Sun protection resources and environmental changes to prevent skin cancer: a systematic review

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Executive Summary

The National Institute for Health and Clinical Excellence (NICE) has been requested by the Department of Health to develop guidance on the provision of information, physical changes to the natural and built environment, and provision of sun protection resources for the prevention of primary skin cancer. The aim of such interventions is the reduction of exposure to ultraviolet (UV) radiation, which is considered a leading cause of skin cancer. In the first phase of work a series of evidence reviews and reports were produced to underpin the guidance on provision of information. This report constitutes one component in the second phase of work, and includes a systematic review of the evidence on physical changes to the natural and built environment and provision of sun protection resources to prevent primary skin cancer attributable to UV exposure. It also encompasses multi-component interventions where the environmental interventions or provision of resources are combined or are accompanied by the provision of information.

The aim of the review was to evaluate the effectiveness and cost effectiveness of three types of intervention (changes to the built or natural environment, provision of sun protection resources, and multi-component interventions) in helping to prevent the first occurrence of skin cancer attributable to UV exposure. The overarching questions relating to sun protection resources, environmental changes and multi-component interventions addressed in the review, were:

1) What physical changes to the natural or built environment are effective and cost-effective at helping to prevent the first occurrence of skin cancer attributable to UV exposure?

2) Which methods of supplying sun protection resources to prevent first occurrence of skin cancer attributable to ultraviolet (UV) exposure are effective and cost-effective?

3) Which multi-component interventions (combination of one or more of supply of sun protection resources, physical changes to the environment, information provision) are effective and cost-effective at helping to prevent the first occurrence of skin cancer attributable to UV exposure?

Studies addressing the primary review question were also used to answer the secondary review questions (where relevant data were available). Secondary review questions included:

1) What factors impact on the effectiveness and cost-effectiveness of sun protection resources, changes to the natural or built environment and multi-component interventions?

2) What factors help or hinder the provision or use of sun protection resources, physical changes to the natural or built environment and multi-component interventions?

Methods

Twenty-four electronic databases were searched from 1990 onwards without restrictions by language, study design or publication status. A total of 65 websites were scanned for references to research and/or publications including Cancer Research UK, Cancerbackup, Skin Cancer Foundation (US), Health Protection Agency, Health and Safety Executive, Cancer Council Australia, SunSmart (Victoria), Skin Cancer Hub. The reference lists of relevant systematic reviews and included studies were also scanned as well as stakeholder submissions and other references sent from the commissioner.

Studies meeting the following criteria were eligible for inclusion:

- Population: Studies conducted in a primary prevention population in developed countries were included.
- Intervention: Studies assessing (a) physical or structural changes to the built or natural environment such as provision of shade in public spaces and changing time of day that outdoor activities occur); (b) supply of sun protection resources such as sunscreen or protective clothing; (c) multi-component intervention combining the above or either or both of the above with the provision of information were included. The intervention could be delivered in any setting and delivered and/or implemented by any individual or group. Evaluations of policy, legislative or fiscal changes were excluded.
- Comparator: There were no restrictions on the type of comparator.
- Outcomes: Studies reporting any of the following outcomes were eligible for inclusion: (a) reduction in the incidence of mortality from skin cancer, (b) reduction in the incidence of morbidity from skin cancer, including sunburn, (c) change in behaviour or attitudes, (d) increase in knowledge and awareness of skin cancer, causes of skin cancer (including risks), prevention of skin cancer, (e) costs or cost-effectiveness, (f) process and implementation outcomes, (g) adverse or unintended effects of the intervention.
- Study design: All primary study designs were eligible for inclusion.

Following an initial sift by a single reviewer to remove totally irrelevant records, two reviewers screened titles and abstracts based on the inclusion criteria. The full papers of potentially relevant records were ordered and these were screened independently by two reviewers against the inclusion criteria. Disagreements were resolved through consensus and through discussion or recourse to a third team member.

Data extraction and quality assessment were carried out by one reviewer and checked by a second. Any disagreements were resolved through discussion or by recourse to a third reviewer.

Due to the diversity of the included studies a narrative synthesis was undertaken. The effectiveness and cost-effectiveness data were synthesised separately. Data were grouped by intervention category (changes to the built or natural environment, provision of sun protection resources, and multi-component interventions) and within intervention category by setting and study design.

The evidence-base

The database searches identified 11,445 references after the removal of duplicates. Two hundred and seventy-nine full papers were ordered. Of the 279 full papers ordered, six did not arrive and one was a duplicate. A total of 272 full papers were available for assessment. Of these, 47 met the criteria for inclusion (46 papers reporting 30 individual studies relating to effectiveness and one paper relating to a single cost-effectiveness study).

Three studies provided evidence about changes to the natural or built environment (3 effectiveness studies); no studies assessed the provision of sun protection resources (one study was identified but only baseline data were provided, and attempts to retrieve follow-up data from the author were unsuccessful) and 28 studies assessed multi-component interventions (27 effectiveness studies and 1 cost-effectiveness study). None of the studies were undertaken in the UK.

The three studies assessing change to the natural or built environment were undertaken in educational settings; one was an RCT and the other two were observational studies. The multi-component Interventions were delivered at beaches and outdoor pools (n=8; 4 RCTs, 1 non-RCT, 2 before-after studies, 1 observational study); in community settings (n=5; 3 cluster RCTs, 1 non-RCT, 1 before-after study); in educational settings including schools, nurseries and day care (n=7; 4 RCTs, 3 non-RCTs); in healthcare settings (n=5; 2 RCTs, 1 non-RCT, 2 before-after studies); and work settings (n=2; 1 RCT, 1 non-RCT). The single cost-effectiveness study was from a community setting.

Evidence Statements

Change to natural or built environment or timing of outdoor activities

ER 4.1 There is a limited body of evidence on the effect of change to the natural or built environment in the prevention of skin cancer in educational settings and no evidence from other settings. No studies were identified that focused solely on the impact of changing the timing of

outdoor activities.

ER 4.2 There was evidence from a single good quality RCT (Dobbinson 2009 [++]) undertaken in Australia that adolescents in Years 7 to 12 used rather than avoided newly provided sail shade areas at secondary schools, during lunch time periods. An extra 2.7 students were observed to have used the shaded sites (95% CI: 0.7 to 4.7) during spring/summer term compared to unshaded sites in the control schools (p=0.011).

ER 4.3 There was evidence from two observational studies, with methodological limitations, undertaken in Sweden, of an association between availability of natural shade in preschool play areas and reduced UV exposure for children under 6.5 years old (Boldemann 2006 [-] and Boldeman 2004[-]). The Boldemann ([-] 2004) study reported an absolute reduction in UVR exposure of 2% ($p<0.05$) and the second 10% less UVR exposure ($p<0.001$) for children with access to a shaded compared to unshaded play area.

ER 4.4 None of the studies assessed longer term outcomes such as skin cancer or changes to skin that may increase the risk of skin cancer (Dobbinson 2009 [++]; Boldemann 2006 [-]; and Boldeman 2004 [-]).

ER 4.5 Regarding implementation, Dobbinson (2009 [++]) reported that, on average, only six students used the shaded areas at any one time, despite the relatively large size of the sails. The authors suggest that optimal use of shade sails may be limited by friendship groups avoiding encroaching on other student's space. Boldemann 2006 [-] and did not contain evidence pertinent to the secondary review questions. Boldeman (2004 [-]) reported that all subgroups had lower UVR exposure at the shaded site compared to the unshaded site except for 1-4 year old boys who were exposed to 23.1% compared to 16.7% of available UVR at the shaded and unshaded sites respectively. In the later study gender and environment (high and low quality) were statistically significant predictors of step count a linear mixed model (Boldemann 2006 [-]).

Applicability

The evidence is likely to be applicable to nursery schools and schools in the UK where outside play areas are exposed to full sun.

Provision of protective clothing, sunglasses or hat

ER 4.6 No evidence was identified on the effectiveness or cost-effectiveness of provision of protective clothing, sunglasses or hat as a single component intervention.

Multi-component interventions at beaches and outdoor swimming pools

ER 4.7 None of the multi-component studies carried out at beaches or outdoor swimming pools were designed specifically to assess the effect of the individual components that comprised the intervention. Therefore, where studies find an effect, it is not possible to determine the contribution of the various components (Glanz 2002 [+]; Mayer 1997 [+]; Weinstock 2002 [-]; Winett 1997 [-] study 1 and [-] study 2; Pagoto 2003 [-]; Dobbinson 1999 [-]).

ER 34.8 There was weak evidence from two American studies, an RCT (Weinstock 2002 [-]) and a non-randomised controlled trial (Pagoto 2003 [-]), that a multi-component intervention including provision of information by trained interviewers or researchers, showing adult beachgoers photographs of their own UV skin damage and provision of sunscreen was associated with statistically significant improvements in a number of self-reported sun protective behaviours. The RCT (Weinstock 2002 [-]) reported a modest but statistically significant benefit for the intervention group on a composite measure of sun protective behaviours ($p<0.001$), sunscreen use ($p=0.001$), hat use ($p=0.047$) and sun avoidance ($p=0.008$) at 24 month follow-up. The mean general stage of change ($p=0.004$) and mean sunscreen stage of change ($p=0.001$) also increased significantly more over time in the intervention group than the control group. The quantity of sunscreen provided and use of and response to the free sunscreen was not reported. The non-randomised controlled trial (Pagoto 2003 [-]) also reported a statistically significant improvement on a composite measure of sun protective behaviours ($p<0.01$) but not sun exposure for the intervention group compared to control at 2 month follow-up and more participants in the intervention group advanced by at least one stage of change (49% versus 25%, $p<0.02$).

ER 4.9 There was weak evidence from a further RCT (Winett 1997 [-], study 1) that provision of information through posters, weekly lotteries to reinforce appropriate sun protective behaviours (ie. staying in the shade; wearing hats, shirts and sunglasses), provision of hats and shirts for lifeguards and free sunscreen for pool users improved observed sun protective behaviours amongst children and lifeguards, but not adult pool users. There was a statistically significant increase in the proportion of children in the intervention group observed engaging in sun protective behaviours (ie.

staying in the shade; wearing hats, shirts and sunglasses) over the 32 day intervention period, compared to the baseline period ($p<0.05$), the proportion of lifeguards in the intervention group engaging in sun protective behaviours ($p<0.001$), but not adult pool-users ($p>0.05$). There was no statistically significant change in the control group. Between-group comparisons were not made. Approximately 10 applications per day were used from the two large self-serve sunscreen containers provided at each pool (pools served at least 50-75 users on warm summer days) (Winett 1997 [-], study 1). There were two poor quality before and after studies assessing a similar intervention but due to several limitations it is difficult to attribute any variations in observed sun protection behaviours to the intervention (Winett 1997 [-], study 2; Lombard 1991 [-]).

ER 4.10 There was contradictory evidence from two American RCTs (Glanz 2002 [+]; Mayer 1997 [+]) about the effect of an intervention including provision of information by pool staff to children under 12 years old during a series of swimming lessons, information provided through other activities, incentives and free sunscreen and hats. One RCT (Glanz 2002 [+]) reported a statistically significant benefit ($p<0.05$) at 8 week follow-up in the intervention group for some self-report sun protective behaviours in children though the effect sizes were modest (sunscreen use, $d=0.17$; shade, $d=0.23$; composite score of sun protection habits and sunburn, $d=0.22$) and there was no statistically significant benefit for wearing a shirt, sunglasses or hat. The results were similar for adults: there was a statistically significant benefit in the intervention group compared to the control group for the composite score ($p<0.05$, $d=0.19$), use of sunscreen ($p<0.01$, $d=0.17$), wearing a hat ($p<0.01$, $d=0.17$), but not wearing a shirt, sunglasses, staying in the shade or knowledge. By contrast, results for lifeguards showed no statistically significant differences between groups in the use of sunscreen, use of shirt, use of a hat, staying in the shade, use of sunglasses, or for the composite score, though lifeguards in the intervention group at moderate or high risk of sunburn had significantly fewer sunburns by the end of the summer than the control group (1.42 versus 2.07. $p<0.05$). The second RCT (Mayer 1997 [+]) reported no statistically significant improvement, at approximately one month follow-up, in sun exposure as measured by the darkness of suntan or in self-reported sun protective behaviours (composite score of sun protective behaviours $p=0.15$; sunscreen use $p=0.44$), except for hat wearing which showed a statistically significant ($p=0.029$) but very small benefit for the intervention group at follow-up, a difference of 0.32 points between intervention and control on a 5 point scale.

ER 4.11 There was weak evidence from a single observational study (Dobbinson 1999 [-]) that a 10 year sponsorship programme for lifeguards in Victoria, Australia, that included provision of free sunscreen for lifeguards to sell at a profit to beachgoers in the first year, and provision of long-

sleeved tops and hats for lifeguards to wear themselves, improved several observed sun protective behaviours in the intervention group when compared to lifeguards from New South Wales (wearing hats in the sun, $p<0.001$; long-sleeved shorts in the sun, $p<0.05$; sunscreen use in the sun, $p<0.001$; shelter use in the sun, $p<0.05$; hats when no sun, $p<0.001$; sunscreen use when no sun, $p<0.001$); shelter use when no sun $p<0.01$; and experiencing sunburn whilst on patrol that summer ($p<0.001$).

ER 4.12 In relation to the secondary review questions, Glanz 2002 [+]reported a small but statistically significant trend indicating a dose response relationship between exposure to information sessions received by children and sun protection habits: scores on the composite behaviour measure indicated slightly higher scores amongst participants who had received the most sessions.

ER 4.13 Weinstock (2002 [-]) stated that, based on an analysis of covariance, the multi-component intervention including provision of information and free sunscreen to beachgoers was most effective for younger individuals, people who had low sun sensitivity and individuals with incomes less than $25,000. However the results of this analysis were not presented and should therefore be treated with caution.

