quality [++] (GATE assessment for RCTs). Three SRs and 18 RCTs were considered of moderate quality [+]. The remaining SRs and RCTs were of low or poor [-] quality. Issues that affected the validity of the included studies were commonly use of self-report of behaviours and sun exposure, no adjustments for potential confounding variables, high attrition and lack of reporting. Lack of details on the participants and their source populations influenced the generalizability of most of the studies.

The overall quality assessment is summarized in Table 8.1, and the full results presented in the Appendices.

**Table 8.1: Characteristics of the included studies of sun protection behaviours and effects of sun exposure**

| Reference                               | Study design and quality | Country  | Objectives   | Population   | Sample size (Number analysed)  |
|---|--------------------------|--|--|--|--|
| Eagle (2009)<br><sup>37</sup>           | SR<br>moderate           | Australia, Canada, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden, UK, and the USA.       | To assess effective and cost-effective ways to provide information on skin cancer prevention to change people's knowledge, awareness and behaviour.<br><br>To investigate the content of effective and cost-effective primary prevention messages and what is the most effective and cost-effective content. | Children and adults  | 84 studies   |
| Williams (2013)<br><sup>16</sup>        | SR<br>low                | NR   | To assess the effectiveness of appearance-based interventions to reduce UV exposure and/or increase sun protection intentions and behaviours.  | Teenagers and adults   | 21 studies<br>6344 participants                                      |
| Italia (2012)<br><sup>53</sup>          | SR<br>moderate           | Australia, New Zealand, the UK, Sweden, Germany, Italy, Switzerland, Finland, the USA, Canada and Columbia | To conduct a systematic review of the effectiveness of the UV index as a health promotion instrument.  | Children in childcare and adults   | 219  |
| Reinau (2013)<br><sup>12</sup>          | SR<br>low                | North America, Europe, Australia/New Zealand, Israel, Brazil and Japan                                     | To present an overview of outdoor workers' sun-related knowledge, attitudes and protective behaviours.<br><br>To evaluate the effectiveness of sun-safety education programmes in outdoor occupational settings.   | Outdoor workers  | 50 studies   |
| Rodrigues 2013<br><sup>92</sup>         | SR<br>high               | USA, Canada, France, Australia, UK. (Review: first author UK)  | Efficacy of skin cancer prevention interventions designed to promote sun- protective behaviours in recreational/tourist settings.  | Adults, children, outdoor staff, ski outdoor staff, group leaders of a 'Summer Fun Programme' and aquatics staff | 30,794 participants (mean sample size 1,534.4; range, 27 to 12,385). |
| Lin <i>et al.</i> 2011<br><sup>81</sup> | SR<br>moderate           | Predominantly Australia, Canada, European countries, and the USA   | To assist the U.S. Preventive Services Task Force in updating its 2003 recommendation on behavioural counselling to prevent skin cancer.   | Adults, adolescents and children"  | 11 RCTs, 10,037 participants.  |

| Reference                         | Study design and quality | Country  | Objectives   | Population   | Sample size (Number analysed)             |
|-----------------------------------|--------------------------|--|--|--|---|
| Kutting 2010 <sup>74</sup>        | SR<br>low                | Not reported for the included studies (Review: first author Germany) | "To provide an overview of skin cancer with particular focus on occupational concern and giving evidence-based recommendation for effective prevention at workplace  | Workers at risk of skin cancer                       | NR  |
| Aarestrup (2014) <sup>58</sup>    | Cluster RCT<br>-         | Denmark  | To investigate whether an educational intervention targeting pupils aged 14-18 years at continuation schools in Denmark affected their sunbed use and intentions and attitudes toward sunbed use.  | Secondary school pupils (aged 15-17)                 | 2351                                      |
| Adams (2009) <sup>40</sup>        | +                        | USA  | To examine the mediating effects of a special case of the decisional balance construct where the pros of competing behaviours (i.e. sun protection versus exposure) were measured rather than the pros and cons of the same behaviour.   | Adolescents (aged 10-16)                             | 819                                       |
| Aneja 2012 <sup>88</sup>          | RCT<br>-                 | USA  | To determine if interactive computer-assisted learning patient education delivered through Skinsafe, used as a part of a multimodal patient education programme, could influence use of sun-protective clothing and sunscreen.   | Individuals presenting to a dermatology clinic.      | 132                                       |
| Armstrong 2009 <sup>86</sup>      | RCT<br>+                 | USA  | To evaluate the effectiveness of cellular telephone text messaging as a reminder tool for improving adherence to sunscreen application.  | Adults owning a cellular phone.                      | 70  |
| Armstrong 2011 <sup>71</sup>      | RCT<br>++                | USA  | To assess the efficacy of online videos as an educational medium compared to an informational pamphlet to improve sunscreen behavioural outcomes and sunscreen application knowledge.  | Adults >18 years of age with internet access.        | 94 (47 in each group)                     |
| Buendia Eisman 2013 <sup>68</sup> | RCT<br>-                 | Spain  | To determine the knowledge and behaviour of a Spanish adolescent population in relation to sun exposure through an Internet-based system   | Secondary school children.                           | 12 centres 1290 pupils.                   |
| Buller 2008 <sup>73</sup>         | RCT<br>+                 | USA  | To assess if changes in outcome expectations and self-reported sun protection behaviour produced by the computer program were different from those produced by the presentation and whether combined presentation of the computer program and teacher presentation produced superior outcomes. | School children enrolled in kindergarten to grade 5. | 1033 students from 12 elementary schools. |
| Carli 2008 <sup>127</sup>         | RCT<br>+                 | Italy  | To analyze the effects of UV-Index (UV-I) information provided by low cost, commercially available UV-I sensors on major indicators of sun-tanning behaviour and frequency of sunburns.  | University students                                  | 91  |
| Chait (2011) <sup>51</sup>        | RCT<br>+                 | USA  | To determine if a dissonance induction intervention might be successful in changing UV-related behaviours.   | Female university undergraduates                     | 260                                       |
| Craciun 2012 <sup>83</sup>        | RCT<br>-                 | Worldwide  | To compare the effectiveness of motivational and volitional interventions in changing sunscreen use in women   | Women.   | 222                                       |

| Reference                     | Study design and quality | Country   | Objectives   | Population   | Sample size (Number analysed)        |
|-------------------------------|--------------------------|-----------|--|--|--------------------------------------|
| Crane (2012) <sup>38</sup>    | RCT<br>+                 | USA       | To test the effectiveness of a partially tailored mailed intervention based on the Precaution Adoption Process Model, delivered in the spring over 3 years to parents and children.  | Children aged 6  | 867 (677)                            |
| Dubas 2012 <sup>78</sup>      | RCT<br>-                 | USA       | To explore the effect of sunscreen availability on its application among outdoor collegiate athletes.  | Adult females at college on golf teams                         | 83                                   |
| Emmons (2011) <sup>14</sup>   | RCT<br>++                | USA       | To evaluate four strategies for addressing skin cancer prevention in beach settings.   | Beach goers (median age 49)                                    | 593                                  |
| Falk (2011) <sup>39</sup>     | RCT<br>+                 | Sweden    | To investigate, in primary health care, differentiated levels of prevention directed at skin cancer, and how the propensity of the patients to change sun habits/sun protection behaviour and attitudes towards sunbathing were affected, three years after intervention. To evaluate the impact of the performance of a phototest as a complementary tool for prevention. | Adults   | 316                                  |
| Glanz 2010 <sup>90</sup>      | RCT<br>+                 | USA       | To evaluate the impact of a mailed, tailored intervention on skin cancer prevention and skin self-examination behaviours of adults at moderate and high risk for skin cancer.  | Patients in primary care clinic                                | 724                                  |
| Glanz 2013 <sup>89</sup>      | RCT<br>++                | USA       | The aim was to develop and evaluate a tailored intervention hypothesized to help decrease children's skin cancer risk by reducing sun exposure, improving sun protection behaviours, and increasing parental skin examinations for children.   | Grade 1 to 3 students at moderate or high risk for skin cancer | 1301                                 |
| Glasser 2010 <sup>69</sup>    | RCT<br>+                 | USA       | To assess the effect of a multi-component intervention on parental knowledge, sun avoidance behaviours and sun protection practices in children aged 3-10 years.   | English speaking parent-child pairs.                           | 197 parent/caregiver and child pairs |
| Gold (2011) <sup>54</sup>     | RCT<br>-                 | Australia | To evaluate the effectiveness of messages related to safer sex and sun safety.<br>To pilot the use of mobile advertising for health promotion.   | Teenagers and young adults (16-29 years old)                   | 7606                                 |
| Hiemstra (2012) <sup>57</sup> | RCT<br>+                 | USA       | To examine changes in: (1) sunburn frequency over a summer while controlling for sun exposure, sun protection habits, and participation in a skin cancer prevention programme; and (2) tanning attitudes while controlling for participation in the prevention programme.  | Lifeguards   | 3014                                 |

| Reference  | Study design and quality | Country | Objectives  | Population  | Sample size (Number analysed)                        |
|--|--------------------------|---------|---|---|--|
| Hillhouse 2010 <sup>91</sup>   | RCT<br>+                 | USA     | To evaluate the robustness of an appearance-focused intervention to prevent skin cancer in individuals reporting seasonal affective disorder (SAD) symptoms and pathological tanning motives.   | Adult females.  | 430  |
| Hunter 2010 <sup>79</sup><br>(See also Roetzheim 2011) <sup>80</sup> | RCT<br>++                | USA     | To increase the use of hats among children who received educational training on sun protection at school and at times other than school.  | Grade 4 children attending primary school.                  | 22 schools;<br>2395 students.                        |
| Jessop (2009) <sup>35</sup>  | RCT<br>-                 | UK      | To compare the efficacy of three self-affirmation manipulations in reducing defensive processing and instigating behaviour change in response to personally relevant information about the health risks of sunbathing.  | Adult female sunbathers                                     | 169 (163)  |
| Mahler (2008) <sup>26</sup>  | RCT<br>-                 | USA     | To examine whether the efficacy of an appearance-based sun protection intervention could be enhanced by the addition of social norms information.   | University undergraduates                                   | 125  |
| Mahler (2010) <sup>19</sup>  | RCT<br>+                 | USA     | To examine the impact of adding upward and/or downward social comparison information on the efficacy of an appearance-based sun protection intervention (UV photos and photoaging information).   | College undergraduates                                      | 126  |
| Mahler (2013) <sup>27</sup>  | RCT<br>-                 | USA     | To compare the sun protection practices of college students from two universities located in climatologically different regions of the USA. To explore whether there are regional differences in the efficacy of two validated appearance-based sun protection interventions: UV photography and information about photoaging   | College undergraduates                                      | 442  |
| Manne 2010 <sup>10</sup>   | RCT<br>++                | USA     | To evaluate the impact of generic print and telephone counseling versus tailored print and telephone counseling interventions on engagement in total cutaneous examination by health provider (TCE), skin self-examination (SSE), and sun protection habits.  | First degree relatives of patients with cutaneous melanoma. | 443 (381 completed time 2 and 384 completed time 3). |
| Midboe (2011) <sup>52</sup>  | RCT<br>-                 | USA     | To examine interpersonal factors, specifically social support, in the relationship between worry and health decision-making.  | Young women (aged 18-24)                                    | 59   |
| Moser (2012) <sup>25</sup>   | RCT<br>-                 | USA     | To compare the effects of intervention content eliciting strong emotional responses to visual images showing photoaging and skin cancer, specifically fear and disgust, coupled with a message of self-efficacy and benefits of sun protection with an intervention that did not contain an emotional arousal component. These were compared to a control condition that contained an emotional arousal component that elicited emotion unrelated to the threat of skin | Female undergraduates                                       | 352  |

| Reference   | Study design and quality | Country   | Objectives  | Population                           | Sample size (Number analysed) |
|---|--------------------------|-----------|---|--------------------------------------|-------------------------------|
|   |                          |           | cancer or photoaging.   |                                      |                               |
| Pagoto 2010 <sup>125</sup>  | RCT<br>+                 | USA       | To examine the impact of a skin cancer prevention intervention that promoted sunless tanning as a substitute for sunbathing.  | Adult beachgoers.                    | 250                           |
| Rat (2014) <sup>13</sup>  | Cluster RCT<br>+         | France    | To assess the effect on patient prevention behaviours of a targeted intervention to reduce the risk and increase the early detection of melanoma.   | People at elevated risk of melanoma  | 173                           |
| Reid (2013) <sup>55</sup>   | RCT<br>+                 | USA       | To examine the utility of correcting misperceptions of injunctive norms for improving sun protection and whether changes in attitudes mediated the injunctive norm-intention relationship.  | Adult women (aged 36 to 77)          | 189                           |
| Reynolds (2008) <sup>63</sup>   | RCT<br>-                 | USA       | To assess the effectiveness of an intervention that included tailored and non-tailored print communications delivered by mail to adolescents (age 11 to 15) and their parents who were also participating in an evaluation of an in-school intervention. Communications promoted sun protection use and sun avoidance, and fostered family communication and environmental change strategies. | High school students (aged 11 to 15) | 599                           |
| Roberts (2009) <sup>67</sup>  | RCT<br>+                 | USA       | To evaluate the efficacy of two interventions to reduce UV exposure in college students prior to an opportunity for high-intensity exposure: a community-based informational campaign with or without a cognitive-behavioural small group intervention.   | Undergraduates                       | 61                            |
| Robinson 2013 <sup>82</sup>   | RCT<br>-                 | Australia | To investigate the relationship of normative constructs and image norms to sun-protective intentions among young adult females playing recreational sport and at risk of repeated sun exposure.   | Female netball players.              | 100                           |
| Roetzheim 2011 <sup>80</sup><br>(See also Hunter 2010) <sup>129</sup> | RCT<br>-                 | USA       | To assess year-2 results from a cluster randomized trial promoting hat use at schools   | Children.                            | 2491                          |
| Sancho-Garnier (2012) <sup>4</sup>                                    | Cluster RCT<br>++        | France    | To determine the effectiveness of a preventive programme entitled "Living with the Sun", a transverse and multidisciplinary sun safety education guide for teachers.  | School children (aged 9-12)          | 1365                          |
| Sambrook (2012). <sup>100</sup>                                       | Cluster RCT<br>+         | Australia | To determine whether increased sunlight exposure was effective at improving vitamin D status and reduce falls in the elderly.   | Older people.                        | 602                           |

| Reference                    | Study design and quality        | Country     | Objectives  | Population   | Sample size (Number analysed)                      |
|------------------------------|---------------------------------|-------------|---|--|--|
| Schuz (2013) <sup>21</sup>   | RCT<br>+                        | Germany     | To assess whether a self-affirmation manipulation can mitigate defensive responses to personalized visual risk feedback in the skin cancer prevention context (UV photography), and whether the effects pertain to individuals with high behavioural risk status (high personal relevance of tanning).                                    | People visiting a public science event.  | 266  |
| Siegel (2010) <sup>23</sup>  | RCT<br>-                        | USA         | To assess the effectiveness of UV-filtered photography on knowledge of skin cancer, sun protective behaviours, perceptions of acquiring skin cancer, and health promotion in skin cancer prevention in freshman student nurses  | First year student nurses  | 90   |
| Stock (2009) <sup>20</sup>   | RCT<br>-                        | USA         | To examine the effectiveness of UV photography and both photoaging and skin cancer information in a sample of high-risk, male outdoor workers over a 1-year period. To examine potential mediators of changes in their protective behaviour. To examine which component of the intervention would be more effective with this population. | Male outdoor workers   | 162 (148)  |
| Van Osch 2008 <sup>84</sup>  | RCT<br>-                        | Netherlands | To determine whether formulating specific plans with regard to sunscreen use can influence parental sun protection behaviour.   | Parents of children aged 6 to 9 years, residing in the Netherlands who were registered members of an Internet panel of a private research company. | 1036 parent child dyads.                           |
| Wollina (2014) <sup>94</sup> | Cluster RCT<br>++               | Germany     | To assess the effects of regular education of parents as a tool in the primary prevention of acquired melanocytic naevi (MN) in their children.   | Children   | 395  |
| Turner (2014) <sup>76</sup>  | Observational (ecological)<br>+ | Australia   | To determine hat-wearing compliance rates of students attending primary school and their adult role-models in the skin-cancer prone population of Townsville, North Queensland, Australia.  | Primary school students, parents, caregivers and teachers.   | 36 primary schools<br>28,775 students; 2954 adults |



| Reference           | Study design and quality   | Country   | Objectives  | Population  | Sample size (Number analysed)  |
|---------------------|--|-----------|---|---|--|
| Dono (2014)<br>30   | Online survey<br>+   |           | To assess the relationship between the existence and comprehensiveness of written policies and the comprehensiveness of sun protection practices. The impact of school demographics on the strength of the relationship was also examined, as was the possibility that 'SunSmart' membership would have an additional impact on practices, beyond having any formal policy.   | Primary school principals.  | 1573 schools   |
| White (2010)<br>42  | Non-randomized comparative study using a questionnaire<br>-  | Australia | To provide a preliminary test of a theory of planned behaviour (TPB) belief-based intervention to increase adolescents' sun-protective behaviours in a high risk area, Queensland, Australia. The intervention comprised three, one hour in-school sessions facilitated by Cancer Council Queensland employees with sessions covering the belief basis of the TPB (i.e., behavioural, normative, and control [barrier and motivator] sun-safe beliefs). Participants completed questionnaires assessing sun-safety beliefs, intentions, and behaviour pre- and post-intervention. | Adolescents attending one of two secondary schools (one government and one private) | 80 recruited, 54 analysed  |
| Bandi (2010)<br>85  | Nationally representative cross-sectional telephone survey<br>+  | USA       | To assess the population prevalence and correlates of ever receiving physician advice to practice sun protection (i.e. sun protection counselling) and whether such counselling is associated with sun protection behaviours in adolescents and their parents   | US adolescents ages 11 to 18 and their parents.                                     | 1589 adolescents and parents   |
| Quereux (2009)<br>7 | Non-randomized comparative open control study (teacher decided whether or not to teach using "to live with the sun" programme) Questionnaire (described as self-administrated) | France    | To assess the impact of an educational programme on both children's knowledge and behaviour towards the sun   | Children aged between 8 and 11 years  | 13 schools; 1 class per school; 120 children in intervention and 162 in control groups |

| Reference             | Study design and quality   | Country   | Objectives  | Population   | Sample size (Number analysed)           |
|-----------------------|--|-----------|---|--|---|
|                       | and standardised)  |           |   |  |   |
| Woolley (2008)<br>15  | Survey Questionnaire and measurements of current sun damage<br>- | Australia | 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. | Outdoor workers (defined as a minimum of 30 minutes out in the sun on a usual workday) | 69                                      |
| Potente (2011)<br>41  | Survey conducted online.<br>+                                    | Australia | To determine whether entertainment-education strategies could be combined in a creative communication campaign to improve sun protection behaviours.  | Teenagers and young adults.  | 8250                                    |
| Makin (2013)<br>95    | Telephone surveys<br>+   | Australia | To examine trends in key sun-protection behaviours and sunburn for the Melbourne population from 1987 to 2007, and to examine for the first time patterns of change among age groups.                                 | General population.  | 8802 interviews                         |
| Thieden (2013)<br>96  | Longitudinal<br>+  | Denmark   | To investigate whether people change their sun behaviour over a period of 7 years.  | Adults.  | 38                                      |
| Stover (2012)<br>5    | Pre- to post-intervention questionnaires<br>+                    |           | To evaluate the 'SunPass' project (an interventional lecture, site inspections and a certification).  | Children in kindergartens and their caregivers.  | 55 kindergartens; 5424 children         |
| Kahn (2011)<br>97     | Longitudinal survey.<br>+  | USA       | To explore whether maternal communication about behaviours that prevent skin, cervical, and lung cancer is associated with adolescent cancer prevention behaviours.   | Adolescents.   | 10409                                   |
| Hay (2009)<br>98      | Cross-sectional telephone or online survey<br>+                  |           | To examine the association among mass media health information exposure (general health, cancer, sun protection information), skin cancer beliefs, and sun protection behaviours.                                     | Adults with no skin cancer history.  | 1736                                    |
| Aullbert (2009)<br>70 | Pre- to post-intervention<br>+                                   | Germany   | To establish a feasible certification programme for sun protection in a German child day-care centre, for a better sun protection of the children and the reduction of skin cancer incidence in the long term.        | Children, parents and University hospital  | 1 kindergarten; about 150 children aged |

| Reference                      | Study design and quality  | Country   | Objectives   | Population  | Sample size (Number analysed)                                    |
|--------------------------------|---|-----------|--|---|--|
|                                |   |           |  | kindergarten staff members.                                     | 0–6 years; 12 staff; 46 parents.                                 |
| Gilaberte (2008) <sup>6</sup>  | A non-randomized, before/after, community intervention without control group, with schools as the unit of intervention using a 'Draw and Write research strategy' and a questionnaire.<br>+ | Spain     | To evaluate SolSano's effects on students' knowledge, attitudes and practices about sun safety.  | Elementary school children                                      | 5845 children from 215 Aragonese primary schools. 1522 analysed. |
| Dixon (2008) <sup>77</sup>     | Serial cross-sectional observational field surveys.<br>+  | Australia | To describe the prevalence and determinants of teenagers' and adults' observed sun protection behaviour while engaged in outdoor leisure activities on summer weekends, over a decade of the SunSmart skin cancer prevention programme, which involved public education and advocacy.          | Teenagers and adults.   | 46,810 observations.   |
| Dobbinson (2008) <sup>59</sup> | Nine serial cross-sectional telephone surveys.<br>+   | Australia | To examine trends over time in sun-protective behaviours of residents of Melbourne, capital of the state of Victoria, Australia, and the effect of SunSmart-paid television media on skin cancer prevention attitudes and behaviours in the context of a long-term health promotion programme. | One adult per household was interviewed, (aged 14 to 69 years). | 11,589   |
| Koster (2011) <sup>99</sup>    | Telephone and online surveys<br>+   | Denmark   | To describe the development in sunbed use after the start of the campaign in the period 2007–2009.   | Teenagers and adults.   | 17217  |

## 8.2 SUN PROTECTION POLICIES AND PROGRAMMES

Two systematic reviews <sup>53, 74</sup>, five RCTs <sup>4, 40, 57, 63, 75</sup> and seven observational studies, three comparative <sup>15, 30, 76</sup> and four non-comparative <sup>5, 6, 59, 77</sup> assessed the effects of sun protection policies and programmes on changes in sun protection practices and the effects of sun exposure. The results of these studies are summarized here and further details are provided in the Appendices.

### 8.2.1 Systematic Reviews

One moderate quality SR [+] <sup>53</sup> was identified that assessed studies using the UV index as a health promotion instrument via media campaigns, programmes aimed at specific settings (e.g. childcare, high radiation), programmes delivered through health care providers, programmes using general or personalized information, or a combination of approaches. The 25 included studies were conducted in countries across the world and participants in the studies ranged from school children aged 5 to 12 years to a nationally representative sample of individuals. In terms of general sun protection, the SR reported mixed results:; one trial showed an increase in general sun protection and one showed no effect. Five cross-sectional studies showed an increase in sun protection behaviour, but a further five cross-sectional studies showed no effect. For use of protective clothing, the SR also reported mixed results: one trial showed no effect in hat use, one trial showed a decrease with the use of UV meters and an additional cross-sectional study found an increase in use of protective clothing. Similarly, mixed results were reported for sunscreen use: one trial showed no effect, one trial showed a decrease and an additional cross-sectional study found an increase in use of sunscreen <sup>53</sup>.

One low quality SR [-] <sup>74</sup> assessed the effects of employer policies on individual workers through the provision of awnings, protective clothing and skin examinations. One study in the SR reported increased sunscreen use with the intervention but details on this finding were sparse.

### 8.2.2 Randomized Controlled Trials

Five RCTs <sup>4, 40, 57, 63, 75</sup> assessed the effects of validated programmes on sun protection behaviours. One RCT was of good quality [++], three were of moderate quality [+] and one was of poor quality [-]. Two RCTs were conducted in schools, one in the home environment, one multi-centre RCT was undertaken in swimming pools throughout the USA, and one was a computer adaptation of the Sun Smart programme for delivery in primary health care.

In a good quality trial [++] <sup>4</sup>, French children aged 9 to 12 were randomized to Living with the Sun programmes or no programme in primary schools. Living in the Sun comprised 10 practical workshops and activities designed to increase children's scientific knowledge of the sun, its characteristics and the effect of sun exposure on the body; the different skin types and their sensitivity to sunlight; the determinants of variations in the UV intensity; and sun protection strategies <sup>4</sup>. The children in the intervention were significantly more likely to report wearing a hat, using a sunshade on the beach, and reapplying sunscreen more frequently than members of the control group. The intervention children were also more likely to attribute their information source to the school.

In one moderate quality trial [+] <sup>75</sup>, multiple US school board districts, school administrators and board members received the Sun Safe intervention comprising sun protection policy information, tools, and technical assistance in the form of printed materials, a website, meetings and presentations to school boards. There was no statistical difference between the number of school districts which adopted or changed sun protection policies as a result of the intervention and school districts which had not received the intervention.

A moderate quality trial [+] <sup>57</sup> focused on the sun protection habits of US lifeguards in a wide variety of swimming pool settings. A basic Pool Cool programme was compared with an enhanced Pool Cool programme. Lifeguards at the participating swimming pools took part in and delivered the programme to children. Lifeguards received training about skin cancer prevention and the programme, conducted Pool Cool educational lessons as part of swimming lessons, carried out poolside activities, and helped to implement related environmental and policy changes <sup>57</sup>. Sun protection habits (frequency of practice of five sun protective measures) across the study arms increased from a measure of 2.49 (SD =0.56) at baseline to 2.61 (SD = 0.57) at follow-up [t (2947) = e11.83, p<0.001] <sup>57</sup>.

In a second moderate quality trial [+] US adolescents received a Sun Smart intervention over 24 months <sup>40</sup>. This was an adapted version of the Sun Smart expert-system computer program delivered in the primary care setting and involved an interactive tailored computer session that assessed self-reported stage of change, decisional balance, self-efficacy, and processes of change, and also generated tailored feedback reports. Adolescents interacted with the expert system in the physician's office twice: at the start of the intervention and at 12-months. The adolescents were asked to rate how often they practised seven recommended sun protection behaviours on a 5-point Likert scale. The behaviours included wearing a shirt, staying in the shade, avoiding the sun during midday, using a sunscreen (SPF, and location of application). More positive increases were found in the intervention group who received SunSmart than the control group, however, these findings were not statistically significant.

A poor quality trial [-] <sup>63</sup> reported the delivery of a summer programme of communications aimed at adolescent school children and their parents in the USA. Sun Scoop involved newsletters for parents, while Summer Raze comprised newsletters for adolescents and small gifts to encourage them to practice the recommended sun protection. There was no significant difference in sun protection behaviour as a result of the programme among adolescents or their parents <sup>63</sup>.

The programmes assessed were all different, with different components and populations. Three programmes reported significant improvements in some sun protection behaviours.

Living with the Sun and Sun Smart, suggested that primary school children in France and adolescents in the USA benefited from these school programmes <sup>4,40</sup>.

Only one RCT <sup>57</sup> addressed quantifiable outcomes such as sunburn or naevi.

### **Observational studies**

A moderate quality [+] comparative observational study <sup>76</sup> investigated the hat-wearing compliance rates of 28775 students aged 5 to 12 years and 2954 adult role-models attending 36 Australian primary schools. Hat use (all styles) among SunSmart school (SSS) and non-SunSmart school (NSSS) students was similar before (24.2% vs 20.5%;  $p = 0.701$ ), after (25.4% vs 21.7%;  $p = 0.775$ ) and during school-hours (93.0% vs 89.2%;  $p = 0.649$ ) except SSS students wore gold-standard (broad-brim/ bucket/ legionnaire) hats during school play-breaks more often in the warmer months (October–March) than NSSS students (54.7% vs 37.4%;  $p = 0.02$ ). Although the proportion of adults who wore hats (all styles) was similar at SSS and NSSS (48.2% vs 46.8%;  $p = 0.974$ ), fewer adults at SSS wore them before school (3.7% vs 10.2%;  $p = 0.035$ ) <sup>76</sup>.

A moderate quality [+] comparative observational study <sup>30</sup> assessed the relationship between the existence and comprehensiveness of written policies and the comprehensiveness of sun protection practices by sending principals from 1573 primary schools a questionnaire. Schools with a written policy had more comprehensive practices than schools without a written policy. SunSmart membership was indirectly related to practice comprehensiveness via policy comprehensiveness <sup>30</sup>.

A poor quality [-] comparative observational study <sup>15</sup> investigated whether mandatory sun protection for outdoor workers in Queensland, Australia is associated with reduced sun damage by comparing employees working under a mandatory sun protection policy (mean age 42 years (SD  $\pm$  11); 89% male) with 21 employees working under a voluntary sun protection policy (mean age 44 years (SD  $\pm$  16); 100% male). Compared to workers with a mandatory policy, employees working under a voluntary sun protection policy were less likely to usually wear a long-sleeved shirt while out in the sun at work ( $p < 0.001$ ) <sup>15</sup>.

In a moderate quality [+] non-comparative study, a questionnaire was administered before and after a 'SunPass' project conducted in 5424 children attending 55 kindergartens in Germany <sup>5</sup>. The SunPass project involved an interventional lecture, site inspections and certification of nursery schools. Children were aged between 0 and 12 years (mean 3.8 years). There was a significant increase in sun protection behaviour after the intervention ( $p < 0.001$ ). The number of parents who did not use sunscreen on their children decreased from 4.3% to 2.6% <sup>5</sup>.

In another moderate quality [+] non-comparative observational study<sup>6</sup> a questionnaire was administered before and after 'SolSano', a sun safety programme which recruited 5845 children with a mean age of 6.6 years (SD not reported) from 215 Aragonese primary schools in Spain. Results were reported for 1522 children. Sunscreen re-application rates increased in children who always (change 3.2% (0.3 to 6.3) and sometimes (change +1.9% (1.1 to 4.9) reapplied sunscreen. The use SPF >15 increased overall by 20.3% (17 to 23.6). There were improvements in sun protection practices while doing outdoor activities in parks (change of 7.7% (4.6 to 10.7); during sports (change of 5.5% (2.2 to 8.8) and in the mountains (change of 4.9% (1.5 to 8.3) but not at beaches<sup>6</sup>.

A moderate quality [+] non-comparative observational study<sup>77</sup> described the prevalence and determinants of 46,810 teenagers' (aged 14 and over) and adults' observed sun protection behaviour while engaged in outdoor leisure activities on summer weekends, over a decade of the SunSmart skin cancer prevention programme, which involved public education and advocacy. Significant improvements in the extent of body cover occurred over the decade observed, such that the odds of the proportion of people wearing clothes cover above the median level increased by 3% per year (95% confidence interval, 2 to 4%)<sup>77</sup>.

A moderate quality [+] non-comparative observational study<sup>59</sup> examined trends over time in the sun protective behaviours of residents of Melbourne, Australia, and the effect of SunSmart-paid television media on skin cancer prevention attitudes and behaviours in the context of a long-term health promotion programme in 11,589 teenagers and adults aged 14 to 69 years randomly selected from residential telephone directories. Use of hats and sunscreens significantly increased over time and peaked during the mid to late 1990s, compared with the pre-SunSmart baseline. The mean proportion of unprotected skin was reduced and was lowest in the summer of 1997–1998<sup>59</sup>.

#### **Evidence statement 8.1**

There is moderate, inconsistent evidence from two systematic reviews<sup>53, 74</sup>, five RCTs<sup>4, 40, 57, 63, 75</sup> and seven observational studies, three comparative<sup>15, 30, 76</sup> and four non-comparative<sup>5, 6, 59, 77</sup> about the effects of sun protection policies and programmes on changes in sun protection practices and the effects of sun exposure.

One moderate quality [+] systematic review<sup>53</sup> assessed studies using the UV index as a health promotion instrument and reported one trial showed an increase in general sun protection and one showed no effect. Five cross-sectional studies showing an increase in sun protection behaviour, but a further five cross-sectional studies showed no effect. For use of protective clothing, the SR also reported mixed results: one trial showed no effect in hat use, one trial showed a decrease with the use of UV meters and an additional cross-sectional study found an increase in use of protective clothing. Similarly, mixed results were reported for sunscreen use: one trial showed no effect, one trial showed a decrease and an additional cross-sectional study found an increase in use of sunscreen<sup>53</sup>. Another poor quality [-] systematic review<sup>74</sup> assessed the effects of employer policies on individual workers through the provision of awnings, protective clothing and skin examinations and identified one study in the SR reporting increased sunscreen use with the intervention but details on this finding were sparse.

There is moderate, inconsistent evidence from five RCTs about the effects of sun protection policies and programmes on changes in sun protection practices and the effects of sun exposure. One good quality [++] RCT<sup>4</sup> reported that the Living in the Sun programme results in increased sun protection

behaviour including wearing a hat, using a sunshade on the beach, and reapplying sunscreen more frequently in French children aged 9 to 12 years. A second, moderate quality [+] RCT<sup>40</sup> reported that the SunSmart intervention increases sun protection behaviour through increases in shirt wearing, staying in the shade, avoiding sun at midday and using a sunscreen in US adolescents. Three RCTs (two moderate quality [+]<sup>57, 75</sup> and one poor quality [-]<sup>63</sup> reported that the Pool Cool programme in adult lifeguards, and the Sun Safe and SunScoop educational programmes in children do not change sun protection practices or the effects of sun exposure.

In Australian children there were no differences in hat wearing<sup>76</sup> however, schools with a written policy were found to have more comprehensive sun protection practices than schools without a written policy.<sup>30</sup> Australian outdoor employees working under a voluntary sun protection policy were less likely to usually wear a long-sleeved shirt while out in the sun at work than those under a mandatory policy ( $p < 0.001$ ). A SunSmart-paid television media aimed at the Australian general public found that the use of hats and sunscreens significantly increased over time and peaked during the mid to late 1990s, compared with the pre-SunSmart baseline<sup>59</sup> while a second SunSmart study saw significant improvements in the extent of body cover occurred over the decade observed, such that the odds of the proportion of people wearing clothes cover above the median level increased by 3% per year (95% confidence interval, 2 to 4%)<sup>77</sup>. In Germany a 'Sunpass' programme found significant increases in sun protection behaviour in kindergarten children ( $p < 0.001$ ). The number of parents who did not use sunscreen on their children decreased from 4.3% to 2.6%<sup>5</sup> while in Spanish children, a 'SolSano' programme reported that sunscreen re-application rates increased in children who always (change 3.2% (0.3 to 6.3) and sometimes (change +1.9% (1.1 to 4.9) reapplied sunscreen. The use SPF >15 increased overall by 20.3% (17 to 23.6). There were improvements in sun protection practices while doing outdoor activities in parks (change of 7.7% (4.6 to 10.7); during sports (change of 5.5% (2.2 to 8.8) and in the mountains (change of 4.9% (1.5 to 8.3) but not at beaches<sup>6</sup>.

<sup>53</sup>Italia et al. (2012)

<sup>74</sup>Kutting et al. (2010)

<sup>40</sup>Adams et al. (2009) [+]

<sup>4</sup>Sancho-Garnier et al. (2012) [++]

<sup>75</sup>Buller et al. (2011)

<sup>57</sup>Hiemstra et al. (2012)

<sup>63</sup>Reynolds et al. (2008)

<sup>76</sup>Turner et al. (2014)

<sup>30</sup>Dono et al. (2014)

<sup>15</sup>Woolley et al. (2008)

<sup>5</sup>Stover et al. (2012)

<sup>6</sup>Gilaberte et al (2008)

<sup>77</sup>Dixon et al. (2008)

<sup>59</sup>Dobbinson et al. (2008)



### 8.3 PROVISION OF SUN PROTECTION CLOTHING OR SUNSCREEN

Two RCTs reported in three publications <sup>78-80</sup> assessed the influence of making available or providing sun protection to study participants. The results of these studies are summarised here and further details are provided in the Appendices. Another four studies provided sun protection as part of other interventions <sup>12, 38, 63, 125</sup> (reported above).

A poor quality trial [-] <sup>78</sup> of 83 female undergraduate golfers at a US college explored the effect of sunscreen availability on its application. Each team in the intervention group received one (1-gallon) tub of sun-protection factor (SPF) 30+ sunscreen lotion which was positioned at the entrance the team's locker room. Written and verbal directions informed players to use the locker room tub of sunscreen daily. Participants were also given five tubes of SPF 30+ sunscreen and told to keep at least one tube of sunscreen in their golf bag at all times. Making sunscreen readily available to athletes in the locker room significantly increased the initial application of sunscreen by over 1 day per week compared with the control group for whom sunscreen was not readily available. However, there was no significant increase in the re-application of sunscreen during practice for either group <sup>78</sup>.

Two reports of a single study in elementary school children in Florida <sup>80</sup> observed the wearing of hats following the provision of or emphasis on hat use together with brief educational sessions. One of these reports were considered to be of good quality [++] <sup>79</sup> and the other to be of poor quality [-] <sup>80</sup>. Students were provided with two free wide-brimmed hats (one to use at school and one to use at home) and took part in classroom sessions targeting sun protection attitudes and social norms. A 45-minute comprehensive sun protection educational session was carried out in classrooms by a community health education organization. Three 60-minute follow-up sessions addressed the benefits of sun protection (with emphasis on hat use), promoted favourable attitudes about sun protection, and made clear that fourth-grade students were both allowed to wear hats at school and should be wearing hats while outside at school. Observed hat use increased by 41% at the end of one year in the intervention group, compared to the control who received similar sessions on topics other than sun protection but whose hat use declined to an increase from baseline of 19% after 2 years ( $p < 0.001$ ) <sup>79, 80</sup>. Hat use in the control group did not change during the two-year follow-up period <sup>80</sup>.

Neither RCT addressed quantifiable outcomes such as sunburn or naevi.

### **Evidence statement 8.2**

There is inconclusive, consistent evidence from two RCTs<sup>78-80</sup> that the provision of sun protection clothing or sunscreen is an effective way to increase their use.

A poor quality trial [-]<sup>78</sup> of 83 female undergraduate golfers at a US college reported that making sunscreen readily available to athletes in the locker room significantly increased the initial application of sunscreen by over 1 day per week, however there was no significant increase in the re-application of sunscreen during practice for either group<sup>78</sup>. A poor quality trial in a single study in elementary school in Florida<sup>79,80</sup> reported that observed the wearing of hats increased by 41% at the end of one year in the intervention group, compared to the control who received similar sessions on topics other than sun protection but whose hat use declined to an increase from baseline of 19% after 2 years ( $p < 0.001$ ).

Students were provided with two free wide-brimmed hats (one to use at school and one to use at home) and took part in classroom sessions targeting sun protection attitudes and social norms.

<sup>78</sup>Dubas et al. (2012) [-]

<sup>79</sup>Hunter et al. (2010) [++]

<sup>80</sup>Roetzheim et al. (2011) [-]

## **8.4 MOTIVATIONAL INTERVENTIONS**

Two SRs<sup>16, 81</sup> and twelve RCTs<sup>19, 21, 23, 25-27, 35, 39, 82-84, 125</sup> and two observational studies<sup>42, 85</sup> assessed the effects of various motivational interventions on sun protection behaviours. Interventions ranged from appearance-based photos designed to show the aging effects of sun on the skin, to interventions designed to enhance self-affirmation, motivation, volition, self-efficacy, positive traits and action plans.

### **8.4.1 UV Photos of Participants with or without Photoaging Information**

Two systematic reviews<sup>16, 81</sup> and eight RCTs<sup>19, 21, 23, 25-27, 39, 125</sup> assessed the effects of UV photos with or without photoaging in combination with other interventions. Three of the RCTs<sup>19, 26, 125</sup> also featured in a SR included for this section and are not discussed here.

#### **8.4.1.1 Systematic reviews**

One moderate quality SR [+] <sup>81</sup> included four trials in university students that used appearance-based behavioural interventions (UV photos showing the effects of photoaging) to investigate effects on indoor tanning behaviour and changes in skin pigmentation. In three trials, the appearance-focused intervention successfully reduced indoor tanning in women. No further details were reported<sup>81</sup>.

A low quality SR [-] looked exclusively at indoor tanning behaviour (together with future sun exposure intentions) <sup>16</sup>. The effect of photoaging information alone was examined in terms of the effect on indoor tanning behaviour. Two studies were included in the meta-analysis, with a total of 412 participants. These studies produced a combined effect size of  $r = -0.82$  (large effect size, Cohen) although they were heterogeneous so the significance of this finding is unclear <sup>16</sup>.

#### **8.4.1.2 Randomized controlled trials**

A moderate quality trial [+] compared a UV photo group with a combined UV photo and self-affirmation group against a third group (control; no intervention) in 266 people (aged 11 to 71 years) visiting a public science event <sup>21</sup>. Individuals receiving self-affirmation interventions reported lower rates of deliberate sun exposure when compared with those not receiving this intervention.

A poor quality trial [-] <sup>25</sup> investigated the effects of a combined intervention, using graphic images of photoaging and skin cancer to elicit a strong emotional response plus details of how to use sunscreen effectively, in 352 US undergraduate females aged from 18 to 49 years. The combined intervention with emotional arousal resulted in significantly greater sun protection behaviours than found in the control group, including sunscreen use, attempts to stay in the shade and avoiding the sun.

A poor quality trial [-] <sup>23</sup> involving 90 US first year student nurses compared a UV photo intervention combined with a skin cancer lecture to a lecture alone and also to a no intervention control. The study reported an increase in sun protection behaviour for all groups post intervention, but differences between groups were not reported.