Applicability

This evidence is only partially applicable to the UK setting. The studies were undertaken in countries with a warmer summer climate than UK where attendance at outdoor pools and beaches is likely to be a more regular activity. The benefit of any such interventions may be less in a UK setting.

Multi-component interventions in community settings

ER 4.14 None of the multi-component studies carried out in community settings (Dietrich 2000 [+]; Glanz 2000 [-]; Olson 2007 [-]; Mayer 2001 [-]; Glanz 1998 [-]) were designed specifically to assess the effect of the individual components that comprised the intervention. Therefore, where studies find an effect, it is not possible to determine the contribution of the various components.

ER 4.15 There was weak evidence from a single RCT (Glanz 2000 [-]) that adding sun protection resources plus other environmental components to an information intervention, delivered by recreation staff over a 6 week period, had limited benefit for self-reported sun protective behaviours. The RCT, conducted at outdoor recreation sites for 6 to 8 year olds in Hawaii, reported significantly better self-reported sun protection behaviours (composite measure) post-intervention and maintained at three month follow-up, for children (difference in change 0.19, SE 0.06; $p<0.01$),

but not recreation staff, following information provision, incentives including sun protection resources, plus an environmental component (large dispensers of free sunscreen, portable shade tents, signage and policy consultations) compared to no intervention. The environmental plus information intervention did not appear to have any benefit over information alone (Glanz 2000 [-]). An additional before and after study conducted at Hawaii recreation sites reported a significant improvement in children ($p<0.01$) and parent ($p<0.05$), but not staff self-reported sun protection practices (i.e. wearing a shirt with sleeves, wearing sunglasses, seeking shade, using sunscreen, wearing a hat) following a similar intervention of information provision and incentives plus provision of free sunscreen in dispensers (Glanz 1998 [-]).

ER 4.16 There was weak evidence from a non-randomised controlled trial that there was significantly increased ideal hat use in children who appeared to be 12 years or younger during the winter (OR 1.84, 95% CI: 1.13 to 2.98) but not summer, following provision of sun safety information and behaviour prompts at a zoo, plus discount coupons for the purchase of hats and sunscreen in the gift shop (Mayer 2001 [-]). Hat use was recorded by trained observers for children as they exited the intervention and comparator sites.

ER 4.17 There was mixed evidence within two RCTs (Olson 2007 [-]; Dietrich 2000 [+]) delivered in multiple American community settings including schools, primary care and recreational areas where the only resource provision element was sunscreen samples. The resource provision element (sunscreen samples) was so minimal that these studies provide little, if any evidence, about the provision of sun protection resources and are more informative about information provision. There was weak evidence from one of these studies (Olson 2007 [-]), targeted at adolescents, of a significant reduction in the proportion of observed body areas covered while at the beach and self-reported use of sunscreen two years after the introduction of the intervention, although the reduction was significantly smaller ($p<0.01$) in the intervention compared to control group. There were no significant differences between the two groups in observed use of sun protective clothing. There was moderate evidence from the second RCT (Dietrich 2000 [+]) providing a similar intervention to 11 year olds of statistically significant improvements in self-reported sunscreen use on the back ($p=0.04$) but not other body areas, and no observed differences in use of shade or protective clothing one year after a three month intervention.

ER 4.18 In relation to the secondary review questions, Glanz 2000 [-] stated that 86% of staff in the education/environment and education only arms reported giving sun safety messages to children; 89% encouraged children to be sun smart at home; and 77% went over the ABCs of sun protection. There were no statistically significant differences between the education/environment and

education only groups in levels of implementation. Mayer 2001 [-] reported that in both winter and summer children aged 0-3 years wore ideal hats significantly more than children aged 4-9 years (OR 0.35, 95% CI 0.27 to 0.45; p<0.001 in winter and OR 0.22, 95% CI 0.19 to 0.26; p<0.001 in summer) and children aged 10-12 years (OR 0.44, 95% CI 0.30 to 0.65; p<0.001 in winter and OR 0.24, 95% CI 0.19 to 0.30; p<0.001 in summer). In both winter and summer, girls wore ideal hats significantly more than boys (OR 1.32, 95% CI 1.04 to 1.66; p=0.002 and OR 1.39, 95% CI 1.21 to 1.60; p<0.001 respectively). Olson 2007 [-] stated that the intervention was more effective than control in improving sun protection in girls compared to boys (coefficient 5.88, 95% CI: 0.84 to 10.92, p=0.022) and when the UV index was high (coefficient 7.04, 95% CI: 1.72 to 12.35, p=0.010).

Applicability

This evidence is only partially applicable to the UK setting. The studies were undertaken in countries with a warmer summer climate than the UK, and for some studies sunny winters. The benefit of implementation of any such interventions may be less in a UK setting.

Cost-effectiveness studies - community setting

ER 4.19 One economic evaluation evaluated a multi-component intervention in a community setting which included the supply of water-resistant, broad spectrum sunscreen with a sun protection factor of 15+; advice on application to the head, neck, arms and hands; and quarterly encouragement by nurses to use the sunscreen. A number of limitations to the study methods were identified, which could have under- or overestimated the cost-effectiveness of the intervention. The incremental cost per skin cancer prevented indicated that the provision of free sunscreen (factor 15+), advice and regular encouragement to apply the sunscreen in a community setting in Australia was more effective and more costly than usual discretionary use of sunscreen. The lack of a quality-adjusted life-year (QALY) measure of benefit means that the cost-effectiveness ratio is not directly comparable to the NICE guidance on cost-effectiveness thresholds (Gordon 2009). There were potentially serious limitations to this study, which may change the cost-effectiveness conclusions.

Applicability

As the climate is significantly different in Australia compared to the UK and the awareness of skin cancer is likely to be higher, it is not clear that the population studied would respond to the intervention in the same way as a UK population.

multi-component interventions in educational settings

ER 4.20 There was moderate evidence from a single RCT (Bauer 2005 [+]) in nursery schools in Germany, that adding provision of sun protection resources to an information intervention (possibly delivered by the research team) did not result in improved sun protective behaviours. This RCT found no statistically significant reduction in number of observed new nevi (p=0.779), newly experienced self-reported sun burns and several self-reported sun protective behaviours ("almost always" using sunscreen, wear protective clothing or hats, or amount of time spent in the sun) obtained by adding 800 ml of free sunscreen per year to a 3 hour education session for parents of nursery school children (aged 2 to 7 years) plus educational material mailed three times per year for three years.

ER 4.21 None of the other studies (Barankin 2001 [-]; Gritz 2007 [-]; Milne 2006 [+]; Buller 1997 [-]; Crane 1999 [-]; Reding 1996 [-]) carried out in an educational setting were designed to assess the specific contribution of resource provision to outcome. Therefore, where studies find an effect, it is not possible to determine the contribution of the various components.

ER 4.22 There was contradictory evidence from two studies (Barankin 2001 [-]; Gritz 2007 [-]) relating to information provision combined with provision of free sunscreen. There was weak evidence from a Canadian non-randomised controlled study (Barankin 2001 [-] that provision of free sunscreen and information to parents of 9 to 10 year old children, in addition to provision of information by school staff in a classroom setting was not associated with a statistically significant reduction in the number of sunburns or increase in the use of sun protective clothing 4 months later (Barankin 2001 [-]). The quantity of free sunscreen provided and recipients' response to, and use of, the sunscreen was not reported. The study did find a reduction from baseline to follow-up in the number of children wanting a tan (enhanced group, 33% to 4%, p=0.05; standard group, 31% to 16%, p value not reported), but not in the control group (23% to 21%, p value not reported). In contrast, there was weak evidence from an American RCT (Gritz 2007 [-]) that provision of information for teachers and parents, free sunscreen for teachers to use on children at school and a sun protection curriculum for preschool children significantly improved staff and parent reported sun protective behaviour towards the children. The adjusted mean difference on the sunscreen use scale for staff at 24 months was 7.41 (SE 1.15), (p=0.000, n=174); and 3.85 (SE 0.85), (p=0.000, n=192) on the sun avoidance scale at 24 months. For parents the adjusted mean difference on the sunscreen use scale at 24 months was 0.96 (SE 0.44), (p=0.03, n=643), but there was no statistically significant difference for the sun avoidance scale at 24 months. The extent of parental consent for use of the free

sunscreen in school was not reported (Gritz 2007 [-]).

ER 4.23 There was moderate evidence from an Australian non-randomised controlled trial (Milne 2006 [+]) that an intensive information intervention for 5 to 6 year olds, provided by teachers in a classroom setting, and an offer of low cost swimwear for 5 to 6 year olds had minimal benefits compared to a standard health education curriculum for development of nevi. At 6 year follow-up there was no statistically significant difference between the two groups for the primary outcome number of back nevi, as assessed by trained observers, (ratio of change 0.89, 95% CI: 0.81 to 0.99; p=0.09) or number of nevi on the face or arms (p=0.2). There was a statistically significant reduction in the mean number of nevi on the chest (assessed in boys only) at 6 year follow-up (ratio of change 0.82 (95% CI 0.74 to 0.91; p=0.0004). Uptake of the offer of low-cost sun protective swimwear was not reported. There was greater parental reported use of swimwear for children that covered the back and arms in the intervention group compared to control at two year follow-up (OR 3.41, 95% CI: 2.14 to 5.45, p<0.001), 4 year follow-up (OR 1.53, 95% CI: 1.11 to 2.12, p=0.03) and 6 year follow-up (OR 0.75, 95% CI: 0.53 to 1.05, p=0.06), though the differences were progressively smaller and at 6 years were not statistically significant.

ER 4.24 In two RCTs (Buller 1997 [-]; Crane 1999 [-]) and one non randomised controlled study (Reding 1996 [-]) the resource provision was sunscreen samples only. And as this is such a minimal element of the intervention, it is unlikely to contribute in any meaningful way to the overall findings.

None of these studies contained evidence pertinent to the secondary review question.

Applicability

This evidence is only partially applicable to the UK setting. The studies were mainly undertaken in countries with a warmer summer climate than the UK. The benefit of any such interventions may be less in a UK setting, though the two studies from Canada and Germany may have greater applicability than the rest.

Multi-component interventions in healthcare settings

ER 4.25 None of the multi-component studies carried out in healthcare settings (Norman 2007 [-]; Crane 2006 [-]; Bolognia 1991 [-]; Franklin 2003 [-]; Geller 1999 [-]) were designed specifically to assess the effect of the individual components that comprised the intervention. Therefore, where studies find an effect, it is not possible to determine the contribution of the various components.

ER 4.26 There was weak evidence from a single US RCT (Norman 2007 [-]) of a statistically significant benefit in self-reported sun protection behaviours (composite score) amongst adolescents (aged 11 to 15 years) following an intensive information intervention tailored to individual stage of change, delivered in primary care and via telephone by a counsellor, plus provision of four 90ml bottles of SPF 15 sunscreen over 18 months. Mixed model repeated measures parameter estimate 2.36 (95% CI 0.79 to 3.94, p=0.003).

ER 4.27 There was contradictory evidence from four US studies (Crane 2006 [-]; Bolognia 1991 [-]; Franklin 2003 [-]; Geller 1999 [-]) regarding the effectiveness of multi-component interventions for parents of young babies (birth to 4 years of age), delivered in healthcare settings, in changing their self-reported sun protective behaviours towards their babies and their own sun protection practices. The resource component of the interventions generally included multiple items such as sunscreen samples, sun hats and sunglasses. There was weak evidence from one RCT (Crane 2006 [-]) of a decline in sun protective behaviours (composite score) following a multi-component intervention, though decline was less in the intervention group than control (12 months mean score: intervention 18.55, control 18.40, not significant; 24 months mean score: intervention 18.52, control 18.05, p=0.04; 36 months mean score: intervention 18.18, control 17.71, p=0.049). There was weak evidence from a non-randomised controlled trial (Bolognia 1991 [-]) of significantly more mothers and babies spending no time in direct or midday sun and less time outdoors in the intervention group compared to control (p<0.001) and from a before and after study (Franklin 2003 [-]) of increased avoidance of the midday sun amongst parents (p=0.03) and children (p=0.043) parents overall sun protective behaviours (p=0.038); both studies used self-report measures. However, Bolognia [-] reported no statistically significant benefit for other sun protective behaviours (use of hats, pram hoods, umbrellas, loose-fitting clothing) and Franklin [-] reported no statistically significant improvement in the overall sun protection measures (composite measure) for children or in individual sun protective behaviours apart from avoiding the midday sun (related to wearing of sunscreen, sun protective clothing and sunglasses and seeking shade). Franklin (2003 [-]) also found that parental knowledge of areas of the skin that should be protected from the sun deteriorated from baseline to follow-up. There was very weak evidence from a before and after study of high sun protective behaviours after one-to-one sun protection advice plus information and a gift pack that included hats (89% of mothers reported that their baby always or almost always wore a hat in direct sunlight; 90% (n=122) stated that their child spent less than three hours in direct sunlight per week; and 13% (n=18) reported that their child had been sunburned once in the previous year (Geller 1999 [-]).

ER 4.28 In relation to the secondary review questions, Crane 2006 [-]reported that exit interviews with 10 to 20% of parents and yearly surveys with parents showed that more participants in the intervention group were provided with sun protection advice by their healthcare provider than in the control group. Receipt of advice about sunscreen use was much more common than advice about avoiding midday sun, using shade and using sun protective clothing and hats but the study did not explore reasons for this. Only 38% of children had a skin examination and those who participated had parents who were older, more highly educated, had higher incomes and were more likely to be non-Hispanic whites than those who did not participate. There was no statistically significant difference between the intervention and control group for skin colour or number of nevi (Crane 2006).

ER 4.29 Geller 1999 [-] reported that 88% of mothers said that receiving educational material within 24 hours of having their baby was a "good time" to receive this type of information. 64% of mothers stated that they information they were given at the maternity unit was their only source of sun protection information from a provider over the year.

Applicability

The evidence regarding adolescents has limited applicability in the UK as the study was undertaken in California, which has a much warmer summer climate, and a much longer warm, sunny season. The benefit of such an intervention is likely to be less in a UK setting. The evidence from studies of parents of young babies has similar limitations due to climate differences.

Multi-component interventions in work settings

ER 4.30 Neither of the multi-component studies carried out in work settings (Mayer 2007 [+]; Azizi 2000 [-]) were designed specifically to assess the effect of the individual components that comprised the intervention. Therefore, where studies find an effect, it is not possible to determine the contribution of the various components.

ER 4.31 There was moderate evidence from one cluster RCT (Mayer 2007 [+]) conducted in the USA, that provision of information plus sun protective resources, delivered by health educators, improves sun protective behaviours in outdoor workers. There was higher self-reported sunscreen use, which was sustained, though somewhat reduced, at two year follow-up (OR 2.03, 95% CI: 1.60 to 2.58) and greater self-reported hat use amongst American postmen over a two year period (OR 2.88 95% CI: 2.31 to 3.61), following brief educational messages, visual reminders and provision of protective hats

and sunscreen. These findings were corroborated by research assistants' direct observations, and partially supported by an objective measure of suntan (dimensions of skin colour were assessed by trained data collectors using colorimeters). A three year follow-up found that increased hat use was sustained but not sunscreen use, but delivery of the intervention to the comparison group had already started when the follow-up was carried out.

ER 4.32 There was weak evidence from a non randomised controlled trial (Azizi 2000 [-]) conducted over a 20 month period in a non-OECD country (Israel) of a statistically significant reduction in sun-exposed skin amongst outdoor workers. Workers received complete, partial, or minimal intervention in two waves, one year apart, including safety officer training, provision of information or personal sun-protective gear (wide brimmed hats, standard sunglasses, and topical sunscreen), or skin examinations. The amount of sunscreen used was recorded using an inventory. At the end of the intervention the complete intervention group reported 25% less sun-exposed skin area compared to a partial intervention group ($p<0.05$), and inventories reported a 30% use of total volume of sunscreens in the complete group, with significantly lower use of sunscreen in the minimal group compared to other groups ($p<0.01$).

ER 4.33 In relation to the secondary review questions, Mayer 2007 [+] reported exploratory analyses to evaluate whether number of educational sessions attended impacted on the outcomes. With each additional education session attended, there was a 21% increase in the odds of reporting "always" wearing a wide-brimmed hat (OR 1.21, 95% CI 1.06 to 1.38, $p=0.005$) and a similar increase in sunscreen use (OR 1.18, 95% CI 1.03 to 1.34, $p=0.017$). Azizi 2000 [-] found that a lower mean daily occupational solar ultraviolet radiation exposure dose at post-test was associated with more extensive intervention, higher level of education, and lower seniority in outdoor occupation.

Applicability

This evidence is only partially applicable to the UK setting as the studies were undertaken in countries with a warmer summer climate. The benefit of any such interventions may be less in a UK setting, though the evidence may be applicable to people who spend long periods outdoors as part of their occupation.

Conclusions

Overall the evidence on the effects of provision of sun protection resources or changes to the natural or built environment, either alone or in conjunction with information provision is very

limited, making it difficult to provide clear implications for practice. Few studies were designed to properly address the review question and none were undertaken in a UK setting.

Only three studies were identified that assessed the effectiveness of a single component intervention, all of which assessed provision of shade. The remaining twenty-seven effectiveness studies evaluated multi-component interventions that combined information provision with provision of sun-protection resources or shade. Only one of these studies was designed to properly assess the effect of adding sun-protection resources to an information intervention. The majority of the studies were not specifically designed to assess the effect of the individual components that comprised the intervention. Therefore, where studies found an effect, it was not possible to determine the contribution of the various components. Additionally, in several studies the resource provision was a very minor component, for example in the form of sunscreen samples, often given as an incentive. Most of the studies relied upon self-reported behaviours as an outcome measure and very few assessed participants use of, or response to the resources provided. For example, only three studies providing free sunscreen measured the quantity used.

Only one cost-effectiveness study was identified, which included a multi-component intervention in a community setting. There were potentially serious limitations to the study, which may change the cost-effectiveness thresholds. In addition, the effectiveness data were derived from a trial investigating the effectiveness of sunscreen per se rather than addressing the question of interest to this review (methods of providing people with sun protection resources).

There is a clear need for good quality research, undertaken in a UK setting assessing the effectiveness and cost-effectiveness of these types of interventions in a range of settings and population groups. Where multi-component interventions are being evaluated the trials need to be designed so that the contribution of the individual components can be assessed, including the measurement of appropriate intermediate outcomes, such as amount of sunscreen used. Current reporting standards should be followed; the CONSORT statement for randomised studies and the TREND statement for non-randomised studies.

Ideally, long-term outcomes relating to the number of primary skin cancers should be assessed. Where this is not feasible, a consensus is required as to the best quality proxy outcomes and how they should be measured. Reliance on self-reported sun protective behaviours alone should be avoided and, where possible be replaced by or supplemented with robust behavioural observation. The reliability of self-reported measures can be assessed against more objective measures such as observed behaviour or objective measures of sun exposure (e.g. UV dosimeters) in the context of

RCTs. Regardless of the specific outcome measure used, medium and long-term follow-up is required; short-term outcomes such as those assessed at the end of a single summer season are likely to have very limited generalisability as they give no indication of the maintenance of any changes into the next summer season. Future evaluations should also systematically assess potentially adverse consequences of interventions, for example, the effect of shade areas in schools on children's activity levels and the effect of providing high SPF sunscreen on other sun protective behaviours such as amount of time spent in direct sun.

1. Introduction

The National Institute for Health and Clinical Excellence (NICE) has been requested by the Department of Health to develop guidance on the provision of information, physical changes to the natural and built environment, and provision of sun protection resources for the prevention of primary skin cancer. The aim of such interventions is the reduction of exposure to ultraviolet (UV) radiation, which is considered a leading cause of skin cancer. In the first phase of work a series of evidence reviews and reports were produced to underpin the guidance on provision of information. This report constitutes one component in the second phase of work, and includes a systematic review of the evidence on physical changes to the natural and built environment and provision of sun protection resources to prevent primary skin cancer attributable to UV exposure. It also encompasses multi-component interventions where the environmental interventions or provision of resources are combined or are accompanied by the provision of information.

The project is based on a logic model that links interventions to reduce UV exposure to short-term outcomes such as increased knowledge about how to protect against exposure and/or changes in attitudes (such as to having a sun-tan) and/or changes in behaviour (such as avoiding UV exposure during peak hours or using high sun protection factor sunscreen). In the longer term these changes in knowledge, attitudes and behaviour may reduce the incidence of overexposure to UV radiation or sunburn which may reduce the number of cases of non-melanoma and malignant melanoma skin cancer.

Changes to the built or natural environment include interventions such as provision of shade in public spaces or school grounds using built shelters or planting of trees and vegetation and changing the time of day that outdoor activities take place. Provision of sun protection resources encompasses, for example, provision of sunscreen as well as protective clothing such as hats to outdoor workers.

1.1 Aims of the review

The aim of the review was to evaluate the effectiveness and cost effectiveness of three types of intervention (changes to the built or natural environment, provision of sun protection resources, and multi-component interventions) in helping to prevent the first occurrence of skin cancer attributable to UV exposure. The overarching questions relating to sun protection resources, environmental changes and multi-component interventions addressed in the review, are as follows:

Primary review questions

1) What physical changes to the natural or built environment are effective and cost-effective at helping to prevent the first occurrence of skin cancer attributable to UV exposure?

It was initially intended that if direct comparisons were available comparing different methods of supplying sun protection resources, we would assess which were the most effective and cost-effective.

2) Which methods of supplying sun protection resources to prevent first occurrence of skin cancer attributable to ultraviolet (UV) exposure are effective and cost-effective?

It was initially intended that if direct comparisons were available comparing different methods of supplying sun protection resources, we would assess which were the most effective and cost-effective.

3) Which multi-component interventions (combination of one or more of supply of sun protection resources, physical changes to the environment, information provision) are effective and cost-effective at helping to prevent the first occurrence of skin cancer attributable to UV exposure?

Secondary review questions

Studies addressing the primary review question were also used to answer the secondary review questions (where relevant data were available). Secondary review questions included:

1) What factors impact on the effectiveness and cost-effectiveness of sun protection resources, changes to the natural or built environment and multi-component interventions?

2) What factors help or hinder the provision or use of sun protection resources, physical changes to the natural or built environment and multi-component interventions?

2. Methods

The systematic review was carried out in accordance with the methods outlined in the NICE public health guidance manual and with CRD's Guidance for undertaking reviews in health care.[1, 2] The review included a literature search, and screening of titles, abstracts and full papers to identify studies meeting the inclusion criteria. The final set of studies for inclusion in the review was quality assessed, data were extracted and synthesised, and evidence statements formulated.

2.1 Literature Search

Searches were undertaken to identify a broad range of literature on changes to the built or natural environment, provision of sun protection resources, and multi-component interventions encompassing one or more of these interventions plus provision of information. The following electronic databases were searched from 1990 onwards without restrictions by language or study design:

- MEDLINE
- EMBASE
- Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- ERIC, PsycINFO, Social Science Citation Index
- Science Citation Index
- ASSIA
- Enviroline
- EPPI Centre databases (BiblioMap, DoPHER and TRoPHI)
- Campbell Collaboration Library of Systematic Reviews
- Cochrane Database of Systematic Reviews (CDSR)
- Cochrane Central Register of Controlled Trials (CENTRAL)
- CRD Databases (Database of Abstracts of Reviews of Effects (DARE)
- NHS Economic Evaluation Database (NHS EED)
- Health Technology Assessment Database (HTA)
- EconLIT and Health Management Information Consortium (HMIC) Database

Details of the search strategies are provided in Appendix 1a.

Information on studies in progress, unpublished research or research reported in the grey literature was sought by searching the following databases:

- Conference Proceedings Citation Index: Science (ISI)
- Inside Conferences
- National Technical Information Service (NTIS)
- Clinical Trials.gov

Internet searches were carried out using the specialist search gateways intute: Health and Life Sciences (http://www.intute.ac.uk/) and MedlinePlus (http://medlineplus.gov/) to identify relevant cancer and environmental protection organisation websites including: Cancer Research UK, Cancerbackup, Skin Cancer Foundation (US), Health Protection Agency, Health and Safety Executive, Cancer Council Australia, SunSmart (Victoria), Skin Cancer Hub. A total of 65 websites were scanned for references to research and/or publications (see Appendix 1b).

The reference lists of relevant systematic reviews and included studies were also scanned. Additional sources of records were the stakeholder submissions (submitted at scope consultation and call for evidence stage) and other references sent from the commissioner including a list of potential multi-component studies from the Phase I evidence review of information provision and a list from the Health Education Authority/Health Development Agency databases.

2.2 Selection of studies

Inclusion criteria

The primary aim of the review was to identify empirical evidence examining the effects of three types of intervention (changes to the built or natural environment, provision of sun protection resources, and multi-component interventions) on the prevention of the first occurrence of skin cancer attributable to UV exposure. Studies meeting the following criteria were eligible for inclusion:

- Population

  Studies conducted in a primary prevention population in developed countries were included (see Appendix 2 for list of Organisation for Economic Co-operation and Development (OECD) countries). Given the relatively small number of studies identified during screening, a protocol amendment was made to include non-OECD countries.

- Intervention

  Studies assessing (a) physical or structural changes to the built or natural environment (including changing time of day that outdoor activities occur); (b) supply of sun protection resources; (c) multi-component intervention combining the above or either or both of the above with the provision of information were included. The intervention could be delivered in any setting and delivered and/or implemented by any individual or group. Evaluations of policy, legislative or fiscal changes were excluded.

  Changes to the built or natural environment include interventions such as provision of shade in public spaces or school grounds using built shelters or planting of trees and vegetation, and changing the time of day that outdoor activities take place. Provision of sun protection resources encompasses, for example, provision of sunscreen as well as protective clothing such as hats to outdoor workers.

  All multi-component studies meeting the intervention criteria were included regardless of whether the physical/structural change or provision of sun resources was a substantial or minor component of the intervention and regardless of whether there were outcomes directly related to these components.

- Comparator

  There were no restrictions on the type of comparator.

- Outcomes

  Studies reporting any of the following outcomes were eligible for inclusion: (a) reduction in the incidence of mortality from skin cancer, (b) reduction in the incidence of morbidity from skin cancer, including sunburn, (c) change in behaviour or attitudes, (d) increase in knowledge and awareness of skin cancer, causes of skin cancer (including risks), prevention of skin cancer, (e) costs or cost-effectiveness, (f) process and implementation outcomes, (g) adverse or unintended effects of the intervention.

- Study design

  All primary study designs were eligible for inclusion. The intention was to identify the types of study design used to evaluate each type of intervention and if a number of randomised controlled trials (RCTs) were identified, then we would have limited inclusion to RCTs. As only a

few RCTs were identified for each type of intervention, all types of study design were included in the review. Systematic reviews were identified with the purpose of checking their bibliographies for relevant primary studies, (they were not eligible for inclusion in the review).

Only papers with a publication date of 1990 or later were included. Language restrictions were not applied.

Screening process

Due to the broad scope of the search strategy, and therefore the large number of irrelevant records identified, titles and abstracts from the database searches were initially pre-screened by one researcher to remove totally irrelevant records. The following criterion was used:

- The record clearly does not address in any way changes to the built or natural environment or the provision of sun protection resources or a combination of both of these or a combination of either or both of these with provision of information.