One poor quality trial [-] <sup>27</sup> explored the effect of three photoaging interventions compared to each other and to no intervention in 442 Californian college students, of whom a majority (62.7%) were female and with an ethnic mix. The photoaging interventions included UV facial photographs, photoaging information presented in a 10 minute videotaped slide show, and a combination of both approaches. The study found that college students who received a UV photo intervention had lighter skin colour ( $M=61.81$ ,  $SD=3.57$ ) than those who had not ( $M= 61.01$ ,  $SD = 3.59$ ;  $F(1, 308) = 4.01$ ,  $p < .05$ ,  $\eta = .11$ ) and those who watched an educational video had lighter skin colour ( $M= 61.87$ ,  $SD = 3.57$ ) than those who did not ( $M= 60.95$ ,  $SD = 3.58$ ),  $F(1, 308) = 5.31$ ,  $p = .02$ ,  $\eta = .13$ ). The increase in tan skin colour following the summer months was present in both study locations, but was more pronounced in the Iowa sample <sup>27</sup>.

One moderate quality trial [+] <sup>39</sup> found no statistically significant difference in individuals' perceptions of risk of skin cancer in 316 adults registered at a health centre who were given general sun protection advice and different forms of personalized feedback over a three-year period. The trial evaluated three strategies using general sun protection advice with different personalized feedback: (1) a standard letter + personalized risk assessment + other information; (2) personal GP consultation + adjusted information + other info; (3) the same as (2) but with the inclusion of a phototest. There were no significant differences reported between groups for the number of times participants had been sunburnt during the past year <sup>39</sup>.

### **Evidence statement 8.3**

There is moderate, consistent evidence from one moderate quality RCT [+] <sup>81</sup> and four poor quality RCTs [-] <sup>21, 23, 25, 27</sup> that UV photographs with or without photoaging are effective in increasing sun and sunbed protective practices in adults.

There is moderate, consistent evidence from one moderate quality systematic review [+] <sup>81</sup> and one poor quality review [-] <sup>16</sup> that UV photographs with or without photoaging are effective in reducing indoor tanning practices.

There is moderate, inconsistent evidence from two systematic reviews <sup>16, 81</sup> and five RCTs <sup>21, 23, 25, 27, 39</sup> about the effects of UV photos with or without photoaging in combination with other interventions in increasing sun protection behaviours.

One systematic review <sup>81</sup> and two RCTs <sup>21, 25</sup> reported significant effects of UV photographs (with or without photoaging) in increasing sun protection behaviours. One moderate quality [+] systematic review <sup>81</sup> included four trials in university students; three trials reported that an appearance-based behavioural intervention (UV photos showing the effects of photoaging) successfully reduced indoor tanning in women. No further details were reported. A moderate quality [+] RCT <sup>21</sup> comparing a UV photo group with a combined UV photo and self-affirmation group in 266 people (aged 11 to 71 years) visiting a public science event reported that individuals receiving self-affirmation interventions reported lower rates of deliberate sun exposure. A poor quality trial [-] <sup>25</sup> in 352 US undergraduate females aged from 18 to 49 years reported that a combined intervention (graphic images of photoaging and skin cancer to elicit a strong emotional response plus details of how to use sunscreen effectively) with emotional arousal resulted in significantly greater sun protection behaviours than found in the control group, including sunscreen use, attempts to stay in the shade and avoiding the sun.

Two RCTs, one of moderate quality [+] <sup>39</sup> and one of poor quality [-] <sup>23</sup> found no statistically significant difference in individuals' perceptions of risk of skin cancer in participants receiving UV photo interventions.

One poor quality [-] systematic review <sup>16</sup> and one poor quality [-] RCT <sup>27</sup> reported unclear findings.

<sup>81</sup>Lin et al. (2011) [+]

<sup>16</sup>Williams et al. (2013) [-]

<sup>27</sup>Mahler et al. (2013) [-]

<sup>25</sup>Moser et al. (2012) [-]

<sup>23</sup>Siegel et al. (2010) [-]

<sup>39</sup>Falk et al. (2011) [+]

<sup>21</sup>Schuz et al. (2013) [+]

## 8.4.2 Other Motivational Interventions

Four trials <sup>35, 82-84</sup> and two observational studies <sup>42, 85</sup> investigated other motivational interventions.

### 8.4.2.1 Randomized controlled trials

One poor quality [-] trial compared interventions where 100 Australian female netball players (aged 17 to 25 years) studied bar graphs and read statements about different norms of sun protection behaviour and examined colour photos of a recreational sportswoman (pale or tanned) <sup>82</sup>. Two groups of norms were compared: supportive group norms (sportswomen had high levels of sun protection behaviour or low levels) and image norms (appeared tanned) and non-supportive group norms (sportswomen had low levels of sun protection behaviour compared to non-sporting women) and image norms (women appeared pale). Results showed no differences between intervention groups in terms of sun protection behaviours.

A poor quality [-] trial assessed the effects of a motivational intervention combined with risk and resource communication in 222 women aged 18 to 66 years <sup>83</sup>. The intervention involved a message about the risk of unprotected sun exposure, highlighting negative consequences, plus a description of positive outcomes to be expected with the use of sunscreen of SPF 15+ (and a self-efficacy message about the ease of applying sunscreen) versus a volitional intervention (participants were asked to develop an online interactive action plan after being told about someone who makes an action plan for sunscreen use, and also asked to think about ways to overcome obstacles to sunscreen use) versus a control intervention where women received brief feedback on their skin type after completing a questionnaire. Women were recruited on the internet from universities worldwide. The trial found that women in the volitional group were significantly more likely to use sunscreen when compared to the motivational group or control (mean 1.94 vs 1.73 and 1.73, respectively).

One poor quality [-] British trial <sup>35</sup> compared three self-affirmation strategies with control: the self-affirmation strategies focused variously on values, kindness and positive traits. Participants were female sunbathers (aged 18 to 32) on a beach in the UK. Those women who received a positive traits affirmation condition were significantly more likely to request a free sample of sunscreen (63% versus 40% in the control group) <sup>35</sup>.

One poor quality trial [-] <sup>84</sup> assessed whether formulating specific plans with regard to sunscreen use can influence the sun protection behaviour of parents (applying sunscreen to their child at 5 months follow-up) in 1036 parent-child dyads. The control group did not receive a specific plan. Although there was no significant difference between intervention and control in sunscreen use, the outcome was increased by 13.5% in those who were highly motivated.

### 8.4.2.2 Observational studies

A moderate quality [+] comparative observational study<sup>85</sup> conducted in the US assessed the population prevalence and correlates of ever receiving physician advice to practice sun protection (i.e. sun protection counselling) and whether such counselling is associated with sun protection behaviours in 1589 adolescents aged 11 to 18 years and their parents. Counselling was positively associated with regular sunscreen use, appropriate sunscreen application practices, and intermittent hat use, but not with other recommended behaviours<sup>85</sup>.

A poor quality [-] comparative observational study<sup>42</sup> used a before-and-after study design to provide a preliminary test of a theory of planned behaviour (TPB) belief-based intervention to increase sun-protective behaviours in a high risk area in Australia among adolescents aged 13 to 16 years (mean 14.53 (SD 0.69) years) attending one of two secondary schools (one government, one private). The intervention comprised three, one hour in-school sessions facilitated by Cancer Council Queensland employees with sessions covering the belief basis of the TPB (i.e. behavioural, normative, and control [barrier and motivator] sun-safe beliefs). Students completed questionnaires assessing sun-safety behaviour pre- and post-intervention. At baseline students performed a mean of 2.96 (SD 0.37) sun protective behaviours compared with 3.88 (SD 0.37) following the intervention ( $p=0.04$ ) in the intervention group, but this effect was not seen in the control group (3.93 (SD 0.33) vs. 3.44 (SD 0.33)), however, the control group had a much higher rate of protective behaviours at baseline<sup>42</sup>.

#### Evidence statement 8.4

There is inconclusive, inconsistent evidence from four poor quality [-] RCTs<sup>35, 82-84</sup> and two observational studies<sup>42, 85</sup> about whether other motivational interventions (including UV photographs, motivational interventions compared with volitional interventions, self-affirmation strategies, and formulating specific plans with regard to sunscreen use) are effective in changing sun protection practices or sun exposure.

One RCT<sup>82</sup> in 100 Australian female netball players (aged 17 to 25 years) showed no differences in those who studied bar graphs, read statements about different norms of sun protection behaviour and examined colour photos of a recreational sportswoman (pale or tanned). A second RCT<sup>83</sup> in 222 women aged 18 to 66 years reported that women in a volitional group (participants were asked to develop an online interactive action plan after being told about someone who makes an action plan for sunscreen use, and also asked to think about ways to overcome obstacles to sunscreen use) were significantly more likely to use sunscreen when compared to a motivational (including a message about the risk of unprotected sun exposure, highlighting negative consequences, plus a description of positive outcomes to be expected with the use of sunscreen of SPF15+ group) or control (mean 1.94 vs 1.73 and 1.73, respectively). A third RCT<sup>35</sup> in British female sunbathers (aged 18 to 32) reported that women who received a positive traits affirmation condition were significantly more likely to request a free sample of sunscreen (63% versus 40% in the control group). A fourth trial<sup>84</sup> in parents and children found no differences between formulating specific plans with regard to sunscreen use and having no plan.

Two observational studies reported that counselling was positively associated with regular sunscreen use, appropriate sunscreen application practices, and intermittent hat use<sup>85</sup> and that an increase in sun protection behaviours was seen following educational school sessions.<sup>42</sup>

<sup>82</sup>Robinson et al. (2013) [-]

<sup>83</sup>Craciun et al. (2012) [-]

<sup>35</sup>Jessop et al. (2009) [-]

<sup>84</sup>van Osch et al. (2008) [-]

<sup>85</sup>Bandi et al. (2010) [+]

<sup>42</sup>White et al. (2010) [-]

## 8.5 EDUCATIONAL INTERVENTIONS

Seventeen studies assessed educational and information tools delivered in a variety of ways: text messaging, newsletters, mailings, computer programs, videos, presentations by teachers or GPs: one systematic review <sup>81</sup>, 15 RCTs <sup>10, 13, 38, 39, 54, 63, 67, 68, 71, 73, 86, 88-91</sup> and one comparative observational study <sup>41</sup>.

### 8.5.1 Text Messages

#### Two trials assessed the effects of text messages <sup>54, 86</sup>

One moderate quality trial [+]<sup>86</sup> evaluated the effectiveness of text messaging as a reminder tool for improving adherence to sunscreen application in 70 American adults (mean age 33 to 34 years). The intervention group received daily text-message reminders via cellular telephone for 6 weeks. The text-message reminders consisted of two components: a “hook” text detailing daily local weather information and a “prompt” text reminding users to apply sunscreen. The control group received no text reminders. The trial found that text reminders to use sunscreen significantly increased use compared to no text messages ( $p < 0.001$ ). This trial was the only one to measure sunscreen use objectively, with the use of electronic monitors attached to the sunscreen tube <sup>86</sup>.

One poor quality trial [-]<sup>54</sup> evaluated the effectiveness of messages related to safer sex and sun safety in 7606 Australian young people aged 16 to 29 years. The intervention group received fortnightly text messages on sun safety aimed to increase knowledge, reinforce protective behaviours, change attitudes and increase perceived behavioural control. The control group received the same type of messages, but about safe sex practices. The trial found no significant differences in sun protection measures such as use of hats, sunscreen, shade or clothing in participants receiving sun safety messages compared with participants receiving safe sex messages <sup>54</sup>.

### Evidence statement 8.5

There is weak, inconsistent evidence from one moderate quality RCT [+]<sup>86</sup> and one poor quality RCT [-]<sup>54</sup> about the effectiveness of text reminders in increasing sunscreen use.

One moderate quality [+] RCT<sup>86</sup> in 70 American adults (mean age 33 to 34 years) reported that daily text-message reminders to use sunscreen via cellular telephone for 6 significantly increased use compared to no text messages ( $p < 0.001$ ). The poor quality [-] RCT<sup>54</sup> found no significant differences in sun protection measures such as use of hats, sunscreen, shade or clothing in participants receiving sun safety messages compared with participants receiving safe sex messages in 7606 Australian young people aged 16 to 29 years.

<sup>86</sup>Armstrong et al. (2009) [+]

<sup>54</sup>Gold et al. (2011) [-]

## 8.5.2 Electronic Educational Interventions

Four trials and one observational study assessed the effects of educational communication delivered by websites, computer, or online video <sup>41, 68, 71, 73, 88</sup>.

### 8.5.2.1 Randomized controlled trials

One good quality trial [++] conducted in the US aimed to assess the efficacy of online videos as an educational medium, compared to an informational pamphlet, to improve sunscreen behavioural outcomes and sunscreen application knowledge in 94 adults (mean age 35 to 40 years) <sup>71</sup>. The intervention group watched an online video addressing how sunscreens work to protect skin, different types of sunscreens, importance of sunscreen use, and proper application. The control group received identical educational content as the video but delivered in the form of a pamphlet. Following the intervention, participants who saw the online video had significantly higher frequency of sunscreen use (baseline 1.7 days (SD 2.5) vs. post-intervention 3.4 days (SD 2.6) compared to participants who received the pamphlet (baseline 2.0 days (SD 3.0) vs post-intervention 2.4 days (SD 2.6)) <sup>71</sup>.

One poor quality trial [-] investigated the knowledge and behaviour of a Spanish adolescent population aged 12 to 16 years in relation to sun exposure through an Internet-based system <sup>68</sup>. 730 students from seven schools in the intervention group accessed a website for at least one hour in the presence of their teachers at the end of the school year (June), and were able to use their codes to access the webpage throughout the summer. 560 students from five schools in the control group received no intervention. The trial reported significantly increased use of sun protection clothing, sunscreen and use of protection on cloudy days. Other sun protection behaviours were not significantly different between groups. The trial also reported a significant reduction in sunburns in the intervention group compared to the control group in both the inland schools (control: 43.8% (SE=1.3); intervention: 19% (SE= 4.3) from a baseline of 53.4% (SE=1.8)) and coastal schools (control: 52.8% (SE= 2.7); intervention: 44.8% (SE=3.4) from a baseline of 56.2% (SE=1)). The effect was considerably larger in the inland schools <sup>68</sup>.



A poor quality trial [-] <sup>88</sup> assessed whether interactive computer-assisted learning delivered through SkinSafe, used as a part of a multimodal patient education programme, could influence use of sun-protective clothing and sunscreen in 132 adult American participants visiting a dermatology clinic. All participants received a melanoma brochure, a common form of patient education distributed in dermatology clinics. The intervention group completed the multimodal education programme, while the control group received no additional intervention. Patients in the computer groups were more than twice as likely to wear sun protective clothing at the end of the study compared to control (OR 2.4, 95% CI: 1.09-5.29,  $p=0.03$ ) but there were no significant differences reported for sunscreen use <sup>88</sup>.

A poor quality [-] trial conducted in children aged 5 to 13 years in the US, assessed changes in outcome expectations and self-reported sun protection in 1033 students from 12 elementary schools <sup>73</sup>. The trial had three arms; the first combined a computer program with a teacher-led presentation. The computer programs were tailored with age-appropriate sun safety education for children in primary schools derived from the Sunny Days, Healthy Ways (SDHW) sun safety curriculum. The teacher-led presentation was also based on the same program and facilitated discussion and hands-on learning activities (with worksheets). In the second arm, students received the computer program alone and in the third arm students received the teacher-led presentation alone. No significant differences were found between groups but there was significant treatment by grade interaction. Computer programs with teacher-led presentation improved knowledge over either treatment individually ( $p= 0.001$ ) and compared with teacher-led presentation improved self-reported sun protection in younger but not older children ( $p=0.005$ ).

#### **8.5.2.2 Observational studies**

A moderate quality [+] comparative observational survey aimed to determine whether entertainment-education strategies could be combined in a creative communication campaign to improve sun protection behaviours among 1588 Australian 14 to 24 year olds <sup>41</sup>. The intervention involved a music video showing five recommended forms of sun protection (using sunscreen, wearing sunglasses and hats, getting under shade, and covering up with clothing) which were communicated both visually and lyrically in the video. A greater proportion of participants in the intervention group compared to the control group reported using sunscreen (88% vs. 84%;  $p=.02$ ) hats (42% vs. 37%;  $p=0.03$ ) and sun-protective clothing (32% vs. 27%;  $p=0.04$ ). There were no significant differences in reported use of sunglasses or seeking shade to reduce sun exposure <sup>41</sup>.

### Evidence statement 8.6

There is weak, consistent evidence from one moderate quality RCT [+] <sup>71</sup> and three poor quality RCTs [-] <sup>73, 87, 88</sup> and one observational study <sup>41</sup> that electronic interventions (including educational videos, interactive computer-assisted learning and tailored computer programmes) increase sun protective and sun exposure behaviours compared to paper-based or teacher-led educational interventions or no intervention in children and adults.

One good quality [++] RCT <sup>71</sup> reported that participants who saw the online video had significantly higher frequency of sunscreen use (baseline 1.7 days (SD 2.5) vs. post-intervention 3.4 days (SD 2.6) compared to participants who received the pamphlet (baseline 2.0 days (SD 3.0) vs post-intervention 2.4 days (SD 2.6)) in 94 adults (mean age 35 to 40 years)

One poor quality [-] RCT <sup>68</sup> conducted in 730 students from seven Spanish schools reported significantly increased use of sun protection clothing, sunscreen and use of protection on cloudy days and a reduction in sunburns in the intervention group compared to the control group in both the inland schools (control: 43.8% (SE=1.3); intervention: 19% (SE= 4.3) from a baseline of 53.4% (SE=1.8)) and coastal schools (control: 52.8% (SE= 2.7); intervention: 44.8% (SE=3.4) from a baseline of 56.2% (SE=1)). A second poor quality [-] RCT <sup>88</sup> reported that participants in computer groups (accessing interactive computer-assisted learning) were more than twice as likely to wear sun protective clothing at the end of the study compared to control (OR 2.4, 95% CI: 1.09-5.29, p=0.03) but there were no significant differences reported for sunscreen use. A third poor quality [-] RCT <sup>73</sup> reported that computer programs with teacher-led presentation improved knowledge over either treatment individually (p= 0.001) and compared with teacher-led presentation improved self-reported sun protection in younger but not older children (p=0.005) in 1033 children from 12 US elementary schools. An additional observational study <sup>41</sup> found that entertainment-education strategies (a music video showing five recommended forms of sun protection; using sunscreen, wearing sunglasses and hats, getting under shade, and covering up with clothing) resulted in a greater proportion of participants in the intervention group compared to the control group reported using sunscreen (88% vs. 84%; p=.02) hats (42% vs. 37%; p=0.03) and sun-protective clothing (32% vs. 27%; p=0.04). There were no significant differences in reported use of sunglasses or seeking shade to reduce sun exposure.

<sup>71</sup>Armstrong et al. (2011) [++]

<sup>87</sup>Basch et al. (2013) [-]

<sup>88</sup>Aneja et al. (2012) [-]

<sup>73</sup>Buller et al. (2008) [-]

<sup>41</sup>Potente et al. (2011) [+]

### 8.5.3 Tailored Interventions

Eight trials <sup>10, 13, 38, 39, 63, 67, 89, 90</sup> assessed the influence of tailored interventions on outcomes, many of which used multiple components.

A good quality trial [++] <sup>10</sup> evaluated the impact of generic print and telephone counselling compared with tailored print and telephone counselling interventions on engagement in total cutaneous examination by health provider (TCE), skin self-examination (SSE), and sun protection habits in 443 first degree relatives (mean age 47.6 years) of patients with cutaneous melanoma. In the tailored intervention, participants received three print mailings and a counselling call. During the tailored counselling call, the educator reviewed the participant's current TCE and SSE status, discussed guidelines, benefits of TCE/SSE, personal risk factors, feelings, motivations, habits and barriers. Participants in the generic intervention group received three print mailings and one telephone counselling call delivered two weeks after the last mailing. Participants in the tailored intervention group reported significantly increased sun protection habits compared to the generic intervention ( $p < 0.02$ ); these increases were mediated by sun protection intentions including using sunscreen, wearing a hat, seeking shade, wearing shirt with sleeves, wearing sunglasses <sup>10</sup>.

A second good quality trial [++] <sup>89</sup> compared tailored communication with less intensive education in 1301 children (mean age 7.1 years) at moderate to high risk of skin cancer in New York or Hawaii. The tailored communication participants received multiple mailings, risk feedback, skin cancer information, suggestions for overcoming barriers and reminders to engage in prevention practices, while the control group received a single mailing of a standard skin cancer prevention and detection information brochure. Significant increases in the Sun Protection Habits index were found for total sun protection, use of sunscreen, wearing of protective clothing and sunglasses, but not for staying in the shade, in children who received the tailored intervention compared to control.