A second reviewer checked approximately 10% of the excluded records (n=1,042 papers). There was 100% agreement on decisions. The titles and abstracts remaining after pre-screening were independently screened by two reviewers. This included records obtained from additional sources. Full details of the criteria used for selection of studies based on titles and abstracts are reported in Appendix 3. In addition, records of potential interest for the other work being undertaken as part of this phase (the review of qualitative studies or for the economic analysis) were marked as such and sent to the NICE team for distribution to appropriate contractors.

Full papers were ordered for all potentially relevant records and screened independently by two reviewers. Full details of the criteria used for selection of potentially relevant studies based on full papers are provided in Appendix 4. At both stages disagreements were discussed and resolved through consensus or through discussion with a third reviewer.

2.3 Quality assessment and data extraction

Quality assessment of the included studies was carried out using the tools for evaluation studies and economics studies recommended in the NICE methods document.[1] See Appendix 5 for an example of a completed quality assessment form. Data were extracted and presented in evidence tables as outlined in the NICE methods document.[1] Data extraction and quality assessment were carried out by one reviewer and checked by a second. Any disagreements were resolved through discussion or by recourse to a third reviewer.

2.4 Data synthesis and presentation

The effectiveness and cost-effectiveness data were synthesised separately, beginning with an overview of the evidence at the beginning of each section. Data were then grouped by setting and intervention category (changes to the built or natural environment, provision of sun protection resources, and multi-component interventions) and presented as a narrative synthesis. An overview of the studies included in each intervention category was reported, followed by a detailed narrative on each study (with randomised and non-randomised trials reported first, followed by other study designs). The narrative addresses the primary review questions, followed by any data (where reported) relating to the secondary review questions. The quality of each study is then discussed. Following each intervention category, the studies are summarised in evidence statements.

As only one relevant cost-effectiveness study was identified, information from the study is presented as a narrative and includes study details (including intervention, population and setting) methods (including model structure, costing approach and measure of benefit) and results.

Where there were multiple papers relating to one study, data from the main paper were extracted and presented in evidence tables, alongside any additional data from the related papers.

Based on the evidence that we found we made the decision to place greatest weight on the studies designed to specifically assess the contribution of resource provision to outcome. This was followed by studies in which the resource provision component appears to be a substantial element of the intervention or where outcomes were related specifically to use of the resource, even though the contribution of the individual components cannot be unravelled. Least weight was given to those interventions where the resource provided was in the form of a sunscreen sample.

Where the term 'significant difference' is used this refers specifically to statistically significant differences (at least $p<0.05$), and not clinical significance.

2.5 Evidence base

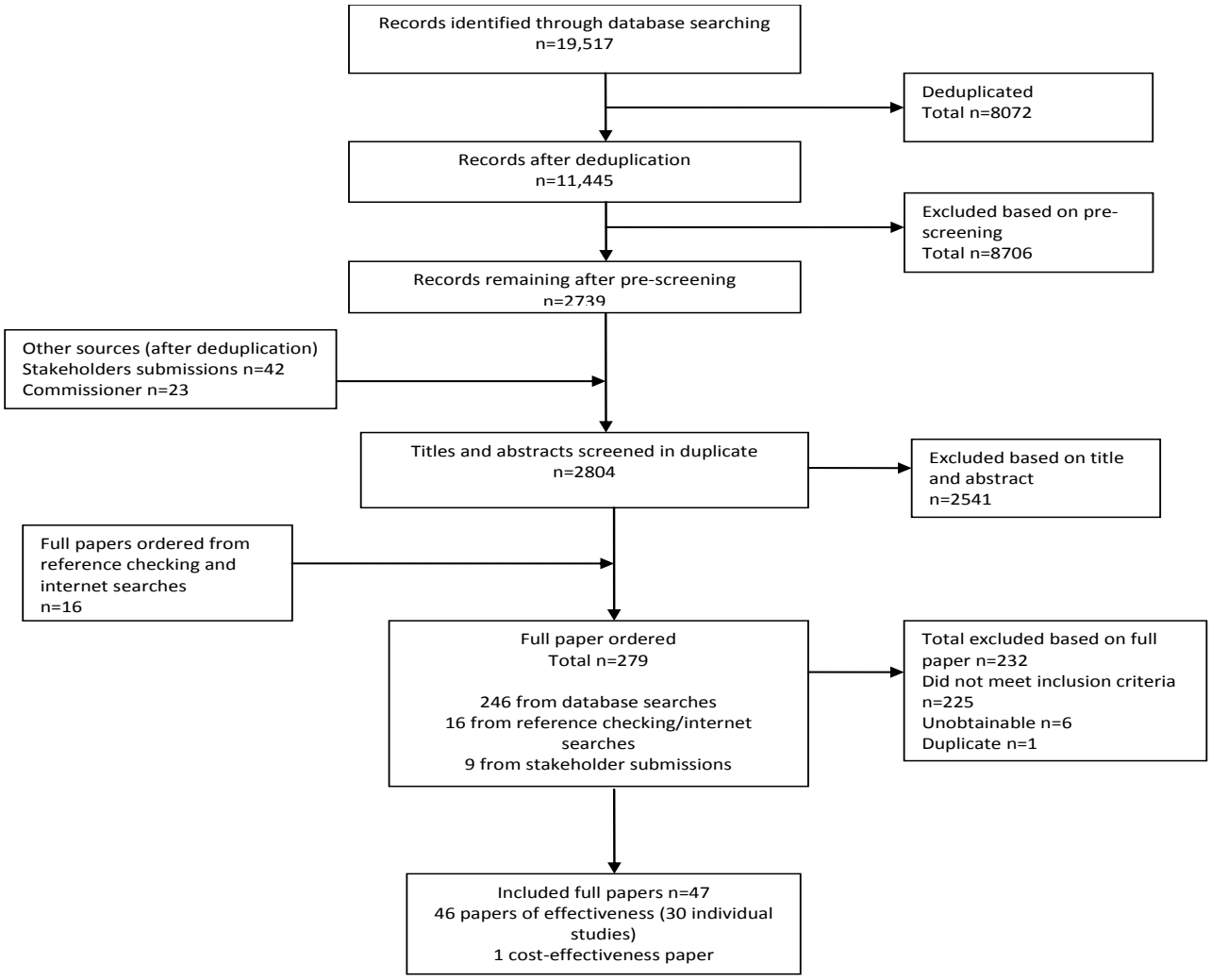
The database searches identified 19,517 references, which reduced to 11,445 after the removal of duplicates (Figure 1). After pre-screening (to remove totally irrelevant documents there were 2739 records remaining. These records, plus 65 records identified at the call for evidence stage by the commissioner (2804 in total), were screened independently by two reviewers. Two hundred and seventy-nine full papers were ordered including 16 papers identified through internet searches and

scanning the bibliographies of systematic reviews and relevant primary studies; nine stakeholder submissions and eight papers from references forwarded by the commissioner.

Of the 279 full papers ordered, six did not arrive and one was a duplicate. A total of 272 full papers were available for assessment. Of these, 47 met the criteria for inclusion (46 papers reporting 30 individual studies relating to effectiveness (in one, two studies were reported in the same paper), and one paper relating to a single cost-effectiveness).

Two hundred and twenty-five papers were excluded (213 effectiveness and 12 cost-effectiveness). Effectiveness studies were excluded because they did not assess a relevant intervention (110 papers, 52%), they were not evaluation studies (89 papers, 42%), they did not assess or report relevant outcomes (12 papers, 6%), because they did not address primary prevention of skin cancer attributable to UV exposure (1 paper) or because only baseline data were available (1 paper) (see Appendix 6a for a complete list of the effectiveness studies excluded at full paper stage). Cost-effectiveness studies were excluded mainly because they were not full economic assessments (see Appendix 6b for a complete list of the cost-effectiveness studies excluded at full paper stage). The six papers that could not be obtained are listed at Appendix 6c. All of the included papers were written in English.

Figure 1: Flow of titles/abstracts and papers through the review process

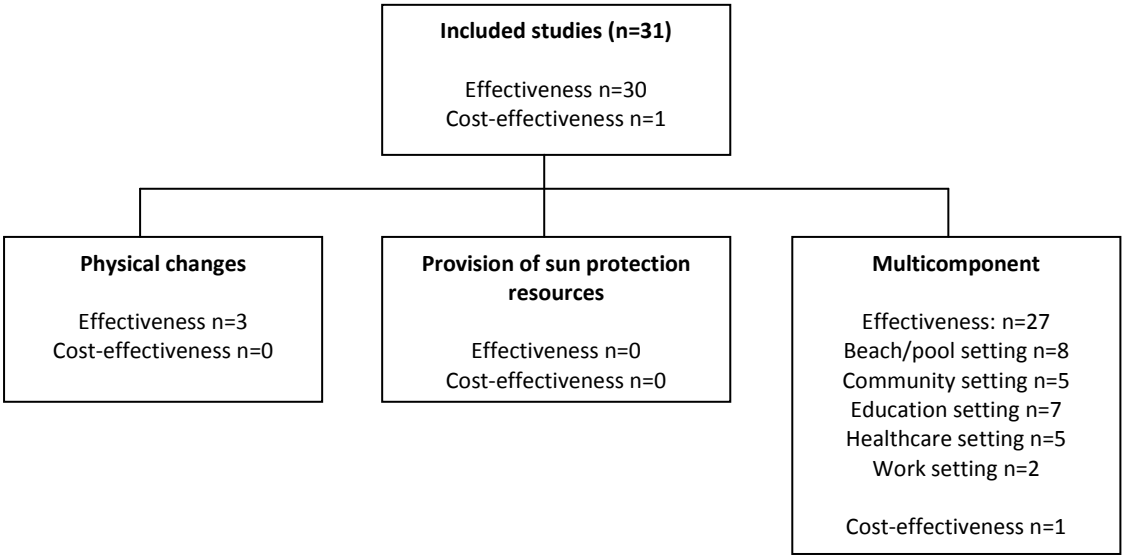


3. Results

3.1 Overview of the evidence

A total of 31 individual studies were included in the review (reported in 47 papers). Thirty studies related to effectiveness and one study to cost-effectiveness. Three studies provided evidence about changes to the natural or built environment (3 effectiveness studies); no studies assessed the provision of sun protection resources (one study[3] was identified but only baseline data were provided, and attempts to retrieve follow-up data from the author were unsuccessful) and 28 studies assessed multi-component interventions (27 effectiveness studies and 1 cost-effectiveness study) (see Figure 2).

Figure 2: Included studies grouped by intervention category



The three studies that addressed changes to the natural or built environment all assessed the provision of environmental supports in school settings to reduce sun exposure. One was an RCT and two were observational studies. The multi-component interventions all included the provision of information, of varying types and intensity, delivered in conjunction with sun protection resources that also varied in terms of type and extent of provision. Interventions were delivered at beaches and outdoor pools (n=8); in educational settings including schools, nurseries and day care (n=7); in healthcare settings (n=5); work settings (n=2); and multiple community settings (n=5). There was some overlap between the categories; for example, in some of the beach and pool settings, the intervention was aimed at lifeguards, creating overlap with the work setting. There were 14 RCTs

that assessed the effectiveness of multi-component interventions, seven non-randomised controlled studies and six before and after or observational studies. There was one cost-effectiveness study.

All the effectiveness studies, except one (Azizi 2000,[4] [-]) were carried out in an OECD-country. OECD countries included the USA (22 studies), Canada (1 study), Australia (3 studies), Sweden (2 studies), Germany (1 study). The non-OECD country was Israel. No studies were conducted in the UK.

Despite the number of controlled studies of multi-component interventions identified, the overall body of evidence had some important limitations. Only one multi-component study reported outcomes that could be attributed to the information provision and to the resource provision components of the intervention (Bauer 2005,[5] [+]). In this study an information intervention was delivered with and without the resource provision component. In the other studies it was not possible to determine the contribution of the separate components to outcome. In addition, in most studies the resource provision element of the intervention was insubstantial compared to the information component, for example, provision of sunscreen samples in conjunction with information. In the majority of studies, few details were provided about the resource provision element of the intervention, possibly a reflection that some of the resource provision was regarded as a gift or incentive comparable to fridge magnets or pens, rather than as a substantial aspect of the intervention. The lack of outcome measurement relating to participants' use of, or views about the resources, provides futher evidence that the provision of resources was not considered to be an integral element of the intervention.

The main outcome in most of the studies was self-reported sun-protective behaviours, which may not reliably reflect actual behaviours. Twenty-four of the 30 included effectiveness studies measured self-reported behaviours (or carer reports of children's behaviours); 11 used objective measures (8 of sun exposure such as skin colour using reflectance spectrophometry, amount of exposure to UV light or number of nevi; and 3 of sunscreen use) and 8 studies measured observed behaviours. Eleven studies measured attitudes and/or knowledge. None of the studies assessed longer term outcomes such as skin cancer and only a few studies used objective measures of sun exposure such as changes to the skin that may increase risk of skin cancer.

Overall, the body of evidence is at best only partially applicable to the UK setting. No UK studies were identified, and with the exception of two Swedish studies, one Canadian study and possibly one German study, they were from countries with much hotter, sunnier summer climates (e.g

Australia and the USA). Interventions implemented in countries with hotter climates may have a lesser benefit when implemented in the UK.

Applicability of the multi-component interventions was also limited by the difficulty in determining what (if any) effect different components may have had. Several individual studies had further limitations in terms of applicability due to inadequate reporting of the actual intervention, particularly the resource provision component, and limited information about participants.

3.2 Change to natural or built environment or timing of outdoor activities

Three studies specifically focused on the provision of environmental supports to reduce sun exposure (Dobbinson 2009;[6] Boldemann 2006;[7] Boldeman 2004[8]). These were all related to the provision of shade in educational settings. Two studies used objective measures of sun exposure (Boldemann 2006[7]; Boldeman 2004[8]) and one measured observed behaviours (Dobbinson 2009[6]). None assessed knowledge and attitudes.

No studies were identified that evaluated the provision of shade in other settings. No studies evaluating the effect of changing the timing of outdoor activities were identified. No cost-effectiveness studies were identified that related to this group of interventions.

3.2.1 Educational setting

One cluster randomised controlled trial (Dobbinson 2009,[6] [++] quality) assessed the impact of construction of shade on use of the shaded area and two observational studies (Boldeman 2004[8] and Boldemann 2006[7] both [-] quality) assessed the impact of shade on UV exposure. Table 1 provides a summary of key study characteristics and the evidence tables are provided in Appendix 7 (Table A).

The RCT (Dobbinson 2009[6]) was undertaken in secondary schools in Australia and the two observational studies (Boldeman 2004;[8] Boldemann 2006[7]) were undertaken in pre-schools in Sweden. A key difference between the observational studies and the RCT was that the RCT evaluated the effect of constructing a shaded area in a school whereas the observational studies compared outcomes for schools that did or did not have existing shade. The observational studies are likely to be subject to confounding and therefore their findings need to be treated with some caution. In contrast, the RCT had no important sources of bias, although generalisability of the findings may be limited. All three studies demonstrated some benefits from provision or availability

of shade in educational settings. The individual studies are discussed below, grouped by study design.

Table 1: Summary of studies evaluating provision of shade

Study details	Setting and population	Intervention (I) and Comparator (C)	Outcomes
Dobbinson 2009[6] Cluster RCT *Validity* Internal ++ External +	51 secondary schools Melbourne, Australia Older children (years 7-12)	I: Construction of shade sail structures C: No shade constructed	• Sun protection practices *Use of shade* ***(observed behaviour)*** • Adverse effects *Vandalism and injuries* • Cost • Process/implementation
Boldemann 2006[7] Observational *Validity* Internal - External +	11 preschools Stockholm, Sweden Young children (4.5 to 6.5 years old)	Outdoor environments at the schools were classified as high or low quality environments for play and shade and outcomes were compared for the two environment types	• Sun exposure *UVR exposure* ***(objective measure)*** • Adverse effects *Activity levels (step count)*
Boldeman 2004[8] Observational *Validity* Internal - External +	2 preschools Haninge, Sweden Young children (1 to 6 years old)	Outcomes were compared based on the location of shade in the two schools: I: Play equipment and most frequently used play areas under a grove of pine trees C: Play equipment and most frequently used play areas exposed to midday sun	• Sun exposure *UVR exposure* ***(objective measure)***

UVR: ultraviolet radiation

Randomised and Non-randomised Controlled Trials

Dobbinson 2009 ([++] quality): A single RCT was included evaluated the impact of installing purpose-built shade sails, at an average size of 74m^2 (range 46-120m^2), at Australian secondary schools, identified as having insufficient available shade. The shaded areas were for student use during passive activities such as eating lunch.

Fifty-one secondary schools were randomised to the intervention (shade sails installed; 25 schools) or a control group where the sails were not provided (26 schools). Two full sun areas considered potentially suitable for a shade structure were identified in each school, following a shade audit and consultations with school principals. Key suitability criteria included being exposed to full sun during Spring and Summer terms, a large enough space for students to congregate that was regularly used by them and was in a main activity area of the school. The site preferred by the school for shade development was defined as the primary site and the second area, which was nearby or adjacent, was defined as the alternative site. The primary outcome measure was the mean number of students using the primary study sites during weekly observations over the lunch-time period, over

Spring and Summer terms. Behaviour was observed over a 16 week period for baseline and a 14 week period after the shade had been introduced. Change in use of the alternative site to assess whether students were avoiding the shaded area was also measured. At baseline the mean temperature at the intervention schools was 19.5ºC (range 9.7 to 33.7) and it was similar at the control schools.

There was a statistically significant increase in use of newly shaded areas by students: the difference between groups in mean change (from baseline Spring/Summer term to follow-up Spring/Summer term, i.e. one year later) in use of the primary study site was 2.67 students (95% CI: 0.65 to 4.68 students, p=0.011). Therefore an average of approximately three more students used the primary site (shaded) at the intervention schools compared to the primary site (unshaded) at the control schools. There was no statistically significant difference between the groups in use of the alternative site suggesting that the primary site was not being avoided: the difference between groups in mean change (from baseline to follow-up) of the alternative site was 0.90 students (95% CI: -2.03 to 0.23 students); the mean change from baseline to follow-up in the intervention group was -0.03 students (95% CI: -1.09 to 1.02) and in the control group was 0.87 (95% CI: -0.22 to 1.95).

There were no incidents reported by schools of vandalism to the shade sails or injuries related to the building of the sails. The average shade cost was approximately £5205 ($A11,500). Construction costs varied depending on site conditions: the maximum cost was approximately £10,500 to £11,000 ($A22,000). The base year is not reported: the average shade cost in British pounds is the figure reported in the journal article and the maximum cost of construction is based on a rough estimate based on the currency conversion for shade.

On average, only six students used the shaded areas at any one time, despite the relatively large size of the sails. The authors state that they had undertaken a pilot test to assess the feasibility of providing shade in active recreation areas but there tended to be more constraints such as safety concerns regarding placement of poles and the need for larger sails.

This was a good quality study and no major sources of bias were identified: it was randomised, with concealed allocation and the primary outcome was analysed on an intention to treat (ITT) basis by a statistician blinded to group allocation. There is a possibility that the intervention effect may have been underestimated as two intervention schools did not receive a shade sail and they were analysed (based on ITT) as receiving the intervention. Outcome assessment could not be blinded, however, it was based on video recorded observations over 14 to 16 days (one day per week for 14

to 16 weeks) using a standardized protocol. This is likely to be a more reliable method than self-reported behaviour.

There are a number of factors to consider in interpreting the findings. As highlighted by the authors, the number of extra students using the shaded areas compared to the control schools was small. Although small improvements may be important, further research is required to investigate what factors might maximize use of shade. On average, only six students used the shaded areas at any one time, despite the relatively large size of the sails. The authors suggest that optimal use of shade sails may be limited by friendship groups avoiding encroaching on other student's space. The authors suggest the need for research on the impact of different seating arrangements, size of sails and the use of multiple sails within a school. In terms of generalisability, although there were variable weather conditions throughout the study, it is unclear whether such shaded areas would have similar usage in a cooler climate such as the UK. In addition, it is unclear whether the effect of the provision of shade would be similar in active recreation areas. In the current study, the sites were mainly for passive recreation such as eating lunch.

Other study designs

The two observational studies (Boldeman 2004; Boldemann 2006), both undertaken in Sweden used broadly similar methods. **Boldeman 2004, ([-] quality):** The earlier study compared a preschool (attended by 108 children, aged 1 to 6 years) where play equipment and areas most frequently used by the children were mainly in the shade at midday, (under a grove of pine trees) to a preschool (attended by 34 children) where access to shade was similar but the play equipment and most frequently used play areas were exposed at midday.

Thirty of 108 children attending the school with shaded play equipment were included in the study and all 34 children attending the school with unshaded play equipment were included in the study. The main outcome measure was sun exposure as measured by commercial spore dosimeters over 11 days in May to June. Each child had two dosimeters attached, one to each shoulder while at school and the mean value for each pair was used. Time spent outdoors was measured and data on global ultraviolet radiation (UVR) at the two sites was obtained. The global UVR was used to calculate the proportion of the available UVR during the time children were outdoors. The weather conditions and total available global UVR during preschool hours (8.30 am to 6.30pm) were similar at both sites over the measurement period. There were clear weather conditions and the highest daily temperature ranged from 15.4 to 26.3ºC. Although children at the school with a shaded play area spent longer outdoors than children at the comparison school (mean 260 minutes per day versus

207 minutes, respectively), children's available UVR was similar at both sites as children at the school with shade were outdoors at times when sunlight was weaker.

Boldemann 2006 ([-] quality): Using similar outcome measures, over 12 days in May and June, this study investigated the relationship between outdoor environment and UVR exposure in 11 Stockholm preschools (199 children, 4.5 to 6.5 years old). In addition, children's physical activity levels were measured using pedometers. At three of the preschools, education was almost entirely outdoors. The researchers classified the outdoor environments of the schools as high or low quality environment for play and shade. This was based on three criteria: the total size of the outdoor area; the extent of overgrown surface (trees and shrubbery) and broken ground; and the integration of play structures and other defined play areas with vegetation. Five preschools were classified as high quality environments and six as low quality. There was cloud and rain at the start and end of the assessment period with clear skies and variable cloudiness on the other days. The temperature ranged from 8.6º to 25.3ºC. The total available global UVR was similar across sites.

In the earlier study (Boldeman 2004), the mean UVR exposure of children at the school with a shaded play area was 175 J/m^2 per day[a] and at the control school 222 J/m^2. The authors state that the average absolute exposure of all children was approximately 200J/m^2 which corresponds to around 1 minimal erythema dose (MED) per day for sun-sensitive skin. Children at the school with a shaded play area were exposed to 13% less UVR than children at the school with an unshaded play area and this was statistically significant ($p<0.05$): children at the shaded site were exposed to 13.3% (CI: 9.9 to 14.6) of the available UV radiation during time spent outdoors compared to 15.3% (CI: 14.3 to 17.5) for children at the unshaded play site (paper does not specify CI used).

In the later study, the mean UVR exposure at the preschools ranged from 83 J/m^2 per day (CI: 67 to 98) to 292 J/m^2 per day (CI: 232 to 351) (Boldemann 2006). As with the earlier study, average UVR exposure was described as roughly equivalent to one MED for sun-sensitive skin. Children in the high quality environment group were exposed to significantly less UVR than the low quality environment group: 14.6% of the available outdoor UVR during time spent outdoors compared to 24.3%, respectively ($p<0.001$). The % of free sky, environment quality (high and low), inter-site attendance and outdoor education were all significantly associated with UV exposure but only the variable % of free sky was a statistically significant predictor in a linear mixed model. In terms of

[a] Exposure was measured in joules/metre^2 based on International Commission on Illumination (CIE) standard

physical activity, the mean step count/minute was higher in high quality environment compared to low (21.5 steps/minute compared to 17.7, respectively p<0.001).

Data were also provided by sex and age in the earlier study (Boldeman 2004). All subgroups had lower UVR exposure at the shaded site compared to the unshaded site except for 1-4 year old boys who were exposed to 23.1% compared to 16.7% of available UVR at the shaded and unshaded sites respectively. In the later study gender and environment (high and low quality) were statistically significant predictors of step count in a linear mixed model (Boldemann 2006).

Both these studies (Boldeman 2004; Boldemann 2006) have the key limitation that they are observational in design and examine the association between shade being available and UV exposure. Unknown variables, other than shade may have influenced the findings. While the 2006 study benefits from having a larger sample of schools than the earlier study, it has the limitation that only one of three criteria used to classify the environment related to shade. This may explain why the % of free sky and not the quality of the environment was correlated with exposure in the mixed model. As with the findings from the RCT, the differences between groups were fairly small, though this could be due to the amount of shade in areas classified as shaded and unshaded being relatively similar.

Change to natural or built environment or timing of outdoor activities

ER 4.1 There is a limited body of evidence on the effect of change to the natural or built environment in the prevention of skin cancer in educational settings and no evidence from other settings. No studies were identified that focused solely on the impact of changing the timing of outdoor activities.

ER 4.2 There was evidence from a single good quality RCT (Dobbinson 2009 [++]) undertaken in Australia that adolescents in Years 7 to 12 used rather than avoided newly provided sail shade areas at secondary schools, during lunch time periods. An extra 2.7 students were observed to have used the shaded sites (95% CI: 0.7 to 4.7) during spring/summer term compared to unshaded sites in the control schools (p=0.011).

ER 4.3 There was evidence from two observational studies, with methodological limitations, undertaken in Sweden, of an association between availability of natural shade in preschool play areas and reduced UV exposure for children under 6.5 years old (Boldemann 2006 [-] and Boldeman 2004[-]). The Boldemann ([-] 2004) study reported an absolute reduction in UVR exposure of 2% (p<0.05) and the second 10% less UVR exposure (p<0.001) for children with access to a shaded

compared to unshaded play area.

ER 4.4 None of the studies assessed longer term outcomes such as skin cancer or changes to skin that may increase the risk of skin cancer (Dobbinson 2009 [++]; Boldemann 2006 [-]; and Boldeman 2004 [-]).

ER 4.5 Regarding implementation, Dobbinson (2009 [++]) reported that, on average, only six students used the shaded areas at any one time, despite the relatively large size of the sails. The authors suggest that optimal use of shade sails may be limited by friendship groups avoiding encroaching on other student's space. Boldemann 2006 [-] did not contain evidence pertinent to the secondary review questions. Boldeman (2004 [-]) reported that all subgroups had lower UVR exposure at the shaded site compared to the unshaded site except for 1-4 year old boys who were exposed to 23.1% compared to 16.7% of available UVR at the shaded and unshaded sites respectively. In the later study gender and environment (high and low quality) were statistically significant predictors of step count a linear mixed model (Boldemann 2006 [-]).

Applicability

The evidence is likely to be applicable to nursery schools and schools in the UK where outside play areas are exposed to full sun.

3.3 Provision of protective clothing, sunglasses or hat

No studies were identified assessing the impact of provision of protective clothing, sunglasses or hat as a single component intervention. The protocol and baseline data from one such study was identified (Harrison 2005)[3] but follow-up data from the trial were not available. No cost-effectiveness studies were identified.