One moderate quality [+] trial <sup>38</sup> conducted in 677 white (non-Hispanic) six year olds considered at the highest risk of skin cancer, used a partially tailored mailed intervention (based on the Precaution Adoption Model) with educational newsletters and the provision of sun protection resources. Children in the intervention group received three sets of educational newsletters and related sun protection resources such as a swim shirt, sun hat, sunscreen, and backpack, while the control group received a letter each spring inviting them to complete data collection. All participants who attended skin exams received a letter informing them of the average nevus count among children examined in that year and the nevus count for their child. Children in the intervention group were more likely to use long clothing, hats, shade and sunscreen and avoid the midday sun compared to the control group over a period of three years, but the differences were small in magnitude and not consistent. The study also reported an effect of the tailored intervention on the presence of naevi of 2 mm, but not on smaller naevi. The authors speculated that lack of clear differences between groups in terms of naevi could be due to inadequate follow-up time since there is a lag between sun exposure and the appearance of naevi. There was no significant effect on child tanning, but a significant effect was reported on the incidence of severe (log odds severe sunburn occurring -0.52 (95% CI: -1.23 to +0.19),  $p = 0.15$ ) and non-severe (log odds non-severe sunburn occurring = -0.25 (95% CI = -0.47 to -0.04),  $p = 0.02$ ) sunburn in one of the follow-up years (2007 and 2005 respectively) <sup>38</sup>.

One moderate quality trial [+] <sup>90</sup> assessed the effects of a tailored mailed intervention on 724 predominantly female (77.5%) adults (mean age 41.7 years) at moderate or high risk of skin cancer in primary care, in either Honolulu or Long Island in the US. The tailored intervention consisted of multiple mailings at two-week intervals of risk feedback information, instructions for skin self-examination and practice tools, UV self-monitoring and information on skin cancer prevention and detection. The control group also received a single mailing of sun safety messages but of less intensity. Individuals receiving the tailored intervention had a significantly greater increase in their sun protection habits index (measured by diary entries) than control (effect size=0.13) but the effect was moderated by location (less in Honolulu, effect size 0.04 vs. 0.23 for Long Island) <sup>90</sup>.

One moderate quality trial [+] <sup>13</sup> assessed the effect of a targeted intervention, aimed at reducing the risk and increasing early detection of melanoma, on 173 predominantly female (77%) patients (mean age 42.8 to 43.6 years) identified as being at elevated risk for melanoma. Twenty general practitioners (GPs), from 20 participating French surgeries, delivered either the targeted screening and education intervention or a conventional information-based campaign. GPs in the intervention group identified patients at elevated risk for melanoma with a validated assessment tool, the Self-Assessment Melanoma Risk Score (SAMScore), examined their skin, and provided counselling and information, whereas GPs in the control group displayed a poster and the leaflets in their waiting room and performed skin examinations at their discretion. The study reported reduced sunbathing in the previous summer for intervention participants (24.7% vs. 40.8%, p=0.048) but no difference in sunburns between the intervention group who received tailored advice from their GP and a control group <sup>13</sup>.

One moderate quality [+] trial was conducted in a single Swedish health care centre with a population of adults of whom 61% were female <sup>39</sup>. In each of three groups, individuals received the same general sun protection advice but also individual feedback on a questionnaire, with adjusted advice based on their responses. In group 1, feedback was provided by letter, with standardized comments on skin type, sun habits, and sun protection. It concluded with a summarized risk assessment with personally adjusted sun protection advice, and an additional information folder from Apoteket (Swedish public pharmacy), containing general information on sun exposure risks and sun protection. Group 2 received feedback during a personal GP consultation, involving oral feedback on the questionnaire as well as adjusted information and sun protection advice, along with naevi inspection and the information folder from Apoteket. Group 3 received the same feedback as group 2, but the GP consultation also included a photo-test on the palmar side of the forearm. After 24 hours, the recipients performed the test reading, by counting the number of erythematous reactions and reported the result, by mail. Feedback based on the photo-test result was mailed back to the individuals. The study found no statistically significant differences between the two subgroups in terms of the number of times the individuals reported being sunburnt. There was also no evidence of a significant difference in the rate of sunbathing, sunbed use or midday exposure at the 3-year follow-up <sup>39</sup>.

One poor quality trial [-] explored the effectiveness of a tailored school-based intervention in Arizona, Colorado and New Mexico (USA) compared to non-tailored print communications delivered by mail to 599 adolescents (age 11 to 15) and their parents<sup>63</sup>. This trial compared a summer programme of newsletters aimed at adolescents (Summer Raze) and parents (Sun Scoop) with no summer programme. The use of sunscreen, protective clothing, and avoidance of the sun were promoted, and family communication and environmental change strategies were fostered. 81.3% of the participants were Caucasian and 18.8% were Hispanic, and 57.9% were female. The trial reported large loss to follow-up (56% and 58% of the initial sample featured in the analysis) and found no evidence of a significant difference in the self-reported sunburn rate between participants in the tailored intervention and those who had received no intervention<sup>63</sup>.

One moderate quality trial [+] <sup>67</sup> evaluated a community-based information campaign with or without a cognitive-behavioural small group intervention in 61 white, predominantly female (73%) undergraduate students in two Midwestern universities in the USA who were intending to have a spring holiday at <35° latitude (i.e. subtropics). The combined community-based and cognitive-behavioural small group intervention had no significant effect; both groups exhibited darker skin colour and higher tan levels from the pre-intervention to post-intervention assessments<sup>67</sup>.

#### **Evidence statement 8.7**

There is moderate, inconsistent evidence from two good quality RCTs [++] <sup>10, 89</sup>, five moderate quality RCTs [+] <sup>13, 38, 39, 67, 90</sup> and one poor quality [-] RCT<sup>63</sup> about the effectiveness of tailored interventions (of varying compositions) in promoting sun protection and exposure behaviours.

A good quality [++] trial <sup>10</sup> reported that participants in a tailored intervention group (tailored print and telephone counselling) reported significantly increased sun protection habits compared to the generic intervention ( $p < 0.02$ ); these increases were mediated by sun protection intentions including using sunscreen, wearing a hat, seeking shade, wearing shirt with sleeves, wearing sunglasses in 443 first degree relatives (mean age 47.6 years) of patients with cutaneous melanoma. A second good quality trial [++] <sup>89</sup> compared tailored communication with less intensive education in 1301 children (mean age 7.1 years) at moderate to high risk of skin cancer in New York or Hawaii. The tailored communication participants received multiple mailings, risk feedback, skin cancer information, suggestions for overcoming barriers and reminders to engage in prevention practices, while the control group received a single mailing of a standard skin cancer prevention and detection information brochure. Significant increases in the Sun Protection Habits index were found for total sun protection, use of sunscreen, wearing of protective clothing and sunglasses, but not for staying in the shade, in children who received the tailored intervention compared to control. One moderate quality [+] trial <sup>38</sup> reported no significant effect on child tanning, but a significant effect was reported on the incidence of severe (log odds severe sunburn occurring  $-0.52$  (95% CI:  $-1.23$  to  $+0.19$ ),  $p=0.15$ ) and non-severe (log odds non-severe sunburn occurring  $= -0.25$  (95% CI  $= -0.47$  to  $-0.04$ ),  $p=0.02$ ) sunburn in one of the follow-up years in 677 white (non-Hispanic) six year olds. Children in the intervention group received three sets of educational newsletters and related sun protection resources such as a swim shirt, sun hat, sunscreen, and backpack, while the control group received a letter each spring inviting them to complete data collection. One moderate quality [+] RCT<sup>90</sup> reported that 724 predominantly female (77.5%) adults receiving the tailored intervention (including multiple mailings at two-week intervals of risk feedback information, instructions for skin self-examination and practice tools, UV self-monitoring and information on skin cancer prevention and detection) had a significantly greater increase in their sun protection habits index (measured by diary entries) than a control group (effect size=0.13) but the effect was moderated by location (less in Honolulu, effect size 0.04 vs. 0.23 for Long Island)

No significant effects were found for one RCT<sup>63</sup> comparing a Summer Raze program for adolescents and the Sun Scoop programme for parents; one RCT<sup>67</sup> comparing a community-based information campaign with or without a cognitive-behavioural small group intervention; one RCT<sup>39</sup> comparing different combinations of general sun protection advice, individualised feedback and a GP consultation; one study<sup>13</sup> comparing GP consultations offering targeted screening and education intervention or a conventional information-based campaign

<sup>89</sup>Glanz et al. (2013) [++]

<sup>10</sup>Manne et al. (2010) [++]

<sup>38</sup>Crane et al. (2012) [++]

<sup>90</sup>Glanz et al. (2010) [++]

<sup>13</sup>Rat et al. (2014) [++]

<sup>39</sup>Falk et al. (2011) [++]

<sup>67</sup>Roberts et al. (2009) [++]

<sup>63</sup>Reynolds et al. (2008) [-]

#### 8.5.4 Counselling Information Provision

One moderate quality SR [++] <sup>81</sup> including 11 studies reported on the effectiveness of counselling individuals (ranging from children through to adults) on sun protective behaviours to reduce sunburns, naevi, keratoses, or skin cancer. The included studies were predominantly from Australia, Canada, Europe and the USA. Counselling interventions were variously defined and included single 15-minute self-directed sessions, several sessions with in-person counselling, phone counselling, written assessments followed by tailored written feedback, a self-guided booklet, a brief video, 30-minute 1:1 peer-counselling sessions, brief counselling with in-office computer support to generate printed tailored feedback and counselling integrated into well-child visits. Four of five trials conducted in adults (n=6949 participants) reported that primary care-relevant counselling with tailored feedback (with or without computer support) can modestly affect self-reported sun protection behaviours. The review reported assessments of changes in skin pigmentation and tanning. The authors reported that in three of four trials in young adults (n=897 participants), an appearance-focused counselling intervention successfully reduced indoor tanning among women who had the intention to tan indoors. Although the interventions decreased indoor tanning behaviour by up to 35%, follow-up for these trials was only 3 to 6 months. The review did not report whether the other included interventions influenced sun exposure behaviours.

**Evidence Statement 8.8**

There is weak evidence from one moderate quality [+] systematic review<sup>81</sup> that counselling information provision can result in changes in sun protection practices in adults and adolescents to reduce sunburns, naevi, keratoses, or skin cancer. Counselling interventions were variously defined and included single 15-minute self-directed sessions, several sessions with in-person counselling, phone counselling, written assessments followed by tailored written feedback, a self-guided booklet, a brief video, 30-minute 1:1 peer-counselling sessions, brief counselling with in-office computer support to generate printed tailored feedback and counselling integrated into well-child visits. Four of five trials conducted in adults (n=6949 participants) reported that primary care-relevant counselling with tailored feedback (with or without computer support) can modestly affect self-reported sun protection behaviours. Three of four trials in young adults (n=897 participants), an appearance-focused counselling intervention successfully reduced indoor tanning among women who had the intention to tan indoors. Although the interventions decreased indoor tanning behaviour by up to 35%, follow-up for these trials was only 3 to 6 months.

<sup>81</sup>Lin et al. (2011) [+]

**8.5.5 Information provision**

One moderate quality [+] RCT<sup>91</sup> investigated the effect of an appearance-focused intervention to prevent skin cancer. In this trial adult females (aged 17 to 21 years) in the USA with seasonal affective disorder symptoms and pathological tanning motives received a booklet containing information about the effects of sun exposure, focused on appearance and skin cancer. Compared to control participants who received no intervention, the study found that the intervention could reduce indoor tanning behaviour in participants by up to 35%. Aspects of the pathological tanning scales moderated the effects; those individuals scoring highly on opiate-like reactions to tanning and dissatisfaction with natural skin tone had the greatest reduction in indoor tanning behaviour<sup>91</sup>.

**Evidence statement 8.9**

There is weak evidence from one moderate quality [+] RCT<sup>91</sup> conducted in US women aged 17 to 21 that written information (a booklet) about the effects of sun exposure focused on appearance and skin cancer information provision can reduce indoor tanning behaviour in females with seasonal affective disorder and intentions to tan by up to 35%.

<sup>91</sup>Hillhouse et al. (2010) [+]

## 8.6 MULTI-COMPONENT INTERVENTIONS

Four SRs <sup>12, 37, 81, 92</sup>, eleven RCTs <sup>13, 14, 39, 51, 52, 55, 58, 69, 80, 93, 94</sup> and seven observational studies <sup>7, 70, 95-99</sup> compared the effects of interventions with multiple components on outcomes. Four RCTs <sup>20, 67, 125, 127</sup> also featured in one of the SRs included in this section and are not discussed here. The results of the studies are summarised here and further details are provided in the Appendices.

### 8.6.1 Systematic Reviews

A good quality SR [+] showed that multiple component interventions (a mixture of educational and environmental components) had a significant effect on sun protective behaviour overall, although with high heterogeneity <sup>92</sup>. The studies were conducted in the USA, Canada, France, Australia, and the UK. The review assessed the frequency of sunburn, changes in skin pigmentation or tanning, the use of protective clothing use of shade and use of sunscreen. Sunburn assessment was self-reported and participants gave information about frequency of occurrence or whether they had experienced any sunburn during the intervention period. Skin colour was assessed in the studies reviewed by spectrophotometry, colorimetry and observational methods. Those interventions targeting children had the most evidence of effectiveness. There was no evidence that interventions increased the use of protective clothing or use of shade. Use of sunscreen was significantly influenced by interventions in children and youths, but not in adults. The intervention groups reviewed had a small, significant decrease in reported sunburns (SMD = -0.11 (95% CI = -0.18; -0.03) with heterogeneity I<sup>2</sup> (squared) = 55% and chi squared = 9.69 11.12 (df = 4, df=5, p = 0.05). The review suggested that evidence for the efficacy of interventions in preventing sunburn is inconclusive for adults (SMD = -0.10 (95% CI = -0.19; -0.01) with heterogeneity I<sup>2</sup> (squared) = 59% and chi-squared = 9.69 (df = 4, p = 0.05)). Interventions targeting children found no evidence of efficacy in preventing sunburn ((1 study): SMD = -0.15 (95% CI = -0.29; -0.02)). No numerical data were reported for change in skin colour and there was no significant effect in favour of the intervention. The intervention resulted in a significant decrease in self-reported sun-exposure amongst adults, with a moderate effect size but when all studies were taken into account, there was mixed evidence of benefit.

A moderate quality SR [+] reported on the effects of a range of combined motivational interventions on sun protection behaviour <sup>37</sup>. Two of the studies reviewed investigated the use of new media with school children and found no significant changes in sun protection behaviour. Ten studies investigating lesson-based sun protection education did not provide strong evidence of behaviour change. The impact of a health fair was reported in one RCT and did not result in significant differences in behaviour. Twelve studies of mixed method education for children (lessons plus verbal advice, videos and/or printed materials) did not report strong evidence of behaviour change. The review authors noted the potential for contamination effects and lack of clarity over which parts of the intervention had the most impact. However, very few primary studies provided sufficient detail of the content of the interventions, or were not designed to enable comparison of different components or content, precluding any evaluation of what intervention components were most effective <sup>37</sup>.



A second moderate quality SR [+] reported mixed findings <sup>81</sup> of behavioural counselling in studies predominantly from Australia, Canada, European countries and the USA. In adults, four of five trials (n=6949 participants) showed that primary care–relevant counselling with tailored feedback (with or without computer support) can modestly affect self-reported sun protective behaviours, as measured by composite behaviour scores. The differences in these scores, although statistically significant, were small, and it is unclear whether these differences translate into clinically meaningful behaviour change. In three trials in young adults (n=897 participants), the appearance-focused counselling intervention successfully reduced indoor tanning among women who had the intention to tan indoors. Although the interventions decreased indoor tanning behaviour by up to 35%, follow-up for these trials was only 3 to 6 months. In one trial (n=819 participants), young adolescents randomly assigned to brief counselling by their primary care providers, coupled with in-office computer support to generate printed tailored feedback, reported both higher composite sun-protection scores and a greater likelihood of avoiding or limiting midday sun exposure or using sunscreen on the face or sun-exposed areas at 24 months than the attention control group. The other cluster RCT in children, conducted in a large managed care organization, integrated counselling into four sequential well-child visits at the discretion of the primary care provider. Parents of newborn babies (728 participants) in practices randomly assigned to receive the intervention reported higher composite sun-protection scores at 36-month follow-up than those in control practices. The clinical significance of these higher scores, however, is unclear, given the very small numerical differences and the lack of statistically significant differences in 6 of the 7 sun-protection questions that contribute to the composite score.

A poor quality SR [-] <sup>12</sup> investigated the effectiveness of sun-safety education programmes in outdoor occupational settings including outdoor workers and participants in outdoor leisure pursuits, provided from 16 interventional studies undertaken in countries all over the world (. The interventions reviewed included combinations of educational lectures, educational video, information brochures, posters, logos, skin examinations, eye examinations, sun-protective gear, UV photos of the face and interactive tasks. The age range of the populations was not reported. Four studies reported a significant decrease in the incidence of sunburn following sun safety education. Significant improvements in at least one of the sun-protective behaviours were also observed. Six authors reported positive long-term effects of 12 months or more. The most favourable changes were found for the use of sunscreen <sup>12</sup>.

### **8.6.2 Randomized Controlled Trials**

One good quality [++] trial <sup>14</sup> in mixed gender beach goers compared interventions with increasing number of components: a combined intervention of education, biometric feedback, and dermatologist skin examinations was compared to three control interventions (skin cancer prevention education, education plus biometric feedback and education plus dermatologist skin examinations). The greatest increases in sun protection behaviours (hat wearing and sunscreen use) were reported in the combined feedback/education/skin examination group and the feedback/education groups compared to the other two groups (hat use: significant condition difference; sunscreen use: significant time by condition difference). There was no evidence of a difference in the time spent in the sun between randomized groups <sup>14</sup>.

A moderate quality trial [+] <sup>55</sup> compared information flyers plus normative feedback with flyers alone in 189 women aged 39 to 77 years. The study reported significantly greater facial sun protection at the end of study in the intervention group, mainly through the use of hats, but no changes in body sun protection.

A moderate quality [+] trial <sup>69</sup> assessed the effect of a multi-component intervention on parental knowledge, sun avoidance behaviours, and sun protection practices in children aged 3 to 10 years in the USA. After controlling for differences, the intervention group was found to have more significant increases in sun protection practices including wearing shirts, sunscreen and/or possessing wide brimmed hats. There was no significant difference between the groups in terms of sun avoidance.

Another moderate quality trial [+] <sup>51</sup> used a variety of dissonance induction tools (videos, focus groups, tasks, role play) compared to education alone and dissonance induction relating to healthy lifestyle in 260 undergraduate females to promote healthy tanning. No significant differences in UV related behaviours (such as indoor or outdoor tanning, sunless tanning and sunscreen use) were reported between the intervention and either control group.

A moderate quality trial [+] <sup>39</sup> compared multiple interventions in response to a pre-study questionnaire in 316 adults in primary care. Groups received general sun protection advice plus either a letter containing feedback, risk assessment and printed information, feedback from a personal GP consultation, or personal GP consultation plus phototest <sup>39</sup>. Findings were generally mixed, although benefits were found for sunscreen use in the group having a GP consultation alone.

A good quality [++] German cluster RCT <sup>94</sup> was undertaken with 395 children aged 3 years old where melanoma checking, including digital imaging, was augmented with additional guidance about sun protection, regular parent meetings with a dermatologist and printed materials. The study found that dermatologists informing parents of the hazards of UV exposure and ways to avoid it, over a period of three years, did not result in reduced numbers of melanocytic naevi among those children in the group receiving the examinations <sup>94</sup>.

One moderate quality trial [+] <sup>13</sup> compared an intervention (personal total skin examination, GP counselling plus the information leaflet detailing primary and secondary prevention measures) with a conventional public health campaign (posters plus information on risk factors) in primary care adults (predominantly female (76%)) considered at elevated risk of skin cancer. Sun protective behaviours did not differ by group <sup>13</sup>.

Four poor quality trials [-] investigated multi-component interventions <sup>52, 58, 80, 93</sup>. One trial compared print booklets, DVD and children's activity packages (a melanoma survivor-centred intervention) with general educational mailings on skin cancer in 340 adults with diagnosed melanoma and their children aged 12 or younger <sup>93</sup>. Findings were mixed; although the intervention increased the children's wearing of wide brimmed hats at 4 months and sunscreen re-application at 1 month, there were no intervention effects on other sun protection outcomes including children's sunscreen composite score, clothing composite score, shade behaviour, limiting time outdoors behaviour or composite sun protection score <sup>93</sup>. A second trial <sup>52</sup> compared multiple interventions addressing interpersonal factors with control (social support) in 59 Caucasian females aged 18 to 24 years. Participants had a worry-induction or a neutral (no worry induction) condition and/or a social support intervention or neutral (no social support) intervention. Some of these interventions included provision of information (either printed or on websites) and photos. No significant differences were reported between groups. A third trial <sup>80</sup> was undertaken in the USA among 2491 fourth grade children. Children in the intervention group were issued two new hats and received a brief educational lesson on sun safety, followed later by two 60 minute reinforcement classes <sup>80</sup>. Control participants received similar sessions but on topics other than sun protection. No changes in skin pigmentation, naevi counts or self-reported use of hats outside school during the two years of the study were reported [88-89]. A fourth trial <sup>58</sup> studied adolescents (aged 14 to 17 years) in a school setting randomized to an e-magazine containing numerous components (exercises, oral teacher-led presentation, teamwork, advocacy, writing, creative work, using social media and debating scientific facts). The trial reported that girls and boys receiving the educational intervention had a 40% and 42% reduced risk of sunbed use over 6 months, respectively, compared with girls and boys in the control group <sup>58</sup>.