2: Provision of protective clothing, sunglasses or hat

ER 4.6 No evidence was identified on the effectiveness or cost-effectiveness of provision of protective clothing, sunglasses or hat as a single component intervention.

3.4 Multi-component interventions

There were twenty seven studies included that assessed the effectiveness of a multi-component intervention. Interventions were delivered at beaches and outdoor pools (n=8); multiple community

settings (n=5) for example, where interventions were implemented across several settings such as recreational and healthcare; in educational settings including schools, nurseries and day care (n=7); in healthcare settings (n=5); and work settings (n=2). There was some overlap between the categories. For example, in some of the beach and pool settings, the intervention was aimed at lifeguards, creating overlap with the work setting. There was one cost-effectiveness study carried out in a community setting.

3.4.1 Beach/swimming pools

Eight studies evaluated the effectiveness of a multi-component intervention in a beach or outdoor pool setting, one which was a two part study reported in a single paper. There were four RCTs (Glanz 2002,[9] [+] quality; [b]Mayer 1997,[10] [+] quality; Weinstock 2002,[11] [-] quality; Winett 1997,[12] [-]quality; study 1); one non-randomised controlled trial (Pagoto,2003[13] [-] quality); two before and after studies (Winett 1997,[12] [-]quality, study 2; Lombard 1991,[14] [-] quality) and one observational study (Dobbinson 1999,[15] [-]quality). Table 2 provides a summary of key study characteristics and the full evidence table is provided in Appendix 7 (Table B). All eight studies reported sun protection behaviours or sun exposure as an outcome: three of the studies used self-report measures only (Dobbinson 1999,[15] [-]; Pagoto,2003[13] [-]; Weinstock 2002,[11] [-]), one used self-report measures and an objective measure of suntan (Mayer 1997,[10] [+]), one used self-report, observed behaviour and an objective measure of sunscreen use (Winett 1997,[12] [-] study 1), in one behaviours were observed and there was on objective measure of sunscreen use (Lombard 1991,[14] [-]) and in two studies observed and self-report measures were used (Winett 1997,[12] [-] study 2, Glanz 2002,[9] [+]). Three studies also reported knowledge or attitudes (Dobbinson 1999,[15] [-], Glanz 2002,[9] [+]Winett 1997,[12] [-] study 2). No cost-effectiveness studies were included that related to this setting.

None of the studies were undertaken in the UK; one was undertaken in Australia (Dobbinson 1999) and the rest in the USA (Glanz 2002; Mayer 1997; Weinstock 2002; Winett 1997 (studies 1 and 2); Pagoto 2003; Lombard 1991). In two studies the intervention was targeted at adult beach goers (Pagoto 2003; Weinstock 2002), one at children attending swimming lessons (Mayer 1997), one targeted specifically at swimming pool lifeguards (Dobbinson 1999) and four at adults, children and lifeguards at swimming pools (Glanz 2002; Lombard 1991; Winett 1997, studies 1 and 2). We have assumed that pools were outdoors even where it was not explicitly stated that this was the case. The extent and nature of the resource provision varied between studies and included free sunscreen

[b] This study was also included in the Phase 1 report. It has been included here to ensure consistency within this report as other similar studies are included.

with or without provision of hats or clothing such as t-shirts. The nature and intensity of the information components varied considerably between the studies and included educational lessons, information provided through posters, pamphlets and other activities. Two of the studies used UV photographs to show participants the extent of their own skin damage. None of the studies were designed to specifically assess the contribution of the resource provision on the outcomes measured. Two of the RCTs were reasonably good quality (Glanz 2002,[9] [+] quality; Mayer 1997,[10] [+] quality). The remaining studies all had methodological limitations; therefore their findings need to be treated with some caution.

The two reasonable quality RCTs (Glanz 2002,[9] [+] quality; Mayer 1997,[10] [+] quality), of a multi-component intervention delivered primarily during children's swimming lessons including provision of information, incentives, and free sunscreen and hats, reported contradictory results. One reported no statistically significant differences between the intervention and control groups in childrens' sun protection behaviours (reported by parents) and an objective measure of suntan (Mayer 1997[10]); the second reported improvements in several child and parental sun protection behaviours, though not all behaviours and largely no benefit in acquatic staff behaviours, though the intervention group reported fewer sunburns (Glanz 2002[9]). The two studies differed in a number of ways including the educational and the resource provision components.

An RCT (Winett 1997,[12] [-]quality, study 1) assessing the provision of information posters, use of weekly lotteries for pool users engaging in safe behaviours (those engaging in Sun Safe practices, in the shade or wearing a shirt and a hat or sunglasses received a ticket for the lottery prize of logo sunhat or shirt), provision of hat and shirts for lifeguards and free sunscreen at the pool reported positive benefits compared to control pools in the observed sun protective behaviours of children and lifeguards but not adult pool users. The related before and after study of a subset of pools reported positive benefits (Winett 1997,[12] [-]quality Study 2) as did an earlier before and after study of a similar intervention (Lombard 1991, [-] quality).

An RCT and a non-randomised controlled study (Weinstock 2002,[11] [-] quality; Pagoto 2003,[13] [-] quality) assessing multi-component interventions including provision of information (in a single session and in multiple sessions), photographs of UV skin damage and provision of free sunscreen to adult beach goers, reported statistically significant improvements in self-reported sun protective behaviours with the intervention compared to control, though the improvements seemed modest.

An observational study reported that a 10 year sponsorship programme including provision of free sunscreen for lifeguards to sell and long-sleeved tops and hats to wear (not sell) was more effective

in improving lifeguards self-reported sun protective behaviours than no sponsorship programme (Dobbinson 1999,[15] [-]quality).

Table 2: Summary of studies evaluating a multi-component intervention delivered in a beach/pool setting

Study details	Setting and population	Intervention (I) and Comparator (C)	Outcomes[†]
Dobbinson 1999[15] Observational study (with a comparison community) *Validity* Internal - External +	30 lifesaving clubs, Victoria and New South Wales, Australia 263 lifeguards	I: A 10 year sponsorship programme of life-saving associations in Victoria to promote structural change, including: (1) education for lifeguards, (2) provision of sunscreen, which they could sell at a profit, (3) Shade structures and protective clothing supplied by sponsor (including broad-brimmed hats and long-sleeved t-shirts), (4) access to training programmes for youth to raise awareness and education related to skin cancer. C: Lifeguards from New South Wales, where the programme had not been implemented.	• Sun protection practices *Use of sunscreen* *Use of shade* *Use of protective clothing or hat* • Sun exposure *Sunburn* • Attitudes, beliefs • Other outcomes
Glanz 2002[9] Related papers Geller 2001[16] (related to the main trial) Diffusion trial[17-21]; Pool Cool with and without peer component [22] Cluster RCT *Validity* Internal + External -	28 public municipal, suburban, YMCA, and military pools, Hawaii and Massachusetts, USA 1010 children and their parents attending outdoor swimming pools and pool staff	I: Based on social cognitive theory. Included a one hour orientation for pool staff; educational components for children and their parents; and environmental components at the pool area. Educational components (1) eight sun-safety lessons taught at the start of swimming lessons, (2) a 'big book' to make lessons more interactive, (3) on-site interactive activities, (4) incentives to reinforce sun safety messages (e.g. sunscreen samples, t-shirts, pool cool hats). Environmental components (1) provision of refillable pump sunscreen container, (2) a portable shade structure or umbrella, (3) sun-safety signs and sunscreen tips poster. C: Lessons and activities on injury prevention	• Sun protection practices *Use of sunscreen* *Use of shade* *Use of protective clothing or hat* *Composite measure* (***some lifeguard behaviours observed***) • Sun exposure *Sunburn* • Knowledge • Process and implementation
Mayer 1997 [10] Cluster RCT *Validity* Internal + External +	48 swimming classes in 4 YMCAs San Diego, California, USA 169, 4 to 11 year old children	I: Four five minute lessons before swimming class each covering a sun protection behavior; home-based curricula provided to parents, including several activities for children; SUNWISE board game and UV meter; sunscreen and hats were available at each lesson. C: No intervention	• Sun protection practices *Use of sunscreen* *Use of protective clothing or hat* *Composite measure* • Sun exposure *Tanning of skin* (***objective measure***)
Lombard 1991[14] Before and after Validity Internal - External -	2 outdoor swimming pools Southwestern Virginia, USA People using the swimming pools	I: informational posters; information fliers; poster providing feedback on the proportion of patrons and lifeguards performing sun protective practices; 3-hour training session for lifeguards encouraging modelling of sun protective behaviours plus a supply of sunscreen, zinc oxide and logo t-shirts; lottery to win logo hats and t-shirts for patrons when children reached their goal of 40% sun protective behaviours for three consecutive days. C: Not applicable	• Sun protection practices *Use of sunscreen* *Use of protective clothing or hat* *Use of shade* *Sunglasses* ***(observed behaviour and objective measure of sunscreen use)***
Pagoto, 2003[13]	Sandy beaches in a midwestern city, USA	I:Sun protection recommendations, based on individual skin type; information pamphlet;	• Sun protection practices *Composite measure*

Non-randomised controlled trial *Validity* Internal - External-	100 adult (≥18years), Caucasian beachgoers	assessment of sun damage to skin using UV photographs; commitment cards, signed by participant and a friend; modeling of proper sun behaviour by research assistants; and provision of a selection of free sunscreens and instructions on their correct use C: No intervention	• Sun exposure *Length of time in sun*
Weinstock 2002[11] Related paper Weinstock 2000[23] RCT *Validity* Internal - External-	Seven coastal salt water beaches Rhode Island, USA 2324, 16 to 65 year old sunbathers	I: On the beach participants received: educational pamphlet; personalised/tailored sun sensitivity assessment and feedback (written and verbal); SPF 15 sunscreen; instant sun damage photographs. Based on data provided at baseline, a feedback report matched to the individual stage of change was mailed two to three weeks later. And a second report after the 12 month assessment. In addition, further information materials were distributed as a booster/reminder eight months post baseline. C: No intervention	• Sun protection practices *Use of sunscreen* *Use of protective clothing or hat* *Composite measure* • Sun exposure *Length of time in sun or time when exposed* • Other
Winett 1997[12] Study 1: Cluster RCT Study 2: Before and after *Validity* Internal - External -	23(Study 1) and 4 (Study 2) outdoor swimming pools Southwestern Virginia, USA People using the swimming pools	Study 1 I: Information posters; poster providing feedback on number of pool goers engaging in sun protective behaviours; weekly lottery for those engaging in Sun Safe practices; Safe Sun logo hat and two shirts for lifeguards; free sunscreen available in two large self-serve containers. C: Informational posters and provision of free sunscreen in two large self-serve containers. Study 2 I: In addition to the above: a 'kick off day' involving music, food and entertainment; large posters; more lotteries; choice of hats and better quality shirts; one hour meetings with lifeguard; meeting with pool manager to agree requirement for lifeguards to follow Sun Safe guidelines; competition; and provision of shaded area at two pools midway through the intervention. C: Not applicable	• Sun protection practices *Use of sunscreen* ***(objective and self-report)*** *Composite measure* ***(observed behaviour)*** • Knowledge (study 2 only)

†Self-report measures, unless otherwise indicated

Randomised and non-randomised controlled studies

Glanz, 2002[9] ([+] quality): One reasonably good quality RCT evaluated an intervention known as Pool Cool. The intervention evaluated the effectiveness of information provision to 5 to 10 year olds attending swimming classes, their parents and acquatics staff (data were reported in a separate paper; Geller 2001[16]) and the provision of sun protective and other incentives plus environmental components including provision of free sunscreen and portable shade, over an eight week period, at outdoor swimming pools in Hawaii and Massachusetts, USA.

Twenty-eight pools were randomised to the intervention group (n=15) or a control group (n=13) that received lessons and activities on injury prevention. All parent-child respondents attending the pools, who completed a useable baseline survey and had a child attending swimming class, and acquatics staff were included. The intervention, which was based on Social Cognitive Theory had

three main components delivered over an eight week summer period: (i) a one hour orientation and training session for pool staff and a leader's guide; (ii) educational components for children including 8, 4 to 6 minute sun safety sessions at the start of swimming classes, various interactive activities and information materials and incentives such as pens, lanyards, magnets, sunscreen samples, t-shirts and hats; and (iii) environmental components including a refillable pump sunscreen bottle at the pool, a portable shade structure, sun safety signs and an information poster. Staff could choose an umbrella for lifeguard stands or a portable tent or canvas structure. The outcome measures were parent and child's sun protective behaviors based on parental surveys and observational assessments of the sun-safety environments at the pools. Two Pool Cool staff at each pool conducted observations at the beginning, middle and end of the summer (over an eight week period) assessing structural and environmental changes. Parental knowledge was also assessed. In addition, acquatics staff self-reported sun protective behaviours and their knowledge, attitudes and social norms were also assessed. The children's mean age was 6.6 years (SD 1.5), 41% had at least one sunburn episode the previous summer and there were a similar proportion of boys and girls. 83% of parents were female, 57% were Caucasian, 68% had a household income of more than $50000 and 86% were college educated. 69% of acquatics staff were female, 62% were Caucasian, 68% reported that the colour of their untanned skin was very fair/fair, approximately 50% reported a history of severe sunburn and almost 80% reported at least one sunburn during the previous summer.

Children's sun protective behaviours were significantly better ($p<0.05$) in the intervention group than in the control group for the composite score, and the individual items related to use of sunscreen, staying in shade and sunburns, but not wearing a shirt, sunglasses or hat. The effect sizes were modest: sunscreen, $d=0.17$; shade, $d=0.23$; composite score of sun protection habits and sunburn, $d=0.22$. The results were similar for adults: there was a statistically significant benefit in the intervention group compared to the control group for the composite score ($p<0.05$, $d=0.19$), use of sunscreen ($p<0.01$, $d=0.17$), wearing a hat ($p<0.01$, $d=0.17$), but not wearing a shirt, sunglasses, staying in the shade or knowledge. By contrast, results for acquatics staff showed no statistically significant differences between groups in the use of sunscreen ($p=0.94$), use of shirt ($p=0.06$), use of a hat ($p=0.54$), staying in the shade ($p=0.70$), use of sunglasses ($p=0.55$), or for the composite score ($p=0.75$), though lifeguards in the intervention group who were at moderate or high risk of sunburn had significantly fewer sunburns by the end of the summer than the control group (1.42 versus 2.07. $p<0.05$). There was no statistically significant difference between lifeguard groups for social norms ($p=0.49$) or knowledge ($p=0.68$).

Parents attending the intervention pools reported significantly greater ($p<0.01$, $d=0.54$) increases in sun protection policies at their pools compared to control parents. Based on the observations of staff, at third observation, there was greater improvement at the intervention pools than control pools in the availability of sunscreen at the pool (86% versus 42% at third observation, $p<0.05$), posting of sun-safety signs (86% versus 17%, $p<0.01$) and lifeguard shirt use (100% versus 83%, $p<0.01$) but not in the presence of shade area around the pools (86% versus 83%) or lifeguards' hat use (79% versus 67%). The authors note that shade areas were already common at many of the pools before the intervention and the dichotomous measure was not sensitive. The quantity of sunscreen used was not assessed.

There was a small but statistically significant trend indicating a dose response relationship between exposure to information sessions received by children and sun protection habits: scores on the composite behaviour measure indicated slightly higher scores amongst participants who had received the most sessions.

This was a reasonably good quality study with no major sources of bias, though it should be noted that it consists of a series of cross-sections and is not a longitudinal study of one set of participants. This raises the possibility of there being differences between the respondents at baseline and follow-up unrelated to the intervention. An important limitation from the perspective of the review question being addressed is that it is not possible to determine the individual influence of the resource provision components. In addition, although the availability of a sunscreen dispenser was assessed, use of the free sunscreen was not. Although data on changes to the environment and lifeguard behaviour were based on observations, changes in sun protection behaviours were based on self-report.

A further six papers were related to the Glanz 2002[9] study; these focus on a Pool Cool diffusion trial (Elliott 2009[17]; Escoffery 2008[18]; Escoffery 2009[19]; Glanz 2005[20]; Hall 2009[21]) and a trial comparing Pool Cool with and without a peer driven component (Hall, 2008[22]). All of these studies were conducted in the USA. These papers were not quality assessed as they were included as related papers to the main trial largely providing information on implementation but individually did not meet the inclusion criteria.

The aim of the diffusion trial was to evaluate the effects of a basic and enhanced method for diffusion of the Pool Cool skin cancer prevention programme on implementation, maintenance sustainability; improvements in environmental supports; and sun protection habits and sunburns among children. Field co-coordinators, who were responsible for a cluster of 4 to 15 pools in a

region, were randomly assigned to receive a basic implementation tool kit (implementation guide, lesson cards, cartoons for interactive use, material for poolside activities, sunscreen dispenser and sunscreen tips) or an enhanced kit (basic kit plus additional sun safety items, signs, shade structures and incentives for field coordinators including hats, UV sensitive stickers and water bottles). At the end of the first year there was a high rate of participation across all the pools. Statistically significant differences were found between the enhanced and basic diffusion in 2 out of 10 comparisons: Pool Cool lessons were taught less frequently in the enhanced group than the basic group (mean 2.94, SD 0.98 versus 3.06, SD 0.94; p=0.04) and pools in the enhanced group displayed sun safety signs less frequently than pools in the basic condition (72% versus 93%; p=0.001) (Glanz 2005[20]). Diffusion was also assessed based on pool activity logs, emails to and from field coordinators, site visits and pool observations over 2 to 4 years. Implementation was high across all pools and there were few significant differences between the enhanced and basic conditions across all years.

An additional partly randomised controlled study (Hall 2008[22]) built on the diffusion trial and involved implementation strategies specifically targeted at Pool Cool lifeguards. Pools were assigned to Pool Cool (the standard programme) or Pool Cool Plus which consisted of the standard programme plus a peer-driven programme for lifeguards. All pools received Pool Cool: the study was designed to assess the effectiveness of a peer approach to implementation and not to evaluate Pool Cool. There was a statistically significant increase in sun protective behaviours in both groups over the summer (approximately 3 months), from baseline (start of the summer) to follow-up (end of the summer) ($p<0.04$); there was a statistically significant increase in sun protective habits at work in the standard intervention only (p=0.02); and a statistically significant decrease in sunburn in the enhanced group only ($p<0.001$).

In a case study, three of 16 pools implementing the Pool Cool programme were identified as having higher sunscreen use than the others, >95% compared to 47% for the others, based on skin swabbing (Elliott 2009[17]). Observations of sun safety behaviours at these three pools revealed statistically significant differences between the three high sunscreen use pools and the other 13 pools in use of sunglasses (45% versus 24%; $p<0.001$), but not any other sun protective behaviours. At the three high sunscreen use pools it was reported that sunscreen was available and conveniently located, highly visible, easy to access and usually located nearer to the pool and or entrance to an office or break-room. No information was reported with regard to the other thirteen pools.

Mayer 1997 [10] ([+] quality): One cluster RCT evaluated the effectiveness of provision of information to 4 to 11 year olds taking swimming lessons in outdoor pools, plus making sunscreen and hats available, in California, USA.

48 swimming classes at 4 YMCA pools were randomly assigned to the intervention or the no intervention control group. All children attending the classes were invited to attend and 169 participated. The information component of the intervention consisted of five-minute lessons at the beginning of four swimming lessons, each lesson covering a different sun protective behaviour. Home-based information and activities included a manual for parents on skin cancer prevention, a range of age-appropriate child activities and family activities. Sunscreen and hats were made available for the children at the swimming lessons; further details were not provided on this component of the intervention. Outcomes were assessed less than one month after the end of the intervention and included tanning of skin and parent reported child sun protection behaviours. The mean age of participants was 7.6 years (range 4 to 11), 50% were female, 80% were white, 26% had skin that usually or always burns and 41% that sometimes burns. Family income was at least $30,000 for 85% of participants and at least $50,000 for 67%.

There was no statistically significant difference at follow-up between the intervention and control groups in tanning, based on L* or B* colour dimensions (p=0.19; p=0.084 respectively); in a composite measure of sun protective behaviours (p=0.15) or sunscreen use (p=0.44). The intervention group showed statistically significant greater hat use (p=0.029) at follow-up: intervention 2.84 versus control 2.52 (adjusted for baseline) on a 5-point scale ranging from 1 'never' to 5 'always'.

Data relating to the secondary review questions were not reported.

The key limitation of this study, from the perspective of the review question being addressed, is that the study was not designed to assess the contribution of the resource provision component. In addition, the resource provision component was a minor component of an intervention that was predominantly information provision and no details are provided about how the resources were made available or on uptake. Overall this was a reasonable quality study with no major sources of bias and an objective measure of sun exposure was used. It was unclear whether the study had enough participants to detect a statistically significant difference between groups for all the outcomes. The authors suggest that the small number of short information sessions may have been too short to produce an effect.

Weinstock 2002[11] ([-] quality): An RCT evaluated the effectiveness of a 12 month multi-component intervention including provision of information and free sunscreen to 16 to 65 year old beachgoers, compared to no intervention, in Rhode Island, USA.

Adult beachgoers (n=2800) at seven public coastal salt-water beaches were approached to participate in the study and were randomised to the intervention or control groups. The intervention consisted of provision of an educational pamphlet, a personalised sun sensitivity assessment with written and verbal feedback, an instant sun damage imaging photograph plus free SPF15 sunscreen. The intervention was based on Stages of Change Theory and was delivered at the beach by trained interviewers who were University students. Beach-goers received a written, personalized feedback report, based on stage of change, at baseline and 12 months later based on information provided at 12 month follow-up. Further information on sun protection was sent to participants through the post. Details of the quantity of sunscreen provided are not reported. The mean age of participants was 33 years and 70% were under 40 years of age. 60% were female, 94% were white non-Hispanic, the majority had an annual household income of more than $25000 and 62% had at least some college education. 74% had moderate or high sun sensitivity. Self-reported sun protection behaviours and stage of change were assessed at 12 and 24 month follow-up.

There was a statistically significant difference between the intervention and control group over 24 months in self-reported sun protection behaviours, in favour of the intervention. The difference was statistically significant for the composite measure of sun protective behaviours ($p<0.001$), sunscreen use ($p=0.001$), hat use ($p=0.047$) and sun avoidance ($p=0.008$). The differences were modest: on the composite measure of sun protective behaviours the intervention group increased from a mean of 2.82 (SD 0.87) at baseline to 3.18 (SD 0.86) at 24 months and the control group from 2.78 (0.88) to 3.02 (0.85) on what appears to be a 5-point scale. The composite scale had nine items each assessed on a 5-point likert scale. However the total possible score range of 5 to 45 does not tally with the mean total scores reported therefore we have assumed that the composite score is a mean of the average individual question score, i.e. ranging from a possible 1 to 5. The mean stage of change for the intervention group also increased significantly more over time in the intervention group than the control group for general stage of change ($p=0.004$) and sunscreen stage of change ($p=0.001$).

The authors stated that, based on an analysis of covariance, the intervention was most effective for younger individuals, people who had low sun sensitivity and individuals with incomes less than $25,000. However the results of this analysis were not presented and therefore this should be treated with caution.

This study was not designed to address the individual contribution of provision of free sunscreen, as part of a multi-component intervention, to the outcomes measured. In addition, the resource provision was a minor component of a predominantly information intervention and no details were provided of how the resources were made available or on their uptake. The study had some

important limitations including a high loss to follow-up (38% at 24 months) and reliance on self-reported behaviours. Participants completing each assessment were eligible for a $1000 lottery prize therefore the study may overestimate continued participation in such an intervention in other settings.

Winett 1997[12] ([–] quality, study 1): One cluster RCT evaluated the effectiveness of provision of information at a pool setting plus free sunscreen for pool users and free hat and shirts for lifeguards compared to an information intervention only, in Virginia, USA.

Twenty-three public and private pools with 50 to 75 users on warm summer days, a pool manager and at least two lifeguards were randomly allocated to the intervention or control group. The intervention consisted of provision of information posters for the pool area, a weekly entry into a lottery (prize was a shirt or hat) for those engaging in sun protective behaviours, a poster to provide feedback on the proportion of pool users engaging in appropriate sun protection behaviours, logo hat and t-shirts for lifeguards for voluntary use, plus free sunscreen available in two large self-serve containers at each pool over 32 days. The comparison group received informational posters plus sunscreen containers as in the intervention group. The primary outcome of interest was the number of lifeguards and pool users using appropriate sun protective behaviour which was defined as being completely in the shade or wearing a shirt plus a hat or sunglasses as assessed by trained observers. The sunscreen containers were weighed every week. The demographic details of participants were not reported.

There was a statistically significant increase in the proportion of children in the intervention group engaging in sun protective behaviours (being completely in the shade or wearing a shirt plus a hat or sunglasses) over the 32 day intervention period, compared to the baseline period (baseline 38%, SD 15 to intervention period 50%, SD 15; $p<0.05$), the proportion of lifeguards in the intervention group engaging in sun protective behaviours (46%, SD 22 to 75%, SD 16; $p<0.001$), but not for adults (27%, SD 11 to 33% SD 13). Between-group comparisons were not made. Based on the weighing of sunscreen containers, about 10 applications per day were used, which appeared to be across both the intervention and control groups.

Data relating to the secondary review questions were not reported.

This study was not designed to address the individual contribution of provision of free sunscreen, as part of a multi-component intervention; given that both groups appeared to receive the free sunscreen it was not really part of the intervention being assessed. However, unlike many of the other included studies, use of sunscreen was assessed. Behaviours were observed rather than self-

reported and the reliability of observations was reported to be high, though details of the processes used were few. The study had a number of limitations, in particular, the number of participants is unclear and no participant details were provided making it difficult to assess whether the findings are generalisable.

Winett 1997[12] ([–] quality) (Study 2): This before and after study built on the randomised study reported above (and was reported in the same paper). The 8 week before and after study supplemented the intervention as described in Winett Study 1 (1997) with 'kick-off' days to introduce the programme involving music, food and entertainment, large posters, frequent lotteries, a choice of hats and better quality shirts for lifeguards, an attempt to reach agreement that lifeguards be required to follow SunSafe guidelines, a competition and provision of a shaded area. Four pools were included and they received slightly different interventions in terms if the timing of delivery of the components, whether new shade was provided and whether there was a requirement for lifeguards to wear sun protective clothing or sit in the shade whilst on duty. There was variability in sun protective behaviours across the pools but it is not possible to meaningfully attribute these to the different ways in which the interventions were delivered.

Lombard 1991[14] [-] quality: An earlier, poor quality before and after study, of a very similar intervention to Winett (1997), which was implemented at two pools, reported improvements in observed sun protective behaviours amongst adults, children and lifeguards. As with Study 2 above the intervention was implemented differently at the two pools; at one pool the components were phased in and at the other they were all implemented from the beginning. There was variability in sun protective behaviours across the pools but it is not possible to meaningfully attribute these to the different ways in which the interventions were delivered. No statistical analysis was reported comparing behaviours before and after the intervention. Importantly, the sunscreen available at each pool was not a part of the intervention; it was available at baseline and during the intervention. Use at both time periods was very low: 0.01 ounces per pool user across both pools and time periods.

Pagoto 2003[13] ([–] quality): One non-randomised controlled trial evaluated the effectiveness of a multi-component intervention, designed to provide education and enhance the personal relevance of sun-related risks in adult beachgoers (≥18 years), compared to a no intervention control, in a midwestern USA city.