### 8.6.3 Observational Studies

A moderate quality [+] comparative observational study <sup>7</sup> assessed the impact of an educational programme taught by their teacher called 'To live with the sun', in 282 children aged between 8 and 11 years from 13 schools in the Nantes area of France. No significant differences were found between the intervention and control groups <sup>7</sup>.

A moderate quality [+] non-comparative study <sup>70</sup> conducted in Germany aimed to implement a certification programme for sun protection among 12 staff and 46 parents of children aged 0 to 6 years attending a kindergarten (about 150 children). The intervention included the implementation of a sun protection policy, training sessions for staff and parents conducted by a dermatologist, and group discussions about personal experiences with excessive sun exposure. Following the intervention, the number of children wearing a hat increased from 13.2% to 73%; sunscreen use increased, with 58.8% of staff members reporting a more regular application of sunscreen to the children. There was a higher percentage of shaded area on the playground (70–80% before intervention, 90% after intervention). The intervention failed in keeping the children inside during periods of the most intense UV and in educating the staff members to be a convincing example of sun protection by wearing appropriate clothes. The clothing habit of the children (excluding head wear) showed no alteration after the intervention. The clothing habit of staff members also did not change as a result of the intervention: hat use and appropriate clothes were not common, neither before nor after intervention <sup>70</sup>.

A moderate quality [+] non-comparative observational study examined trends in key sun protection behaviours and sunburn for the Melbourne population for two time periods (from 1987 to 2007) in 8802 respondents (aged 14 to 69 years) to a telephone survey <sup>95</sup>. The statistical comparison of trends in the two periods confirms that the rapid improvement in sun protection behaviours was in the initial period, with the odds of respondents using sunscreen increasing steadily from 1987–88 and peaking in 1994–95 (OR 4.5; 95% CI 2.97–5.52). Comparisons with the peak levels in 1994–95 showed decreased odds of sunscreen use in the second period in 1999–2000, 2001–02 and 2003–04, but approaching 1994–95 levels again in 2006–07. The mean proportion of the body exposed unprotected fell consistently from 0.22 in 1987–88 (95% CI 0.18–0.25) to 0.10 in 1994–95 (95% CI 0.05–0.16) but was steady in the second period compared with 1994–95. The odds of respondents being sunburnt on summer weekends generally decreased compared with baseline in the early period, with the largest reduction reached by 1994–95 (OR 0.53, 95% CI 0.38–0.74). Odds of sunburn continued to be relatively low in the second period with similar incidence to 1994–95 except for an increase in 2003–04 (OR 1.90, 95% CI 1.32–2.74).

A moderate quality [+] non-comparative longitudinal study <sup>96</sup> investigated whether 38 volunteers of Danish ancestry changed their sun behaviour over a period of seven years as a result of wearing a UVR dosimeter. Participants aged from 31 to 71 years (mean age 51) wore a wrist-borne personal electronic UVR dosimeter and completed sun exposure diaries over the summer half of a year. The participants included 21 indoor workers, 5 outdoor workers (municipal gardeners), 4 "sun worshippers" and 2 golfers. The mean (median) individual daily exposure hours (h) were 2.8 h (2.5) in 2006, 2.8 h (2.2) in 2001, 2.3 h (2.0) in 2000, and 1.8 h (1.8) in 1999. There were significantly more exposure hours in 2006 than in 1999 ( $p = 0.012$ ) and 2000 ( $p < 0.001$ ) but a similar amount to 2001 ( $p = 0.3$ ). Some persons continuously received higher or lower UVR doses than their peer participants throughout the years in spite of the different weather conditions. A "year effect" was seen in the number of days with risk behaviour expressed as "exposing shoulders", which was significantly higher in 2006 than in all three previous years, probably because the summer was sunnier in 2006 than in the other years. There was no statistically significant "year effect" regarding the number of days in which people engaged in risk behaviour expressed as "days sunbathing to get a tan". A significant correlation was found between the estimated UVR dose for 2006 and "the mean estimated annual UVR dose for 1999–2001", Spearman's  $r = 0.83$ ,  $p < 0.001$  <sup>96</sup>.

A moderate quality [+] non-comparative longitudinal survey <sup>97</sup> explored whether maternal communication about behaviours that prevent skin, cervical, and lung cancer was associated with cancer prevention behaviours in 10409 adolescents aged 14 to 21 years participating in the Growing Up Today study in the USA. Maternal communication about the importance of sunscreen use in 2001 and 2003 were both positively associated with adolescent behaviour <sup>97</sup>.

A moderate quality [+] non-comparative cross-sectional study (telephone or online survey) examined the association between mass media health information exposure (general health, cancer, sun protection information), skin cancer beliefs, and sun protection behaviours in 1736 adults with a mean age of 43.8 years with no skin cancer history<sup>98</sup>. Sunscreen use was associated with Internet searching for health information ( $p < 0.01$ ), and Internet searching for sun protection information in the past 12 months ( $p < 0.01$ ). Greater use of sun-protective clothing was also associated with having looked for Internet sun protection information in the past 12 months ( $p = 0.01$ ).

A moderate quality [+] non-comparative observational study described the development in sunbed use after the start of an anti-sunbed campaign in the period 2007–2009<sup>99</sup>. A total of 17217 teenagers and adults (aged 15 to 59 years) were surveyed by telephone or online. Sunbed use in Denmark decreased concurrently with the campaign activities, with the largest change in the youngest age group, which was a prioritized target of the campaign. The age at initiation of use increased during this period. In 2008 and 2009, 52% and 55%, respectively, of sunbed users experienced sunburn caused by sunbed use, and 16% and 17% had been burnt more than once.

#### **Evidence statement 8.10**

There is moderate, inconsistent evidence from one good quality [++] systematic review<sup>92</sup> two moderate quality [+] systematic reviews<sup>37, 81</sup> one poor quality [-] systematic review<sup>12</sup>, one good quality [++] RCT<sup>14</sup>, five moderate quality [+] RCTs<sup>55, 69</sup>, and two poor quality [-] RCTs<sup>93</sup> about the effectiveness of multi-component interventions for changing sun protection behaviour.

A good quality [++] systematic review<sup>92</sup> showed that multiple component interventions (a mixture of educational and environmental components) had a significant effect on sun protective behaviour overall, although with high heterogeneity. Interventions targeting children had the most evidence of effectiveness. There was no evidence that interventions increased the use of protective clothing or use of shade. Use of sunscreen was significantly influenced by interventions in children and youths, but not in adults. The intervention groups reviewed had a small, significant decrease in reported sunburns (SMD = -0.11 (95% CI = -0.18; -0.03) with heterogeneity  $I^2$  (squared) = 55% and chi squared = 9.69 11.12 (df = 4, df=5,  $p = 0.05$ ). The review suggested that evidence for the efficacy of interventions in preventing sunburn is inconclusive for adults (SMD = -0.10 (95% CI = -0.19; -0.01) with heterogeneity  $I^2$  (squared) = 59% and chi-squared = 9.69 (df = 4,  $p = 0.05$ )). Interventions targeting children found no evidence of efficacy in preventing sunburn ((1 study): SMD = -0.15 (95% CI = -0.29; -0.02)). No numerical data were reported for change in skin colour and there was no significant effect in favour of the intervention. The intervention resulted in a significant decrease in self-reported sun-exposure amongst adults, with a moderate effect size but when all studies were taken into account, there was mixed evidence of benefit.

A moderate quality SR [+] reported on the effects of a range of combined motivational interventions on sun protection behaviour<sup>37</sup>. Two of the studies reviewed investigated the use of new media with school children and found no significant changes in sun protection behaviour. Ten studies investigating lesson-based sun protection education did not provide strong evidence of behaviour change. The impact of a health fair was reported in one RCT and did not result in significant differences in behaviour. Twelve studies of mixed method education for children (lessons plus verbal advice, videos and/or printed materials) did not report strong evidence of behaviour change. The review authors noted the potential for contamination effects and lack of clarity over which parts of the intervention had the most impact. However, very few primary studies provided sufficient detail of the content of the interventions, or were not designed to enable comparison of different components or content, precluding any evaluation of what intervention components were most effective<sup>37</sup>.

A second moderate quality SR [+] reported mixed findings<sup>81</sup> of behavioural counselling in studies predominantly from Australia, Canada, European countries and the USA. In adults, four of five trials ( $n=6949$  participants) showed that primary care-relevant counselling with tailored feedback (with or without computer support) can modestly affect self-reported sun protective behaviours, as measured

by composite behaviour scores. The differences in these scores, although statistically significant, were small, and it is unclear whether these differences translate into clinically meaningful behaviour change. In three trials in young adults (n=897 participants), the appearance-focused counselling intervention successfully reduced indoor tanning among women who had the intention to tan indoors. Although the interventions decreased indoor tanning behaviour by up to 35%, follow-up for these trials was only 3 to 6 months. In one trial (n=819 participants), young adolescents randomly assigned to brief counselling by their primary care providers, coupled with in-office computer support to generate printed tailored feedback, reported both higher composite sun-protection scores and a greater likelihood of avoiding or limiting midday sun exposure or using sunscreen on the face or sun-exposed areas at 24 months than the attention control group. The other cluster RCT in children, conducted in a large managed care organization, integrated counselling into four sequential well-child visits at the discretion of the primary care provider. Parents of newborn babies (728 participants) in practices randomly assigned to receive the intervention reported higher composite sun-protection scores at 36-month follow-up than those in control practices. The clinical significance of these higher scores, however, is unclear, given the very small numerical differences and the lack of statistically significant differences in 6 of the 7 sun-protection questions that contribute to the composite score.

A poor quality SR [-] <sup>12</sup> investigated the effectiveness of sun-safety education programmes in outdoor occupational settings including outdoor workers and participants in outdoor leisure pursuits, provided from 16 interventional studies undertaken in countries all over the world. The interventions reviewed included combinations of educational lectures, educational video, information brochures, posters, logos, skin examinations, eye examinations, sun-protective gear, UV photos of the face and interactive tasks. The age range of the populations was not reported. Four studies reported a significant decrease in the incidence of sunburn following sun safety education. Significant improvements in at least one of the sun-protective behaviours were also observed. Six authors reported positive long-term effects of 12 months or more. The most favourable changes were found for the use of sunscreen <sup>12</sup>.

Five RCTs <sup>14, 39, 55, 58, 69</sup> reported positive effects of multicomponent interventions for changing sun protection behaviour.

One good quality [++] trial <sup>14</sup> in mixed gender beach goers compared interventions with increasing number of components: a combined intervention of education, biometric feedback, and dermatologist skin examinations was compared to three control interventions (skin cancer prevention education, education plus biometric feedback and education plus dermatologist skin examinations). The greatest increases in sun protection behaviours (hat wearing and sunscreen use) were reported in the combined feedback/education/skin examination group and the feedback/education groups compared to the other two groups (hat use: significant condition difference; sunscreen use: significant time by condition difference). There was no evidence of a difference in the time spent in the sun between randomized groups. A moderate quality trial [+] <sup>55</sup> compared information flyers plus normative feedback with flyers alone in 189 women aged 39 to 77 years. The study reported significantly greater facial sun protection at the end of study in the intervention group, mainly through the use of hats, but no changes in body sun protection. A moderate quality [+] trial <sup>69</sup> assessed the effect of a multi-component intervention on parental knowledge, sun avoidance behaviours, and sun protection practices in children aged 3 to 10 years in the USA. After controlling for differences, the intervention group was found to have more significant increases in sun protection practices including wearing shirts, sunscreen and/or possessing wide brimmed hats. There was no significant difference between the groups in terms of sun avoidance. A moderate quality trial [+] <sup>39</sup> compared multiple interventions in response to a pre-study questionnaire in 316 adults in primary care. Groups received general sun protection advice plus either a letter containing feedback, risk assessment and printed information, feedback from a personal GP consultation, or personal GP consultation plus phototest <sup>39</sup>. Findings were generally mixed, although benefits were found for sunscreen use in the group having a GP consultation alone. A poor quality [-] RCT <sup>58</sup> studied adolescents (aged 14 to 17 years) in a school setting randomized to an e-magazine containing numerous components (exercises, oral teacher-led presentation, teamwork, advocacy, writing, creative work, using social media and debating scientific facts). The trial reported that girls and boys receiving the educational intervention had a 40% and 42% reduced risk of sunbed use over 6 months, respectively, compared with girls and boys in the control group <sup>58</sup>.

No significant effects were found in six RCTs. <sup>13, 51, 52, 80, 93, 94</sup> One RCT <sup>93</sup> compared print booklets, DVD and children's activity packages (a melanoma survivor-centred intervention) with general educational mailings on skin cancer in 340 adults with diagnosed melanoma and their children aged 12 or

younger; one RCT<sup>52</sup> compared multiple interventions addressing interpersonal factors with control (social support) in 59 Caucasian females aged 18 to 24 years; one RCT<sup>80</sup> among 2491 fourth grade children. Children in the intervention group were issued two new hats and received a brief educational lesson on sun safety, followed later by two 60 minute reinforcement classes; one RCT<sup>13</sup> compared an intervention (personal total skin examination, GP counselling plus the information leaflet detailing primary and secondary prevention measures) with a conventional public health campaign (posters plus information on risk factors) in primary care adults; one RCT<sup>94</sup> compared melanoma checking (including digital imaging), was augmented with additional guidance about sun protection and regular parent meetings with a dermatologist with printed materials; one RCT<sup>51</sup> compared a variety of dissonance induction tools (videos, focus groups, tasks, role play) compared to education alone and dissonance induction relating to healthy lifestyle in 260 undergraduate females

Five observational studies<sup>95-99</sup> reported positive effects of multicomponent interventions, while two observational studies<sup>7,70</sup> reported no significant effects.

<sup>92</sup>Rodrigues et al. (2013) [++]

<sup>81</sup>Lin et al. (2011) [ + ]

<sup>37</sup>Eagle et al. (2009) [ + ]

<sup>12</sup>Reinau et al. (2013) [ - ]

<sup>14</sup>Emmons et al. (2011) [ ++ ]

<sup>55</sup>Reid et al. (2013) [ + ]

<sup>39</sup>Falk et al. (2011) [ + ]

<sup>58</sup>Aarestrup et al. (2014) [ - ]

<sup>93</sup>Gritz et al. (2013) [ - ]

<sup>52</sup>Midboe et al. (2011) [ - ]

<sup>80</sup>Roetzheim et al. (2011) [ - ]

<sup>13</sup>Rat et al. (2014) [ + ]

<sup>94</sup>Wollina et al. (2014) [ ++ ]

<sup>51</sup>Chait et al. (2011) [ + ]

<sup>95</sup>Makin et al. (2013) [ + ]

<sup>96</sup>Thieden et al. (2013) [ + ]

<sup>97</sup>Kahn et al. (2011) [ + ]

<sup>98</sup>Hay et al. (2009) [ + ]

<sup>99</sup>Koster et al. (2011) [ + ]

<sup>7</sup>Quereux et al. (2009) [ + ]

<sup>70</sup>Aulbert et al. (2009) [ + ]

## 8.7 SUN EXPOSURE INTERVENTIONS

One moderate quality trial [ + ]<sup>100</sup>. conducted in 51 residential homes for the elderly (mean age 86.4 years, 71% female) in Sydney, Australia, investigated whether an intervention to increase sunlight exposure in 602 elderly residents would improve their vitamin D status and reduce the number of falls and fractures. One group of elderly residents received increased sunlight exposure (UV) of their face, hands and arms for 30 to 40 minutes daily for 12 months, 5 days per week. 'Sunlight Officers' were employed in each home to monitor and encourage participation. A second group (UV+) received the increased sunlight exposure and also calcium supplements. A control group received a brochure about vitamin D deficiency and how to treat it. Over 12 months, serum 25 hydroxy vitamin D levels increased more in the two active intervention groups than in the control group but this difference was not statistically significant. There was no significant difference in fracture incidence among groups: 18 fractures in 17 (8%) residents in the control group, 19 fractures in 17 (9%) residents in the UV only group and 13 fractures in 13 (6%) residents in the UV+ group. There were also 18 new skin cancer events during the study but there was no significant difference in incidence among the three groups<sup>100</sup>.

### **Evidence statement 8.11**

There is weak evidence from one moderate quality [+] RCT <sup>100</sup> that exposure to sunlight does not increase serum 25 hydroxy vitamin D levels, fracture incidence, or skin cancer events over a 12 month period among elderly rest home residents (mean age 86.4 years, 71% female) conducted in 51 residential homes in Australia.

<sup>100</sup>Sambrook et al. (2012) [+]

## **8.8 EFFECTS OF INTERVENTIONS IN POPULATION SUBGROUPS**

The following summaries represent groups that are thought to be at higher risk of sun damage and skin cancer.

No evidence was identified for individuals requiring specific types of intervention because of disabilities/impairments, age or education, culture or language differences.

### **8.8.1 Studies Targeting Populations at Increased Risk of Skin Cancer**

A number of studies were identified which targeted individuals who were at increased risk of skin cancer. Some of these targeted people with substantial exposure to the sun: either outdoor workers, participants in outdoor sports teams, beach goers and sunbathers or lifeguards at a swimming pool <sup>12, 14, 20, 35, 57, 78, 82, 92, 125</sup>. Two studies targeted either the first degree relatives of patients with melanoma <sup>10</sup> or parents identified through a registry who had been previously diagnosed with melanoma <sup>93</sup>. Four studies targeted either adults or children considered at moderate or high risk of skin cancer <sup>13, 80, 89, 90</sup>. Nine studies focused solely on young children at kindergarten or primary school <sup>4, 38, 73-75, 79, 80, 89, 94</sup>.

Generally, there were more significant findings in these trials for the various sun protection/exposure interventions than in all included studies considered together, although the interventions varied greatly.

Where the studies targeted adults or children with substantial exposure to the sun, all but one study reported positive effects of the interventions. Most evidence was identified for sunscreen use and hat wearing, although some studies found significant effects for overall sun protection behaviour and one study in female adult beach goers found less sunbathing, greater use of protective clothing and an increase in sunless tanning <sup>125</sup>.

Evidence was more mixed in the two studies that targeted adults previously diagnosed with melanoma (or any first degree relatives of melanoma survivors) <sup>10</sup>. The latter study found that sun protection habits were positively influenced by a tailored intervention, while the former study found benefits for sunscreen use and hat wearing but not for other sun protection outcomes.



A few studies targeted adults or children considered at moderate or elevated risk of skin cancer. One low quality SR [-] reported no significant findings<sup>74</sup> but all other studies found benefits for the interventions.<sup>13, 89, 90</sup> One study found reduced sunbathing but no other significant benefits<sup>13</sup>, and another found that both sun protection and sun exposure habits were improved after the intervention<sup>90</sup>. One study focused exclusively on children at elevated risk of skin cancer and found that the interventions increased hat use and also improved other sun protection behaviours such as wearing of sunglasses, sunscreen and clothing<sup>89</sup>.

Nine studies focused exclusively on children. Most studies found benefits with regard to a variety of sun protection behaviours for a variety of interventions in this population. The studies commonly identified greater use of hat wearing, improved use of sunscreen and two found greater use of sun protective clothing<sup>38, 89</sup>.

The high quality [+] systematic review that investigated the effects of multi-component interventions on adults and children within recreational and tourism settings (such as beaches and swimming pools) found that significant effects were found for general sun protection behaviours and sunscreen use in children, but not in adults<sup>92</sup>.

Details on the specific interventions and results of these studies can be viewed under the results tables earlier in this section. In all of these studies, interventions varied markedly and it was not possible to tease out the potentially effective components of the interventions that were effective within specific subgroups. Given the broad scope of the review, there generally appeared to be greater benefits found for the widely differing interventions designed to provide sun safety information to consumers in specific subgroups of participants with a potentially elevated risk of skin cancer, compared to the general population. Future studies could be designed to explore this possibility further. Potential interventions should be compared with each other in specifically targeted groups of participants, particularly those at risk, to enable conclusions to be reached on the relative effectiveness of different approaches.

### **8.8.2 Studies Targeting Populations with Different Levels of Education**

One study provided evidence for populations with differing levels of education<sup>125</sup> including a population where <50% of the population had a college degree. The study found a significant intervention effect for sunburn outcomes.

There were clusters of studies in university students.

## Section 9: Review of Cost-effectiveness Studies

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This section reports the review of the evidence identified for the following questions:

- What are the most cost-effective methods of presenting complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- What are the most cost-effective methods of disseminating complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?
- What are the most cost-effective ways to change people's beliefs about the risk of sun exposure and to encourage them to change their sun protection practices accordingly?

### 9.1 SUMMARY OF EVIDENCE

Six studies were identified as meeting the inclusion criteria for the cost-effectiveness review. On quality assessment, one of the studies<sup>106</sup> was found to have very serious limitations as the study was a comparison of spending on a programme between Australian states using retrospective cancer registry data.

A summary of the country and interventions considered in the five included studies is provided in Table 9.1, the quality and applicability of the studies is summarized in

**Table 9.2**, and the results are summarized in Table 9.3. Full data extraction and quality assessment tables are provided in the Appendices.

**Table 9.1: Country and interventions of the included cost-effectiveness studies**

| Study                       | Country and setting  | Intervention and comparator   |
|-----------------------------|--|---|
| Hirst <i>et al.</i><br>102  | <b>Country:</b> Australia<br><b>Setting:</b> Community   | <b>Intervention:</b> Promotion of daily sunscreen use with detailed guidance and provision of sunscreen<br><b>Comparator:</b> Sunscreen use at own discretion   |
| Gordon <i>et al.</i><br>103 | <b>Country:</b> Australia<br><b>Setting:</b> Community   | <b>Intervention:</b> Promotion of daily sunscreen use with detailed guidance and provision of sunscreen<br><b>Comparator:</b> Sunscreen use at own discretion   |
| Kyle <i>et al.</i><br>101   | <b>Country:</b> USA<br><b>Setting:</b> Schools   | <b>Intervention:</b> SunWise programme. Includes a tool kit with classroom activities, UV-sensitive Frisbee, storybooks, posters, videos, policy guidance and other materials. Lessons in 3 areas: effects of UV radiation, risk factors for over exposure and sun protection habits.<br><b>Comparator:</b> Do nothing  |
| Matrix Evidence 104         | <b>Country:</b> UK (modeling), effectiveness data from USA, Australia and Germany<br><b>Setting:</b> School, swimming pools and workplaces | <b>Interventions:</b> <ul style="list-style-type: none"> <li>• Provision of shade.</li> <li>• Multi-component intervention including changes to the natural or built environment and/or provision of sun protection resources and may include provision of information. Multi-component intervention was modelled in 7 settings.</li> <li>• A cost neutrality model to assess a mass media campaign.</li> </ul> <b>Comparator:</b> Do nothing |
| Andronis <i>et al.</i> 105  | <b>Country:</b> UK (modeling), effectiveness data from USA, Australia and Germany<br><b>Setting:</b> School, university and community      | <b>Interventions:</b> <ul style="list-style-type: none"> <li>• A handbook for parents.</li> <li>• Verbal information delivered in school.</li> <li>• Verbal information delivered at university.</li> </ul> Six studies looking at verbal advice, printed materials and mass media in children and adults were used in threshold analysis<br><b>Comparator:</b> Do nothing  |

**Table 9.2: Summary of quality and applicability assessment of the included cost-effectiveness studies**

| Study                         | Quality                             |  | Applicability     |   |
|-------------------------------|-------------------------------------|--|-------------------|---|
|                               | Judgment                            | Comments   | Judgment          | Comments  |
| Hirst <i>et al.</i><br>102    | Minor limitations [++]              | NOT APPLICABLE   | Partly applicable | Effectiveness and resource data drawn from studies outside UK from populations where climate and culture may be significantly different. Discounting not at reference case rates.       |
| Gordon <i>et al.</i><br>103   | Potentially serious limitations [+] | Only a 5 year time horizon   | Partly applicable | Effectiveness and resource data drawn from studies outside UK from populations where climate and culture may be significantly different. No discounting.                                |
| Kyle <i>et al.</i><br>101     | Potentially serious limitations [+] | Effectiveness data from a before and after study. No PSA undertaken.   | Partly applicable | Effectiveness and resource data drawn from studies outside UK from populations where climate and culture may be significantly different. Discounting did not match reference case.      |
| Matrix Evidence<br>104        | Potentially serious limitations [+] | Studies had limited follow-up so persistence of effect assumed. Utilities derived from expert opinion rather than preference-based studies | Partly applicable | Effectiveness and some resource data drawn from studies outside UK from populations where climate and culture may be significantly different. Discounting did not match reference case. |
| Andronis <i>et al.</i><br>105 | Potentially serious limitations [+] | Studies had limited follow-up so persistence of effect assumed. Utilities derived from expert opinion rather than preference-based studies | Partly applicable | Effectiveness and some resource data drawn from studies outside UK from populations where climate and culture may be significantly different. Discounting did not match reference case. |

**Table 9.3: Summary of results from the included cost-effectiveness studies**

| Study                                 | Incremental costs (intervention compared to control)   | Incremental benefits (intervention compared to control)   | Incremental cost-effectiveness ratio   | Authors' conclusions   |
|---------------------------------------|--|---|--|--|
| Hirst <i>et al.</i> <sup>102</sup>    | AU\$1031 per person  | 0.02 QALYs per person   | AU\$42,614/QALY  | The active promotion of routine sunscreen use to white populations residing in sunny settings is likely to be a cost-effective investment for governments and consumers over the long term   |
| Gordon <i>et al.</i> <sup>103</sup>   | -AU\$83,203 (total Government)<br>AU\$101,449 (Total societal)   | 35 fewer skin cancers   | Government perspective: cost saving.<br>Societal perspective: \$3,041 per skin cancer prevented or \$3.72 per person engaged in intervention                                   | Promotion of daily sunscreen use with provision of sunscreen in a Caucasian population will cost money from a societal perspective but is cost-effective at preventing cancer when compared to other cancer prevention interventions |
| Kyle <i>et al.</i> <sup>101</sup>     | -\$31,197,080  | 159 more QALYs  | Intervention dominates   | From an economic perspective educating children about sun safety is beneficial   |
| Matrix Evidence <sup>104</sup>        | Provision of shade: 3.01<br>Multi-component varied from 0.22 in a beaches and pool setting to 38.60 in a work setting                                    | Provision of shade: £7.4m<br>Multi-component varied from £2.4m in a beach and pool setting to £52m in a primary care setting  | Ranges £207k/QALY (multi-component intervention in a community setting - the only intervention below £1m/QALY) to £82m/QALY (primary care based multi-component intervention). | Interventions modelled were not cost-effective at £20,000/QALY. A mass media campaign would have to increase sunscreen use by between 2 and 6.6 percentage points to break even  |
| Andronis <i>et al.</i> <sup>105</sup> | Information booklet: £0.0000781 per person. Verbal information in school: £0.0000339 per person. Verbal information in university: £0.0000452 per person | Information booklet: £0.52 per person. Verbal information in school: £8.90 per person. Verbal information in university: £1.90 per person. Threshold analysis showed cost per participant of information varied between £1.51 for printed material for adults to £9.07 for six 50-minute lessons with children. | Information booklet: £6,200/QALY. Verbal information in school: £260,000/QALY. Verbal information in university: £42,000/QALY.   | With some caution and acknowledging the weakness of analysis there is evidence that if information provision can be done inexpensively it would be a cost-effective intervention to prevent skin cancer                              |

Four of the five included studies were cost utility analyses, with one study [+] <sup>103</sup> being a cost-effectiveness and cost benefit analysis with the cost per skin cancer avoided being the primary economic outcome.

Two studies, one [+] <sup>103</sup> and the other [++] <sup>102</sup> were based upon the Nambour Skin Cancer Prevention Trial. This trial, undertaken in the 1990s in Queensland, Australia, was community based and involved the provision of sun cream, promotion of daily sun cream use and detailed guidance.

Using a cost utility approach one study <sup>102</sup> [++] used data from the trial to estimate the difference in development of melanoma for those who received the intervention and those who did not. Progression of melanoma to different stages with associated costs was estimated from the literature. Utilities were estimated from published preference-based studies.

The other [+] study <sup>103</sup> used the data from the trial itself on both effectiveness and resource use with additional resource use and costs derived from published sources.

Both studies reported that the intervention was cost-effective from the perspectives considered <sup>102, 103</sup>.

One study from the USA [+] <sup>101</sup> found that a school-based intervention was cost-effective.

Hirst *et al.* [++] <sup>102</sup> reported an incremental cost-effectiveness ratio (ICER) of AU\$42,614/QALY (quality-adjusted life year) and in 64% of probabilistic sensitivity analysis simulations was below AU\$50,000/QALY. The authors concluded that the intervention would be cost-effective at AU\$50,000/QALY for individuals aged 38 to 64, with an annual melanoma risk of 0.09% and a hazard rate of sunscreen use to no sunscreen use of no more than 0.37.

Gordon *et al.* [+] <sup>103</sup> found from a Government perspective (treatment of cancer only) that the intervention was a cost saving strategy. From a societal perspective, including costs to the individual of buying sun cream and costs of delivering the intervention, the ICER was AU\$3,041 per skin cancer averted or from a cost-benefit analysis perspective AU\$3.72 per person engaged by the intervention.

These two studies <sup>102, 103</sup> are partially applicable to the UK setting. The effectiveness data are drawn from a study in a subtropical region of Australia and it is not known how this difference in culture and climate would impact on the effectiveness of the intervention in the UK. The Hirst *et al.* [++] <sup>102</sup> finding on the importance of the annual melanoma risk (which is likely to be higher in Australia compared to the UK) on cost-effectiveness is likely to be of some applicability to UK decision makers. This is especially true given the high ICER found by Hirst *et al.* [++] <sup>102</sup> of AU\$42,614/QALY (approx. £23,400/QALY)<sup>8</sup> albeit such an ICER was considered cost-effective by the author.

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<sup>8</sup> Assuming an exchange rate of AU\$1 = £0.55 as at 22 May 2014 and not assuming a cost rise for inflation.

Kyle *et al.* [+] <sup>101</sup> undertook a cost utility analysis of a school-based intervention (SunWise) in the USA. The intervention included a range of promotional materials and a tool kit for teachers followed by lessons across three sun exposure topic areas. The authors used before and after surveys from children and young people who had received the intervention to assess behaviour change resulting from the intervention. This behaviour change was then modelled onto lifetime UV exposure, which in turn was modelled onto the likelihood of developing skin cancer and premature mortality.

In their analysis, Kyle *et al.* [+] <sup>101</sup> found that the intervention dominated, generating more QALYs than no intervention at a lower overall cost. This finding held over a range of scenarios and sensitivity analyses conducted, unless the discount rate increased from 3% per annum to 7% per annum.

The applicability of this finding to the UK setting may be limited due to the different culture and climate in the area from where the effectiveness data were drawn. The linkage between the intervention and primary health outcome – QALYs – is indirect and involved several modeling steps to derive. As the exposure and cancer risk models are both US-based this also means the findings may be of limited applicability to the UK setting.

Two studies, Matrix Evidence [+] <sup>104</sup> and Andronis *et al.* [+] <sup>105</sup> reported the findings from UK models developed as part of the NICE skin cancer prevention guidance. Andronis *et al.* [+] <sup>105</sup> evaluated the provision of information in educational and community settings, while Matrix Evidence [+] <sup>104</sup> evaluated changes to the environment and provision of a multi-component intervention of changes to a physical environment and/or provision of sun protection resources.

Both studies made use of evidence published in the USA, Australia and Germany with no effectiveness data being found in the UK. Utility data from both studies were drawn from expert opinion. Coupled with modeling approaches that linked short term behavioural change through sun exposure to lifetime skin cancer risk, these form the primary quality concerns of the studies. Both studies acknowledged the limitations of their findings due to the context of their effectiveness data and the way that it had been modelled.

Andronis *et al.* [+] <sup>105</sup> reported that an information booklet for parents would be cost-effective with an ICER of £6,200/QALY and that this would hold provided the cost of the booklet was under £2. Probabilistic sensitivity analysis showed the intervention was cost-effective at £20,000/QALY in 87% of simulations.

Andronis *et al.* [+] <sup>105</sup> found that verbal information provided in schools had a baseline ICER of £260,000/QALY and in probabilistic sensitivity analysis no simulations out of 10,000 had an ICER below £20,000/QALY. They reported that verbal information in universities was also not cost-effective with a base case ICER of £42,000/QALY with 6% of simulations being under £20,000/QALY.



Matrix Evidence [+] <sup>104</sup> found only one intervention had an ICER below £1,000,000/QALY. This was £207,000/QALY for a multi-component intervention in a community setting where there was age specific information delivered in schools, posters, sunscreen samples and educational pamphlets on beaches and sun protection advice and sunscreen samples delivered in a GP setting. Interventions at over £1,000,000/QALY included:

- Interactive computer assessment in a healthcare setting with feedback from healthcare provider and provision of sunscreen;
- Provision of protective hats and sunscreen in a work-based setting;
- Provision of lessons and sun protection at swimming lessons;
- Educational lessons three times a year in schools with information booklets.

The authors concluded that the lack of cost-effectiveness was due to the small changes in behaviour seen in the intervention groups coupled with the low QALY gain with preventing non-melanoma skin cancer and the small number of avoided cases of malignant melanoma <sup>104</sup>.

Matrix Evidence [+] <sup>104</sup> also undertook a threshold analysis for a mass media campaign and found that at an annual cost per person of between £0.0028 and £0.0093 the campaign would have to increase the probability of people in the UK always using sunscreen or decrease never using sunscreen by between 2 and 6.6 percentage points.

#### **Evidence statement 9.1**

There is inconsistent evidence from one study [++] (with minor limitations and four studies [+] (with potentially serious limitations that community- or school-based educational programmes on sun exposure with or without exposure protection resources are cost-effective.

The cost-effectiveness of provision of information in schools was shown in one US study [+] with potentially serious limitations.<sup>101</sup> Two Australian studies, one with minor limitations [++] and the other with potentially serious limitations [+] <sup>102, 103</sup> found that a community-based programme promoting daily use of sun cream, providing sun exposure guidance and limited provision of sun cream is cost-effective. Two studies with potentially serious limitations [+] <sup>104, 105</sup> that took effectiveness data from overseas studies and applied them to UK models of sun exposure and skin cancer risk contradicted these findings. These two studies showed that assuming effectiveness in the overseas studies on behaviour change was also seen in the UK, then community, school and work-based interventions that provided information with or without additional sun care resources or change of the environment were highly cost-ineffective.

The exception was provision of an information booklet for parents, which was estimated to have an ICER of £6,200/QALY. However, the authors noted that this finding was limited by the weakness of the modeling approach linking behavioural change to reduction in cancer risk.

The evidence is limited by the absence of cost-effectiveness studies based upon effectiveness data generated in the UK.

<sup>101</sup> Kyle et al. (2008) [+]

<sup>102</sup> Hirst et al. (2012) [++]

<sup>103</sup> Gordon et al. (2009) [+]

<sup>104</sup> Matrix Evidence (2010) [+]

<sup>105</sup> Andronis et al. (2009) [+]

# Section 10: Effective Content and Effective Interventions

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This review addressed two questions about the content of effective interventions:

- 3a. What content do effective primary skin cancer prevention messages contain?
- 3b. What is the most effective content in primary skin cancer prevention messages?

This section explores the interventions found to be effective in trials of good [++] or moderate [+] quality and reports details of those interventions. Twenty-four trials were identified as having effective interventions <sup>4, 8, 10, 11, 13, 14, 18, 20, 21, 31, 38, 39, 47, 55, 61, 69, 71, 79, 80, 86, 89-91</sup>. Because of resource constraints, the detailed interventions within the primary studies of included systematic reviews have not been included here.

## 10.1 SUN PROTECTION POLICIES AND PROGRAMMES

One good quality trial [++] assessed sun protection programmes in French primary school children <sup>4</sup>. The “Living with the Sun at School” educational programme in primary schools investigated changes in understanding and knowledge, changes in individuals’ perception or attitudes and changes in sun protection practices. The intervention, which involved practical classroom-based activities, was shown to result in a significant increase in knowledge score immediately after completion <sup>4</sup>. The intervention was a multidisciplinary guide for teachers containing practical classroom work and activities designed to increase children’s scientific knowledge of the sun, its characteristics and activities in relation to life on the earth. For children, the aim of the programme was to increase their competencies when dealing with the sun; it was designed to help them to understand the benefits and risks of exposure to the sun are, so that they can modify their own behaviours.

The intervention involved ten workshops, delivered during a three-month period which covered four topics:

- The effect of sun exposure on the body;
- The different skin types and their sensitivity to sunlight;
- The determinants of variations in the UV intensity;
- Sun protection strategies.

To optimize the use of teaching time, proposed lessons corresponded with the official primary school curriculum in the sciences, geography, mathematics, and language <sup>4</sup>.

## 10.2 MOTIVATIONAL INTERVENTIONS

### 10.2.1 UV Photographs with or without Photoaging in Combination with Other Interventions

Three moderate quality trials [+] assessed UV photographs with or without photoaging in combination with other interventions and investigated changes in people's knowledge and understanding of how to competently assess their level of risk and benefit from sun exposure<sup>18, 20</sup> and frequency of sun exposure<sup>21</sup>.

A moderate quality trial [+] investigating perceptions of skin damage examined the impact of UV photography interventions in 148 male outdoor road workers and found that men who saw their UV photo reported more skin damage from the sun than those who did not view their UV photo<sup>20</sup>.

The overall intervention had two primary elements: (a) a photograph taken of the face with a UV-filter camera and (b) a 12-min educational video on UV risk (focusing on either skin cancer or photoaging). The video discussed the impact of the sun and UV exposure on either photoaging or skin cancer and provided pictures of skin damage (wrinkles and age spots or skin cancer). Each video also provided information about sunscreen use and skin protection (e.g. how much sunscreen to use, an explanation of sun protection factor [SPF], recommendation of an SPF of at least 15). Participants were assigned to one of five conditions: a control condition or one of the four intervention conditions: no-UV/aging, no-UV/skin cancer, UV/aging, UV/skin cancer. All participants first had two Polaroid photos taken of their faces: a natural-light black-and-white photo and a UV photo. The filtered UV light is absorbed by the melanin in the skin and the resulting photo highlights the non-uniform epidermal pigmentation that has resulted from chronic exposure to UV rays. Participants in the control and no-UV photo conditions were only shown the natural-light photo and were told the purpose of this photo would be explained at the end of the study. Men in the UV conditions were shown their natural-light photo and their UV photo as comparison. Participants were told that any "dark, freckled, or splotched areas" in the UV photograph that were not evident in the natural-light photograph indicated existing underlying skin damage due to UV exposure that will get worse if they continue to be exposed to the sun without additional protection. Intervention participants then watched their assigned video<sup>20</sup>.

A moderate quality trial [+] <sup>18</sup> investigating changes in individuals' perception of or attitudes compared the effects of efficacy enhancement and self-affirmation for two risk messages in 677 female students (aged 16 to 23) in their final year of senior school, or enrolled on a university psychology course, reported that students who received the self-efficacy information showed significantly greater intentions to use sun protection than those who did not when presented with a message evoking the threat of skin cancer. Participants were assigned to one of eight conditions, four conditions for each risk message (skin cancer or photoaging): self-efficacy information present plus high/low self-affirmation manipulation; self-efficacy information absent plus high/low self-affirmation manipulation. The 'high' efficacy condition provided efficacy information designed to bolster perceived efficacy for sun protective behaviours; for example, statements such as 'you can carry a small bottle, sachet or pouch of sunscreen so you can't forget' and 'sunscreen can block up to 96% of UV radiation'; this information was absent in the 'no efficacy' conditions. For the self-affirmation task, participants ranked the following twelve values in terms of personal importance: 'Aesthetic appreciation', 'Sense of humour', 'Relations with family and friends', 'Spontaneity', 'Social skills', 'Athletics', 'Music ability or appreciation', 'Neatness or tidiness', 'Physical attractiveness', 'Creativity', 'Managerial skills' and 'Romantic values'. Those in the high-affirmation condition then had to write a brief description of something they had done which reflected the value they had ranked the most important, and then respond to ten questions or statements designed to reinforce the importance of this value in their lives. The low-affirmation condition was equivalent except it involved writing and answering questions about why the ninth most important value might be important to the average student (e.g. 'how much do you think holding this value makes the average student feel part of something greater than themselves?') The self-efficacy and self-affirmation interventions were completed prior to reading a risk message on either skin cancer or photoaging <sup>18</sup>.

A moderate quality trial [+] <sup>21</sup> compared a UV photo group with a self-affirmation group, a combined UV photo and self-affirmation group compared to control (no intervention). Individuals receiving self-affirmation interventions reported lower rates of deliberate sun exposure when compared with those not receiving this intervention. UV photos were taken with a single lens reflex camera; red colour components were reduced and blue components were increased to improve clarity and interpretability to sun-damaged areas. Photos for the control group were not processed and showed a normal photo of the face. Self-affirmation was manipulated using validated procedure by asking participants to rate themselves on a 5-point scale presenting a range of personal strengths and values. Filling in this scale is assumed to help participants focus on values important to their self-image, which in turn gives them a change to reaffirm themselves. Participants in the non-affirmation condition rated a celebrity on the same scale. Participants filled out the value scale before they were photographed, thereby being self-affirmed before receiving the risk feedback <sup>21</sup>.

## 10.2.2 Other Motivational Interventions

Two trials assessed motivational interventions, both investigating changes in individuals' perceptions or attitudes <sup>31, 47</sup>.

One moderate quality trial [+]<sup>47</sup> investigating changes in individuals' perception or attitudes, examined the impact of essays that manipulated the level of threat and coping appraisal in 254 Caucasian female undergraduates who had previously intentionally sought a tan, and found that both the high threat and high coping appraisal information elicited significantly higher intentions to use sun protection than their low equivalents. Participants were randomized to read one of four possible essays presenting health information, based on protection motivation theory, i.e. targeting two cognitive processes: threat appraisal (high/low) and coping appraisal (high/low). Each essay was about nine pages in length, of which approximately half was photos. The high threat essay presented graphic photos of cancer lesions, leathery skin and age spots, and emphasized the detrimental effects of the sun in terms of appearance, increasing skin cancer rates in younger people, and the changing norms of beauty to a lighter skin tone. In contrast, the low threat essay minimized these concerns by presenting innocuous images and providing positive information about the beneficial effects of the sun. The high coping essay focused on the effectiveness of practices such as sunscreen use and eliminating sunbathing in avoiding skin cancer and damaged skin, and their convenience, whilst the low coping essay considered the inconvenience and practical difficulties of adopting such practices (37).

A moderate quality paper [+]<sup>31</sup> investigating changes in individuals' perception or attitudes examined the impact of framed health messages and message focus in 390 young adults (aged 16 to 26 years) reported increases in a composite intention score (intention to use sunscreen, protective clothing and sunbeds) pre- to post-message for both gain- and loss-framed messages. The framed health messages were embedded in a questionnaire that assessed intentions to perform skin protection behaviours, the threat of skin cancer, and public body consciousness. Each message comprised four lines of factual data about skin cancer, followed by six lines about sun exposure and sunscreen use which formed the framing manipulation, and was presented in terms of the consequences for one's appearance (e.g. prematurely aged skin) or health (e.g. premature death). The gain frame emphasized the benefits of protecting oneself from the sun in terms of appearance or health consequences, whilst the loss frame emphasized the risks of not protecting oneself from the sun. The findings held when individual differences in body consciousness were controlled for <sup>31</sup>.

## 10.3 EDUCATIONAL INTERVENTIONS

### 10.3.1 Information Provision Interventions

Three trials assessed information provision interventions and investigated changes in individuals' perception or attitudes<sup>61</sup>, changes in the frequency and duration of sun exposure<sup>91</sup> and changes in sun protection practices<sup>79, 80</sup>.

One good quality trial [++]<sup>61</sup> investigating changes in individuals' perception or attitudes found that a brief appearance-focused intervention based on decision-theoretical models of health behaviour significantly reduced both intentions to indoor tan and attitudes towards indoor tanning at 6 months compared to no intervention in 430 female university students with prior indoor tanning or with future intentions to tan. Participants in the intervention group received an appearance-focused booklet based on decision-theoretical models of health behaviour, written at an eighth grade (13 to 14 years old) reading level and modified following various feedback from focus groups of indoor tanners. The final booklet comprised sections on the history of tanning, current tanning norms (including media and peer image norms), the effects of UV radiation on skin (with the aim to increase perceived susceptibility to skin damage from UV exposure), the specific effects of indoor tanning (again, with the aim to increase perceived susceptibility), indoor tanning guidelines emphasizing tanning abstinence and providing recommendations for harm reductions, and healthier appearance-enhancement alternatives to tanning (in particular, exercise, clothing, and sunless tanning), with links to interesting and informative websites. Both the booklet and the links related to sunless tanning emphasized that sunless tanning does not protect against UV exposure. The 24-page booklet was produced by a professional commercial art firm<sup>61</sup>.

A moderate quality trial [+] <sup>91</sup> of adult females with seasonal affective disorder symptoms and pathological tanning motives received a booklet containing information about the effects of sun exposure, focused on appearance and skin cancer. The study investigated changes frequency and duration of tanning bed exposure. Compared to control the study found that the intervention could reduce indoor tanning behaviour in participants by up to 35%. The booklet sequentially presented the history of tanning to provide a context for current tanning norms, analysed current tanning norms, and examined media and peer image norms. Next, it discussed UV radiation's effects on skin to increase perceived susceptibility to skin damage and skin damage specifically related to indoor tanning use. The booklet then gave recommendations for indoor tanning use focusing on tanning abstinence and including harm reduction recommendations. Finally, it provided links to and discussed healthier, appearance-enhancing alternatives to tanning, including exercise, choosing fashion that does not require a complementary tan, and sunless tanning products. Both the website links and the booklet content related to sunless tanning highlight the fact that sunless tanning provides little protection against UV exposure<sup>91</sup>.

Two reports of a single study in elementary school children in Florida <sup>79, 80</sup> observed hat-wearing following the provision of or emphasis on hat use together with brief educational sessions. One of these reports were considered to be of good quality [++] <sup>79</sup> and the other to be of poor quality [-] <sup>80</sup>. Observed that use increased by 41% at the end of one year in the intervention group compared to the control and declined to an increase from baseline of 19% after two years. Hat use in the control group did not change during the two-year follow-up period. Students were provided with two free wide-brimmed hats (one to use at school and one to use at home) and took part in classroom sessions targeting sun protection attitudes and social norms. A 45-minute comprehensive sun protection educational session was carried out in classrooms by a community health education organization. Three 60-minute follow-up sessions addressed the benefits of sun protection (with emphasis on hat use), promoted favourable attitudes about sun protection, and made clear that fourth-grade students were both allowed to wear hats at school and should be wearing hats while outside at school <sup>79, 80</sup>.

### 10.3.2 Electronic Educational Interventions

Three trials assessed electronic educational interventions and investigated changes in people's knowledge and understanding of how to competently assess their level of risk and benefit from sun exposure <sup>8</sup>; changes in individuals' knowledge and/or awareness of practices that protect against sun exposure <sup>71</sup> and changes in either the timing, intensity, frequency or duration of sun exposure and sun protection practices, or changes in quantifiable markers of health/outcomes of sun exposure <sup>71, 86</sup>.

One moderate quality [+] trial <sup>8</sup> investigating changes in people's understanding and knowledge randomized university students to three different web links, a control page (the assessment questionnaire), a narrative skin cancer message (a first person account of dealing with skin cancer) and a non-narrative (information-style) message. Exposure to the narrative condition about skin cancer risk significantly increased self-reports of preventive behaviours (2-4 fold). The narrative message contained a first person account of a 21-year-old student who had been diagnosed with skin cancer. The story contained vivid and image-evoking language and a detailed picture of the patient's back showing melanoma. The non-narrative message presented factual information about skin cancer diagnosis and a non-detailed drawing showing the layers of the skin. The language was abstract and neutral. The experimental messages were of comparable length (one page) and contained similar information about skin cancer susceptibility, consequences, self-efficacy and response-efficacy. An identical statement at the end of each message pointed attention to skin protection and (self-) examination of the skin: "To prevent it you should protect yourself from the sun at all times." The physician also advised to regularly check your skin for irregular shaped or unusual coloured moles: "This helps to ensure that suspicious moles are spotted early and they can be checked promptly by a doctor".

Health protection behaviours were measured by asking respondents to state their agreement with statements about sun protection behaviours (“I always protect my skin from the sun”) and skin self-examination behaviour (“I regularly check my skin for strange or irregular moles”). Answers were provided on a 7-point Likert scale ranging from 1: totally disagree to 7: totally agree.

Participants were also asked whether they had been diagnosed with skin cancer (0=no, 1=yes), whether they had had their skin checked by a physician (0=no, 1=yes) and how often they had searched for information about skin cancer in the past year (1=never, 5=very often). Actual protective behaviours in the month following the experiment were measured in the follow-up session by asking whether participants had actually engaged in skin self-examination, had looked for additional information about skin cancer, had paid more attention to information and had talked to family members, friends or a physician about skin cancer (each question: no=0, yes=1) <sup>8</sup>.

One moderate quality trial [+] <sup>71</sup> conducted in the US aimed to assess the efficacy of online videos as an educational medium compared to an information pamphlet to improve sunscreen behavioural outcomes and sunscreen application knowledge in 97 adults. Participants who saw the online video had significantly higher frequency of sunscreen use. The intervention group watched an online video addressing how sunscreens work to protect skin, different types of sunscreens, the importance of sunscreen use, and proper application. No further details were reported <sup>71</sup>.

One moderate quality trial [+] evaluated the effectiveness of text messaging as a reminder tool for improving adherence to sunscreen application in 70 American adults and found that text reminders to use sunscreen significantly increased use compared to no text messages ( $p < 0.001$ ) <sup>86</sup>. All participants were asked to apply sunscreen daily for six weeks in the autumn of 2007. Autumn was defined as September 1 through November 30, according to the standard definition for the meteorological autumn for the northern hemisphere. All participants had an initial visit that lasted approximately 80 minutes in which the study staff explained about and showed the participants how to dispense the study sunscreen. Furthermore, the participants were asked to demonstrate their ability to dispense sunscreen using the study device. All participants were also given written instructions regarding the proper frequency of sunscreen application and how much to apply. Participants’ adherence was captured in real time using transmitting electronic monitors.

The intervention group received daily text-message reminders via cellular telephone for six weeks. The text-message reminders consisted of two components: a “hook” text detailing daily local weather information and a “prompt” text reminding users to apply sunscreen. For example, a reminder message would read, “Wed. Partly Cloudy. High 70, Low 55. Your skin would appreciate some sunscreen today.” The reminders were sent daily between 6:30am and 7am, and a variety of “prompt” messages were used to help maintain participant interest. The control group received no text reminders <sup>86</sup>.



### 10.3.3 Tailored Interventions

Seven trials assessed electronic educational interventions and investigated changes in people's knowledge and understanding of how to competently assess their level of risk and benefit from sun exposure<sup>10, 11, 13</sup>; changes in individuals' perception of or attitudes to the risks and benefits of sun exposure<sup>11, 55</sup>; changes in individuals' knowledge and/or awareness of practices that protect against sun exposure<sup>38</sup> and changes in either the timing, intensity, frequency or duration of sun exposure and sun protection practices, or changes in quantifiable markers of health/outcomes of sun exposure<sup>10, 55, 89, 90</sup>.

A good quality [++] RCT conducted in the USA compared generic with tailored interventions in adult relatives of melanoma patients by investigating changes in people's understanding and knowledge and changes in sun protection behaviours<sup>10</sup>. Both interventions provided educational communication designed to increase sun protection behaviours, but the tailored intervention was more intensive and personal (linked to previous survey answers) and increased the probability of having a total cutaneous examination by a health professional almost two-fold. In the generic intervention there were three print mailings and one telephone counselling call delivered two weeks after the last mailing. The first mailing focused on melanoma, melanoma risk, and total cutaneous examination (TCE). Participants were mailed the American Cancer Society pamphlet "Why You Should Know About Melanoma" (American Cancer Society, 2005) and the American Academy of Dermatology (AAD) bookmark, "The Complete Skin Exam" (2003). The second mailing focused on SSE. A bookmark published by the AAD, "Look for the danger signs in pigmented lesions of the skin" (1992) and a pamphlet published by the Skin Cancer Foundation, "Skin Cancer: If you can spot it- you can stop it!" (1992) were included. The third mailing focused on sun protection. Participants were mailed two pamphlets published by the Skin Cancer Foundation, "Get Smart! Go Under Cover" (2005) and "Simple Steps to Sun Safety" (Skin Cancer Foundation, 2005). Letters accompanying the mailings recommended each behavioural change. The generic telephone counselling call occurred after the third mailing. During the call, the health educator reviewed the guidelines for SSE, TCE, and sun protection, the steps to performing SSE, how to protect one's skin, and ways to reduce sun exposure. In the tailored intervention, the first tailored print was called "Have a Dermatologist Examine your Skin" and included topics like skin cancer risk profiles that were tailored to participants answers to behavioural and objective (e.g., blonde or red hair) risk factors; information about melanoma tailored to the facts about cutaneous melanoma that the participant did not answer correctly; the benefits of a total skin exam showing five barrier/benefit messages. An age and gender matched picture with a quote tailored to the highest ranked barrier was included; and, following the expert's recommendation, contained tailored recommendations from the dermatologist. Several more tailored interventions were included; full details of these can be found in the full text publication<sup>10</sup>.

One moderate quality RCT [+] <sup>13</sup> conducted in France investigated changes in people's understanding and knowledge and compared a targeted screening and educational intervention with a conventional public health in primary care adults considered at elevated risk of skin cancer. Intervention participants had significantly higher overall knowledge scores around correct identification of melanoma risk factors (high mole count, having freckles, being phototype 1 or 2, childhood sunburn, residence in high UV country and family history of melanoma) assessed five months after intervention than controls. In the intervention group, general practitioners accessed a SAMScore risk calculator on a server using an individual password. During the consultation, the general practitioner entered each patient's responses to seven questions (relating to phototype, freckling tendency, number of moles, residence in a country with strong sunshine, severe sunburn during infancy, personal history of melanoma, and family history of melanoma). The calculator integrated the risk factors using the SAMScore algorithm and expressed the risk in dichotomous format: either at elevated risk or not for melanoma. For all patients identified as having elevated risk, general practitioners performed a total skin examination, counselled the patient, and gave the patient the information leaflet detailing primary and secondary prevention measures <sup>13</sup>.

One good quality [++] RCT <sup>11</sup> conducted in the USA investigating changes in people's understanding and knowledge and changes in individuals' perception or attitudes evaluated whether personalized counselling and web-based education could lead to improvements in siblings' (of recent melanoma patients) skin cancer risk reduction practices compared with usual care. By the 6-month follow-up, intervention participants had significantly greater improvements in knowledge regarding location and appearance of melanoma when compared with those in usual care. Intervention condition participants received the following: 1) an initial motivational and goal-setting telephone intervention session delivered by the health educator; 2) computer-generated tailored print materials sent at one, three and five months after randomization; 3) three telephone counselling sessions with the health educator, timed to follow receipt of the mailed materials; and 4) linkages to free screening programmes. The mailed materials were tailored based on responses to the baseline; materials were tailored to level of participation in each of the three target behaviours (skin self-examination, physician screening, and sun protection), self-efficacy, and beliefs. Tailored materials, in which the information is personalized according to specific theoretical constructs, have been found to increase attention to information and behaviour change. Both the tailored materials and the counselling phone calls were designed to address the following: 1) knowledge and attitudes; 2) barriers to change; (3) risk perception; and 4) self-efficacy for improving skin cancer risk behaviours <sup>11</sup>.

A moderate quality [+] study <sup>55</sup> investigated changes in individuals' perception or attitudes as well as changes in sun protection practices and found the addition of personalized normative feedback to information alone yielded more favourable intentions to adopt sun protection measures, both post-test (means 4.71 and 4.54) and at 4-week follow-up (means 4.65 and 4.38), in a sample of 189 community-residing women (aged 37 to 77 years; 94% non-Hispanic White). Control participants (information alone) received a freely available American Academy of Dermatology (AAD, 2008) information flyer recommending sunscreen, protective clothing, and avoidance of sun exposure, which represents the standard of care usually provided at a health practitioner's or dermatologist's office. Intervention participants received the same information sheet but also a personally-tailored normative feedback sheet, with feedback on all four injunctive norm items significantly mis-estimated at baseline: the participant's own perceptions of the norm for each item was juxtaposed against the true injunctive norms observed amongst the sample (mean value at baseline). Norm items assessed "typical women's" views of protection as good and approval for taking specific protective precautions, for example "Typical women in the Valley think that others should wear a hat when they are in the sun". Participants in the feedback group also believed the injunctive norms favouring sun protection to be stronger than those in the control group (post-test means 4.64 and 4.21, respectively) <sup>55</sup>.

One moderate quality trial [+] <sup>38</sup> in school-aged children assessed a partially tailored mailed intervention including educational newsletters about skin cancer sun protection (mailed to parents and children) and an annual invitation to attend a data collection session. Compared to the control group, participants in the intervention group were more aware of skin cancer risk factors. The intervention consisted of three sets of educational newsletters about skin cancer and sun protection, and related sun protection resources such as a swim shirt, sunhat, sunscreen, and backpack. Newsletters were mailed to families in April and May at approximately 2-week intervals each year. Each year, the sequencing of newsletters addressed movement through PAPM stages. The first parent newsletter in each annual series presented general information about skin cancer and its causes (Stages 1 and 2). The second newsletter was designed to personalize risk perception (Stage 3) by providing tailored information about risk factors specific to each child, which included, as relevant to the child, family history of skin cancer; at-risk phenotype (hair, eye, and skin colour; freckling; tendency to burn/tan); and high number of moles. Tailoring utilized information provided by parents at enrolment or observed during skin exams. Parents of children with low-risk racial backgrounds (black and Asian) were informed of the child's low risk and about types of skin cancer not caused by sun exposure. Subsequent newsletters each year discussed the effectiveness of sun protection strategies for reducing children's risk and ways to overcome barriers to those strategies. Shade, sunscreen, clothing/hats, and midday sun avoidance were each discussed, with the latter two emphasized. The choice to emphasize clothing/hats and sun avoidance was based on the high reported use of sunscreen in this and other populations, and unclear evidence at that time that sunscreen is protective against skin cancer. Newsletters for children included age-appropriate information and activities (e.g., word searches, crossword puzzles, and matching games) about the sun, skin cancer, and sun protection. The control group received a letter each spring inviting them to complete data collection. All participants who attended skin exams during a given summer (both study groups) received a letter informing them of the average nevus count among children examined in that year and the nevus count for their child <sup>38</sup>.

Two trials, one of good quality [++] and one of moderate quality [+], used the same study design to target tailored communication in children at moderate to high risk of skin cancer in one study <sup>89</sup> and adults in the other <sup>90</sup> and compared the intervention to less intense education. The trials investigated changes in sun protection practices. Participants were located in either New York (Long Island) or Hawaii (Honolulu). In children, significant increases in the Sun Protection Habits index was found for total sun protection, use of sunscreen, wearing of protective clothing and sunglasses, but not for staying in the shade in children who received the tailored intervention compared to control. In adults, individuals receiving the tailored intervention had a significantly greater increase in their sun protection habits index (measured by diary entries) than control but the effect was moderated by location (less in Honolulu).

Two to three weeks after randomization, participants began receiving mailings according to the group to which they were assigned. The tailored messages and materials were based on the health belief model. The intervention group received three packets, mailed two weeks apart, containing personalized risk feedback and recommendations on the basis of responses to the baseline questionnaire, interactive skin cancer education materials (using pictures and graphics), a family fun guide (which included games and stories about safe sun practices that parents and children could complete together), suggestions for overcoming barriers, and reminders to engage in preventive practices. About two weeks after the second tailored-group mailing, an interviewer contacted all parents by telephone and conducted an interview, querying sun exposure and sun protection habits for the preceding weekend, and receipt of and reactions to the intervention materials. The third and final packet of tailored intervention materials was then mailed; its contents were unaffected by the telephone interview. The control group received a single mailing: a standard skin cancer prevention and detection information brochure for children published by the Skin Cancer Foundation, a tip sheet on use of sunscreen, hats, shade, and shirts to protect from the sun published by the American Cancer Society, and a bookmark encouraging child skin examination <sup>89, 90</sup>.

#### **10.4 MULTI-COMPONENT INTERVENTIONS**

Three trials assessed multi-component interventions and investigated changes in people's knowledge and understanding of how to competently assess their level of risk and benefit from sun exposure <sup>14</sup>; changes in individuals' perception of or attitudes to the risks and benefits of sun exposure <sup>14</sup>; changes in individuals' knowledge and/or awareness of diseases related to sun exposure <sup>69</sup> and changes in either the timing, intensity, frequency or duration of sun exposure and sun protection practices, or changes in quantifiable markers of health/outcomes of sun exposure <sup>14, 39</sup>.

One good quality trial [++] in mixed gender beach goers compared a number of multi-component interventions: a combined intervention of education, biometric feedback, and dermatologist skin examinations was compared to three control interventions (skin cancer prevention education, education plus biometric feedback and education plus dermatologist skin examinations) <sup>14</sup>. In terms of changes in knowledge, the greatest increases in sun risk knowledge (knowing what to look for when examining moles) were found in the biometric feedback intervention group, followed by the feedback plus dermatologist skin examination intervention. In terms of perceived risk, the trial reported a decrease in perceived risk of skin cancer from baseline in all but the feedback plus dermatology examination group. However, it also suggested that the intervention had no effect on perceptions of skin damage. In terms of sun protection behaviours, the greatest increases (hat wearing and sunscreen use) were reported in the combined feedback/education/skin examination group and the feedback/education groups. The four interventions included the following:

- The skin cancer prevention education was delivered by a health educator and covered basic skin cancer knowledge, sun protection information, and signs and symptoms of common skin cancers. Messages highlighted risk associated with unprotected exposure and the effectiveness of protective measures (response efficacy), and self-efficacy.
- The education plus biofeedback intervention involved the previously described education intervention plus biometric feedback, where participants received information on their personal skin damage caused by UV exposure using a Derascan analyzer and UV reflectance photography of their face and head.
- Education plus dermatologist/dermatology nurse practitioner skin examinations involved the previously described education intervention plus skin examinations by board-certified dermatologists or a dermatology nurse practitioner in private examination rooms.
- Education, biometric feedback, and dermatologist skin examinations. Participants in the combined condition received all of the components described above for each condition.

A good quality trial [++] <sup>39</sup> investigated changes in the timing, intensity, frequency and duration of sun exposure and sun protection practices, as well as changes in quantifiable markers of health/outcomes of sun exposure, by comparing multiple interventions in response to a pre-study questionnaire in adults in primary care. Groups received a letter containing feedback, risk assessment and printed information, feedback from a personal GP consultation and personal GP consultation plus phototest. Findings were generally mixed, although benefits were found for sunscreen use in the group having a GP consultation alone. In group 1, subjects received feedback in the form of a letter, with standardized comments on skin type, sun habits, and sun protection. It concluded with a summarized risk assessment with personally adjusted sun protection advice, and an additional information folder from Apoteket (Swedish public pharmacy) was enclosed, containing general information on sun exposure risks and sun protection. Group 2 received feedback by means of a personal GP consultation at the primary health care centre, performed by one of the authors. The consultation was free of charge, took approximately 20 minutes, and consisted of the same, this time oral, feedback on the questionnaire as well as adjusted information and sun protection advice.

Additionally, naevi inspection was performed, and the same information folder from Apoteket was distributed as in group 1. Group 3 received the same feedback as group 2, but the GP consultation also included a phototest (Skin-tester Kit, Cosmedico Medizintechnik GmbH, Schwennigen, Germany), applied on the palmar side of the forearm, consisting of six quadratic fields emitting separate, increasing UV doses, illuminated the skin simultaneously for 25 seconds. After 24 hours, the subjects themselves performed the test reading, by simply counting the number of erythematous reactions and then reporting the result, by mail, according to a specific protocol. Feedback based on the phototest result was then mailed back to the subjects. Test information and how to read and report it took a maximum of two minutes, and did not interfere with the time needed for the consultation.

A moderate quality trial [+] <sup>69</sup> conducted in Australia assessed the effect of a multi-component intervention on parental knowledge, sun avoidance behaviours, and sun protection practices in 197 parents and their children who were aged between 3 and 10 years. Although knowledge in both groups significantly improved following the intervention, the intervention group showed a more significant increase than the control group. The intervention group received a brief (10- to 15-minute) one-on-one presentation from a public health graduate student focused on skin cancer prevention. The talk was targeted to the parent/caregiver, and when the age was appropriate, the child was included. The following issues were stressed during the presentation and reinforced with a hand-out developed for the study called “5 Things Every Parent Should Know About the Sun”: i the epidemic of skin cancer, its relationship to the sun, and the importance of the three key sun protection practices (i.e., shirt, sunscreen and hat use, also known as Slip! Slop! Slap!). Each parent-child pair was also provided with a take-home package. Included in the package was a video entitled “Skin” that was developed by the Anti-Cancer Council of Victoria, which featured educational information presented by cartoon characters singing the now well-known jingle ‘Slip! Slop! Slap! This message was further reinforced by providing each child a shirt with the California SunSense Logo, a bucket hat, and a large container of broad-spectrum sunscreen so he or she was ready to ‘Slip! Slop! Slap!’ Finally, a brochure from the American Academy of Dermatology was provided for review by the parent <sup>69</sup>.

#### **Evidence statement**

There is moderate evidence from good quality [++] and moderate quality [+] trials about the effectiveness of a variety of different interventions and the content of the messages contained within the interventions. Although the interventions and messages appeared to be effective in these trials, the trials were heterogeneous; no two interventions were the same. Many interventions contained multiple components; these components were heterogeneous and it was unclear which component or components contributed to effects or whether there were components that were unnecessary. It is not possible to determine which specific messages contained within effective interventions are effective.

# Section 11: Discussion and Conclusions

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## 11.1 FINDINGS INTO CONTEXT

This review has focused on many countries which have similar cultures and climates to the UK. However, there are also several studies in the review which were undertaken in countries with very different climates to the UK, such as Australia and the southern States of the USA, where the applicability of the findings to the UK population are not clear. Countries whose inhabitants spend a greater proportion of their time in the sun are likely to have different views and practices related to sun protection. Additionally, interventions or sun protection practices may be culture-specific and adaptation to UK settings should consider the applicability to different cultural groups.

Many of the interventions reviewed were multi-component. For many of these studies it was unclear which component or components contributed to effects or whether there were components that were unnecessary. This lack of clarity is compounded by the absence of detail around the content of components in many of the interventions.

There were few long term studies which measured the impact of interventions beyond a year. This means it is difficult to assess whether interventions which were reported to be effective, would have long lasting impacts on knowledge and behaviour. In some studies, such as the study of distributing hats to children, although the intervention was effective at one year, there was a drop off in adherence to hat wearing during the second year. As well as the lack of knowledge and behaviour outcomes at longer term, there were few studies that reported quantifiable measures of sun practice change, such as numbers of sunburns and numbers of naevi, over the longer term. Since naevi and other skin damage takes time to develop, a greater number of studies that follow-up study participants to investigate the long term impact of interventions would be helpful.

The following table gives a summary of the outcomes, particular interventions and strength of the evidence for those interventions.

| <b>Outcome</b>  | <b>Intervention</b>  | <b>Strength of evidence</b>         |
|---|--|-------------------------------------|
| Knowledge of risks of sun exposure                        | Education programmes   | Strong, consistent evidence         |
|   | Tailored interventions   | Strong, consistent evidence         |
|   | Multi-component interventions  | Moderate, consistent evidence       |
| Perceptions   | Education programmes   | Inconclusive                        |
|   | UV photographs with/without photoaging                               | Inconclusive                        |
|   | UV photographs with/without photoaging plus additional interventions | Weak, consistent evidence           |
|   | Message framing  | Weak, consistent evidence           |
|   | Multi-component interventions  | Inconclusive, inconsistent evidence |
|   | Information provision  | Weak evidence                       |
|   | Tailored interventions   | Moderate, consistent evidence       |
| Attitudes   | Education programmes   | Inconclusive, consistent evidence   |
|   | UV photographs with/without photoaging                               | Weak, consistent evidence           |
|   | Message framing  | Inconclusive, consistent evidence   |
|   | Threat/fear scenarios  | Weak, consistent evidence           |
|   | Tailored interventions   | Weak, inconsistent evidence         |
|   | Education programmes   | Moderate, inconsistent evidence     |
|   | Information provision  | Moderate, inconsistent evidence     |
| Change in knowledge/awareness of disease                  | Multi-component interventions  | Moderate, inconsistent evidence     |
|   | Motivational interventions   | Inconclusive, inconsistent evidence |
|   | Educational interventions  | Weak, consistent evidence           |
| Change in knowledge/awareness of sun protection practices | Educational interventions  | Weak, inconsistent evidence         |
| Adoption of sun safe practices                            | Education programmes   | Moderate, inconsistent evidence     |
|   | Provision of hats and sunscreen                                      | Inconclusive, consistent evidence   |
|   | UV photographs with/without photoaging                               | Moderate, consistent evidence       |
|   | Text messages  | Weak, inconsistent evidence         |
|   | Electronic education interventions                                   | Weak, consistent evidence           |
|   | Tailored interventions   | Moderate, inconsistent evidence     |
|   | Multi-component interventions  | Moderate, inconsistent evidence     |

### 11.1.1 Effective methods of presenting and disseminating complex health risk information

The following sections (11.1.1.1 to 11.1.1.4) are in response to research questions 1a and 1b:

Research question 1a: What are the most effective methods of presenting complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?



Research question 1b: What are the most effective methods of disseminating complex health risk information to help people assess their own level of health benefits and risks from sun exposure (or that of others for whom they have a duty of care)?

#### **11.1.1.1 Changes in people's knowledge or understanding of how to competently assess level of risk and benefit from sun exposure**

Among the studies assessed for this review, there were a few trials relevant to the UK that provided information on interventions to change individual's knowledge. Educational programmes involving practical classroom-based activities were shown to increase knowledge in French children aged 9 to 12 years <sup>4</sup> and a Belgian trial showed that narrative format web-based messages may be more conducive to knowledge change <sup>8</sup>. Other evidence came from two good quality US trials that tailored interventions and showed that these were effective in changing people's knowledge or understanding of how to competently assess their level of risk or benefit from sun exposure.

For multi-component interventions this review benefits from the inclusion of evidence from a systematic review, as well as two more recent good quality RCTs (conducted in France and the USA). Multi-component interventions were shown to be effective, however the specific features of the interventions which were the most effective are difficult to determine since the studies report different combinations of communication in widely varying population groups at varying extent of risk from sun exposure. The multi-component interventions reviewed are from many different countries, so there is also a question about whether, even if specific elements and combinations of elements were identified as effective, they would be applicable to the UK.

#### **11.1.1.2 Changes in individuals' perception of or attitudes to the risks and benefits of sun exposure**

UV photos and photoaging were frequently used interventions intended to alter individuals' perceptions of the risks of sun exposure. UV photographs alone may not be as effective as UV photos (with or without photoaging) plus additional interventions (mostly information provision). These combined interventions appeared to enhance participants' perceived susceptibility or vulnerability to skin cancer, although there is inconclusive evidence about which of the additional interventions were most effective. These interventions also seemed to increase individuals' intentions to adopt sun protection behaviours. UV photos with or without photoaging are likely to be applicable to the UK, but which of the additional interventions (which were investigated in several different countries) would be applicable to the UK, may be more challenging to identify.

The ways that risk and benefit information is conveyed to individuals was investigated and studies reported no significant difference between gain- or loss-framed messages for promoting sun protection through attitude change or changing intentions to practice sun protection. Trials reported no significant differences between gain- or loss-framed messages for sun protection or skin cancer messages.

University students were the subject of a systematic review of 18 studies of multi-component motivational interventions. These were interventions conducted worldwide, therefore their applicability to the UK is unclear. However, the review provides inconclusive evidence about the effect of multi-component interventions on students' perceived susceptibility or vulnerability to skin cancer.

#### **11.1.1.3 Changes in individuals' knowledge and/or awareness of diseases related to sun exposure (either under or over exposure) including non-melanoma and malignant melanoma skin cancer and sunburn**

Few published studies were identified since 2008 addressing this outcome and the evidence from them was inconclusive about the effectiveness of motivational interventions to improve individuals' knowledge and/or awareness of diseases related to sun exposure. One moderate quality trial conducted in the USA found that a partially tailored mailed intervention may increase children's awareness of skin cancer risk compared to an annual invitation to attend a data collection session<sup>38</sup>. The value of this trial was its length (three years), but the participants were probably unusual in comparison to the UK population in that they were regularly receiving skin examinations. Thus, they seem likely to be relatively affluent with parents in employment and able to afford health insurance.

#### **11.1.1.4 Changes in individual's knowledge and/or awareness of practices that protect against sun exposure**

Few studies and only one systematic review published since 2008 addressed this question. Weak evidence was identified, reporting that new media, lesson-based delivery, health fair, and other mixed methods may increase school children's knowledge about sun protection. Several studies reported improvements in sun protection behaviours, however, inadequate reporting of interventions made it impossible to determine the effects of individual delivery strategies or components within them, and hence their applicability to the UK is difficult to assess.

There was weak evidence from one moderate quality US trial reporting that an online video improved people's knowledge of sun protection practices significantly more than print-based material. The content of the video would need to be assessed for applicability to the UK.

#### **11.1.2 Effective ways to change people's beliefs about the risk of sun exposure**

This section is in response to research question 2a: What are the most effective ways to change people's beliefs about the risk of sun exposure and to encourage them to change their sun protection practices accordingly?

### **11.1.2.1 Effective interventions for achieving changes in sun protection practices and the effects of sun exposure**

Fifty-one studies informed this outcome, but again few were conducted in the UK.

Sun protection practices were found to increase following certain interventions, including the Living in the Sun and SunSmart programmes. The former was conducted in the USA and was based on receiving information while at the physicians' office. The latter was a 10 workshop intervention delivered in primary schools in France. Other studies investigating sun policy interventions, all conducted in the US, were not effective in increasing sun protection behaviour.

Evidence of the effectiveness of providing hats to school children would seem highly applicable to the UK.

UV photos and photoaging alone seem to result in increased sun protection practices and, as noted previously, are likely to be applicable to the UK. Evidence that text reminders to use sunscreen and other electronic interventions also increase sun protection behaviours compared to paper-based or teacher-led educational interventions suggests that these interventions may be applicable to the UK setting.

Tailored risk feedback (counselling) can produce a small but significant difference in self-reported sun protection behaviours (measured by a composite behaviour score). These interventions vary, but the majority described seem applicable to the UK, although the content may require adaptation.

### **11.1.3 Cost-effective ways to change people's beliefs about the risk of sun exposure**

This section is in response to research question 2b: What are the most cost-effective ways to change people's beliefs about the risk of sun exposure and to encourage them to change their sun protection practices accordingly?

#### **11.1.4 Cost-effectiveness studies**

Two studies (both with potentially serious limitations) took effectiveness data from overseas studies and applied them to UK models of sun exposure and skin cancer risk. Results showed that when assuming the effectiveness in the overseas studies on behaviour change was also seen in the UK, then community, school and work-based interventions that provided information with or without additional sun care resources or change of the environment were highly cost-ineffective.

The exception was provision of an information booklet for parents, which was estimated to have an incremental cost-effectiveness ratio of £6,200/QALY. However, the model was weakened by its linking of behavioural change to reduction in cancer risk.

The evidence on cost-effective interventions is limited by the absence of cost-effectiveness studies based upon effectiveness data generated in the UK.

## 11.2 IMPLICATIONS OF FINDINGS

There was very little evidence on the issue of conveying messages about both the benefits and risks of sun exposure. The vast majority of research reviewed here focused on investigations around the reduction of harmful sun exposure. There is research into the understanding of the UV index and times of day when sun exposure is best avoided, but this does not seem to be coupled with information about the benefits of achieving some sun exposure. Research into knowledge gain or change focused on reducing sun exposure and on increasing the use of sun protection activities. This means there is very little evidence on how to convey the more complex messages about the benefits as well as the risks of sun exposure. The one study which did report an intervention among elderly people in a residential home to increase their sun exposure in order to increase vitamin D levels and reduce fractures, found no significant difference among residents who received more exposure than those who continued normal activities, in terms of serum 25-hydroxy vitamin D, serum parathyroid hormone, fracture incidence or new skin cancer events.

Many of the interventions in the included studies were multi-component and the relative value of the components is difficult to determine. The multi-component interventions are also difficult to compare to each other, since they differ in their individual components. The multi-component interventions have been the subject of systematic reviews and results have been inconclusive in terms of effectiveness.

There seems to be a body of evidence supporting the impact of UV photos and photoaging in combination with other activities such as information giving on perceived susceptibility or vulnerability to skin cancer, and intentions to adopt sun protection behaviour. UV photos and/or photoaging with or without additional interventions can increase the intentions of people with multiple risk factors to use sun protection. There is also evidence that the intervention (with or without additional interventions) increases sun protection practice as well.

In terms of changing perceptions of risk and intentions to adopt sun protection behaviour, from the studies reviewed in this review there seems to be no value in framing risk messages as either gain- or loss-framed messages in terms of altering the perceptions of sun exposure risk. However, health messages manipulated to invoke a sense of fear or increase worry did seem to be effective in promoting intentions to adopt sun protection practices.

Multi-component interventions do not seem to affect university students' perceived susceptibility or vulnerability to skin cancer and there is inconsistent evidence that they change individuals' intentions to use sunscreen. Evidence from a US study showed that interventions tailored to adult beach goers' risk of skin cancer do not seem to increase skin perception cancer risk. Other studies of tailored information provision provided inconsistent evidence of improvement in individuals' intentions to adopt sun protection behaviours or improvement in self-reported sun protection behaviour.

There is inconclusive evidence about the effectiveness of interventions to change perceptions of cancer risk in school-aged children, people at risk of occupational skin cancer, people seeking to gain a tan and people with multiple risks. There is inconsistent evidence of the effectiveness of active participation education sessions (evidence from Australia and the USA) and information giving in changing individuals' attitudes towards sun exposure and protection.

Improving knowledge of skin cancer risk seems best achieved, from the evidence reviewed here, by the use of partially tailored, mailed interventions involving parents and children: these may increase children's awareness of skin cancer risk. Using the UV index as a health promotion instrument has no significant impact on participants' knowledge about skin cancer. There is inconclusive evidence on the effects of multi-component interventions on increasing knowledge of skin cancer.

New media, lesson-based delivery, health fairs, and other mixed methods may increase school children's knowledge about sun protection, and one study suggests that an online video may improve people's knowledge of sun protection practices significantly more than print-based material. New media (rather than paper-based or teacher-led interventions) may increase sunscreen use (text messages), sun protection behaviour and reduce sun exposure.

It is difficult to conclude from the studies reviewed which of the sun protection policies are effective in achieving sun protection behaviours and reductions in sunburn and naevi, but providing hats to school children can increase their use as sun protection, at least in the short term.

Weak consistent systematic review evidence suggests that primary-care relevant counselling with tailored feedback can have modest impact on self-reported UV exposure protection behaviours including reducing indoor tanning over periods of three to six months.

When considering effects in specific subgroups, there generally appeared to be greater benefits (in terms of sun protection behaviour) found for the widely differing interventions designed to provide sun safety information to consumers in specific subgroups of participants with a potentially elevated risk of skin cancer, compared to the general population. Future studies could be designed to explore this possibility further. Potential interventions should be compared with each other in specifically targeted groups of participants, particularly those at risk, to enable conclusions to be reached on the relative effectiveness of different approaches.

### **11.2.1 Cost-effectiveness Evidence**

There were few studies retrieved since 2008 and the UK models reviewed showed some of the challenges of adapting the evidence from non-UK studies to the UK setting, the vast majority of interventions were not cost-effective and the only cost-effective intervention (providing an information booklet to parents) was subject to caveats by the authors.

### **11.3 LIMITATIONS OF THE EVIDENCE**

Many subgroups of the general population were of interest to this review, but there were relatively few studies identified which investigated sun exposure issues in specific subgroups and relatively few studies which explored subgroups within a larger population. There was some research into specific interventions aimed at increasing the sun protection behaviour of outdoor workers, sports people, beach goers, children and individuals at higher risk of melanoma, but other groups, such as people who are non-English speaking or whose first language is not English, people from different religious or cultural backgrounds, people with dark skin, or people who have low or no exposure to the sun, were not investigated at all in the studies identified in the search period for this review. This means that within this review there is little evidence for many of the subgroups, and for those subgroups which were investigated there may not be evidence across all of the questions investigated.

The quality of the studies reviewed was very variable. A high percentage of the systematic reviews and RCTs reviewed were of poor quality. Systematic reviews suffered from poor reporting of their methods which leads to concerns about the rigour with which they were conducted. RCTs suffered from issues that affected their validity, including concerns about randomization, allocation concealment, blinding and the use of intention-to-treat analysis, as well as the comparability of the treatment groups in terms of baseline characteristics and the number of dropouts from studies. This review has only explored studies published since 2008, but considering the very large number of studies included in this review it is likely that earlier studies would display at least the same level of weakness.

Many of the studies report little information on the nature and content of their interventions, although some do provide further detail in linked publications. This absence of detail hampers the comparison of interventions and the identification of the content of effective interventions.

The paucity of UK studies published since 2008 impacts on the applicability and relevance of the findings from this review. In particular, the absence of UK studies impacts on the ability to develop relevant economic models.

### **11.4 LIMITATIONS OF THE REVIEW AND POTENTIAL IMPACT ON FINDINGS**

This review searched for studies published since 1994, but resources only permitted the analysis of studies published in 2008 or later. Systematic reviews were included which reviewed studies published earlier than 2008 but systematic reviews were not available for all of the questions. This means that all of the available evidence was not included in the review, with unknown consequences in terms of the impact on the direction and strength of the evidence statements. There may also be studies in subgroups published earlier than the date cut-off for this review, which might have informed evidence statements for subgroups.

The searches were limited to studies in English, which may have led to the omission of some studies in languages other than English relevant to the climate of Northern Europe. This factor has unknown consequences in terms of the impact on the direction and strength of the evidence statements.

Eligible studies were those conducted in OECD countries. Again, this includes countries which may be very different to the UK in terms of climate and culture, and also excludes some Northern European countries whose climate and culture may be similar to the UK. This factor has unknown consequences in terms of the impact on the direction and strength of the evidence statements,

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