Two areas on a lakeside sandy beach, one mile apart, were designated as the intervention (53 participants) or control area (47 participants). The intervention consisted of modeling by the

researchers of proper sun protection behavior, sun safety recommendations based on individual skin sensitivity, a pamphlet containing safe sun recommendations, assessment of skin photodamage based on instant UV photographs, commitment cards and an offer of a selection of free sunscreens with instructions on proper application. The intervention group participants were slightly older (28 years (SD 6) versus 24 years (SD 3) years old), a higher proportion were female (75% versus 55%), and they reported greater sun exposure at baseline than the control group (mean 14.9, SD 16.9 versus 7.5, SD 7.0 hours per week). Self-reported sun protection behaviours using a composite measure of behaviours (sunscreen use, use of protective clothing, and number of body parts protected from the sun), sun exposure and stage of change were assessed at 2 month follow-up.

Self-reported sun protection behaviours (composite measure) were significantly higher ($p < 0.01$), (i.e better), in the intervention than the control group at 2 month follow-up, when adjusted for baseline scores: intervention mean 6.4 (SD 1.8); control 5.2 (SD 1.8) on a possible score range of 1 to 7. There was no statistically significant difference between groups in sun exposure. For stage of change, significantly more participants in the intervention group advanced by at least one stage (49% versus 25%; $p<0.02$) and there was no significant difference between groups in stage regression.

Data relating to the secondary review questions were not reported.

This study was not designed to address the individual contribution of provision of free sunscreen, as part of a multi-component intervention. In addition, the resource provision component was a minor element of a predominantly information intervention and no details were provided of how the resources were made available or on uptake. Important limitations of the study include its non-randomised design and the likelihood of selection bias due to the process used for selecting people on the beach for inclusion in the study. In addition, the sample of beaches and beachgoers was small, there was a reliance on self-reported outcomes and there was high loss to follow-up.

Other study designs

Dobbinson, 1999[15] ([-] quality): One observational study evaluated the effect of a 10 year sponsorship programme of life-saving associations in Victoria, Australia on sun protective behaviours of lifeguards.

Dobbinson[15] undertook a survey of 129 lifeguards in Victoria, following 10 years of the sponsorhip programme, a survey of 134 lifeguards in New South Wales, where the programme had not been implemented, plus interviews with 381 beachgoers across the two areas to assess lifeguards' sun protection behaviours. The sponsorship programme included education for lifeguards, provision of

free sunscreen in the first year of the programme that they could sell at a profit, shade structures and protective clothing (including broad-brimmed hats and long-sleeved t-shirts) and access to lifeguard training programmes for youth that raise awareness and provide education related to skin cancer. The majority of lifeguard participants were male (67%) and one third reported that their skin was susceptible to sunburn; 52% of participants in Victoria were under 20 years old compared to 37% in New South Wales.

There was consistently higher regular use of sun protective behaviours (self-reported) amongst Victorian lifeguards than New South Wales lifeguards: for wearing hats in the sun (89% in Victoria versus 55% in New South Wales, $p<0.001$); long-sleeved shorts in the sun (81% in Victoria versus 60% in New South Wales, $p<0.05$); sunscreen use in the sun (97% in Victoria versus 85% in New South Wales, $p<0.001$); shelter use in the sun (77% in Victoria versus 62% in New South Wales, $p<0.05$); hats when no sun (71% in Victoria versus 22% in New South Wales, $p<0.001$); sunscreen use when no sun (76% in Victoria versus 54% in New South Wales, $p<0.001$); and shelter use when no sun (59% in Victoria versus 42% in New South Wales, $p<0.01$). Significantly fewer lifeguards in Victoria had had sunburn whilst on patrol that summer (42% in Victoria versus 65% in New South Wales; $p<0.001$). There were no statistically significant differences between the two groups in attitudes to having a suntan and sunbathing. Interviews with beachgoers found that 76% believed that lifeguards sun protective role modeling provided some encouragement to beachgoers to take precautions in the sun and this was similar in the two states. Significantly more Victorian beachgoers said they had noticed health messages at the beach compared to those in New South Wales (29% versus 9%; $p<0.001$) though, this seems a small proportion.

Data relating to the secondary review questions were not reported.

This study was not designed to assess the individual contribution of free sunscreen and provision of hats and long-sleeved t-shirts, as part of a multi-component intervention, on sun protective behaviours. The sunscreen, which was for selling at profit, rather than for use by the lifeguards, appears to have been provided only in the first year of the 10 year sponsorship programme. The timeframe over which the clothing and hats had been available was unclear. The study design was not prospective and it is highly likely that other differences between the two areas may have influenced the results. For example, the authors suggest that the sunburn differential may be due in part to higher UV levels in New South Wales than Victoria. Details of the participants are limited and the generalisabilty of the findings is unclear.

Multi-component interventions at beaches and outdoor swimming pools

ER 4.7 None of the multi-component studies carried out at beaches or outdoor swimming pools were designed specifically to assess the effect of the individual components that comprised the intervention. Therefore, where studies find an effect, it is not possible to determine the contribution of the various components (Glanz 2002 [+]; Mayer 1997 [+]; Weinstock 2002 [-]; Winett 1997 [-] study 1 and [-] study 2; Pagoto 2003 [-]; Dobbinson 1999 [-]).

ER 4.8 There was weak evidence from two American studies, an RCT (Weinstock 2002 [-]) and a non-randomised controlled trial (Pagoto 2003 [-]), that a multi-component intervention including provision of information by trained interviewers or researchers, showing adult beachgoers photographs of their own UV skin damage and provision of sunscreen was associated with statistically significant improvements in a number of self-reported sun protective behaviours. The RCT (Weinstock 2002 [-]) reported a modest but statistically significant benefit for the intervention group on a composite measure of sun protective behaviours ($p<0.001$), sunscreen use ($p=0.001$), hat use ($p=0.047$) and sun avoidance ($p=0.008$) at 24 month follow-up. The mean general stage of change ($p=0.004$) and mean sunscreen stage of change ($p=0.001$) also increased significantly more over time in the intervention group than the control group. The quantity of sunscreen provided and use of and response to the free sunscreen was not reported. The non-randomised controlled trial (Pagoto 2003 [-]) also reported a statistically significant improvement on a composite measure of sun protective behaviours ($p<0.01$) but not sun exposure for the intervention group compared to control at 2 month follow-up and more participants in the intervention group advanced by at least one stage of change (49% versus 25%, $p<0.02$).

ER 4.9 There was weak evidence from a further RCT (Winett 1997 [-], study 1) that provision of information through posters, weekly lotteries to reinforce appropriate sun protective behaviours (ie. staying in the shade; wearing hats, shirts and sunglasses), provision of hats and shirts for lifeguards and free sunscreen for pool users improved observed sun protective behaviours amongst children and lifeguards, but not adult pool users. There was a statistically significant increase in the proportion of children in the intervention group observed engaging in sun protective behaviours (ie. staying in the shade; wearing hats, shirts and sunglasses) over the 32 day intervention period, compared to the baseline period ($p<0.05$), the proportion of lifeguards in the intervention group engaging in sun protective behaviours ($p<0.001$), but not adult pool-users ($p>0.05$). There was no statistically significant change in the control group. Between-group comparisons were not made. Approximately 10 applications per day were used from the two large self-serve sunscreen containers provided at each pool (pools served at least 50-75 users on warm summer days) (Winett 1997 [-],

study 1). There were two poor quality before and after studies assessing a similar intervention but due to several limitations it is difficult to attribute any variations in observed sun protection behaviours to the intervention (Winett 1997 [-], study 2; Lombard 1991 [-]).

ER 4.10 There was contradictory evidence from two American RCTs (Glanz 2002 [+]; Mayer 1997 [+]) about the effect of an intervention including provision of information by pool staff to children under 12 years old during a series of swimming lessons, information provided through other activities, incentives and free sunscreen and hats. One RCT (Glanz 2002 [+]) reported a statistically significant benefit ($p<0.05$) at 8 week follow-up in the intervention group for some self-report sun protective behaviours in children though the effect sizes were modest (sunscreen use, d=0.17; shade, d=0.23; composite score of sun protection habits and sunburn, d=0.22) and there was no statistically significant benefit for wearing a shirt, sunglasses or hat. The results were similar for adults: there was a statistically significant benefit in the intervention group compared to the control group for the composite score ($p<0.05$, d=0.19), use of sunscreen ($p<0.01$, d=0.17), wearing a hat ($p<0.01$, d=0.17), but not wearing a shirt, sunglasses, staying in the shade or knowledge. By contrast, results for lifeguards showed no statistically significant differences between groups in the use of sunscreen, use of shirt, use of a hat, staying in the shade, use of sunglasses, or for the composite score, though lifeguards in the intervention group at moderate or high risk of sunburn had significantly fewer sunburns by the end of the summer than the control group (1.42 versus 2.07. $p<0.05$). The second RCT (Mayer 1997 [+]) reported no statistically significant improvement, at approximately one month follow-up, in sun exposure as measured by the darkness of suntan or in self-reported sun protective behaviours (composite score of sun protective behaviours $p=0.15$; sunscreen use $p=0.44$), except for hat wearing which showed a statistically significant ($p=0.029$) but very small benefit for the intervention group at follow-up, a difference of 0.32 points between intervention and control on a 5 point scale.

ER 4.11 There was weak evidence from a single observational study (Dobbinson 1999 [-]) that a 10 year sponsorship programme for lifeguards in Victoria, Australia, that included provision of free sunscreen for lifeguards to sell at a profit to beachgoers in the first year, and provision of long-sleeved tops and hats for lifeguards to wear themselves, improved several observed sun protective behaviours in the intervention group when compared to lifeguards from New South Wales (wearing hats in the sun, $p<0.001$; long-sleeved shorts in the sun, $p<0.05$; sunscreen use in the sun, $p<0.001$; shelter use in the sun, $p<0.05$; hats when no sun, $p<0.001$; sunscreen use when no sun, $p<0.001$); shelter use when no sun $p<0.01$; and experiencing sunburn whilst on patrol that summer ($p<0.001$).

ER 4.12 In relation to the secondary review questions, Glanz 2002 [+]reported a small but statistically

significant trend indicating a dose response relationship between exposure to information sessions received by children and sun protection habits: scores on the composite behavior measure indicated slightly higher scores amongst participants who had received the most sessions.

ER 4.13 Weinstock (2002 [-]) stated that, based on an analysis of covariance, the multi-component intervention including provision of information and free sunscreen to beachgoers was most effective for younger individuals, people who had low sun sensitivity and individuals with incomes less than $25,000. However the results of this analysis were not presented and should therefore be treated with caution.

Applicability

This evidence is only partially applicable to the UK setting. The studies were undertaken in countries with a warmer summer climate than UK where attendance at outdoor pools and beaches is likely to be a more regular activity. The benefit of any such interventions may be less in a UK setting.

3.4.2 Community setting

Three cluster randomised controlled trials (Dietrich 2000,[24] [+] quality; Glanz 2000,[25] [-]; Olson 2007,[26] [-] quality), one non-randomised controlled trial ([c]Mayer 2001,[27] [-] quality), and one before and after study (Glanz 1998,[28] [-] quality) assessed the impact of multi-component interventions in various community settings. Table 3 provides a summary of key study characteristics and the full evidence tables are provided in Appendix 7 (Table C). All five studies reported sun protection behaviour or sun exposure as an outcome; two of the studies used self-report measures only (Glanz 1998,[28] [-]; Glanz 2000,[25] [-]), two used observed and self-report measures (Dietrich 2000,[24] [+];Olson 2007,[26] [-]) and in one study behaviour was observed in conjunction with an objective measure of sunscreen and hat sales Mayer 2001,[27] [-]. Two studies also reported knowledge or attitudes (Glanz 1998,[28] [-]; Glanz 2000,[25] [-]). A single cost-effectiveness study was included for this setting (Gordon (2009[29]).

All five effectiveness studies were conducted in the USA in schools/day care, primary care practices, a zoo, and various types of recreation sites. All study interventions included education or the provision of information in conjunction with sun protection items, such as sunscreen samples and/or

[c] This study was also included in the Phase 1 report. It has been included here to ensure consistency within this report as other similar studies are included.

dispensers, t-shirts and hats, and portable shade tents, or discounts towards sun protection items. The target audience included children, their parents, and staff in the various community settings.

Only one RCT scored well on quality (Dietrich 2000,[24] [+] quality), the remaining studies had several limitations which need to be taken into consideration when interpreting the findings.

The evidence was mixed, both within and between studies. A three-arm RCT (Glanz 2000,[25] [-]) conducted at outdoor recreation sites in Hawaii found significantly better self-reported sun protection behaviours (composite measure) for 6 to 8 year old children but not recreation staff following an intervention consisting of (i) information provision, (ii) sun protection resources in the form of incentives plus (iii) an environmental component (sunscreen in large dispensers, portable shade tents, sun safety posters and policy consultation with SunSmart staff) compared to control. The intervention consisting of all three elements had no additional benefit compared to information plus sun protection resources in the form of incentives. An earlier before and after study assessing a similar intervention in Hawaii, of information provision, sun protection resources in the form of incentives, and sunscreen in dispensers at recreation sites, reported a significant improvement in child and parent but not staff self-reported sun protection practices (Glanz 1998 [-]).

A non-randomised controlled study in California assessing the effects of information provision plus discounted sunscreen and hats in zoo gift shops[27] found a significant increase in observed ideal hat use in under 12s leaving the zoo, compared to the control park, in winter but not in summer. There were significant increases in sunscreen sales during the year and hat sales during summer (Mayer 2000 [-]).

In two RCTs of different duration, 3 months (Dietrich 2000 [+]) and one year (Olson 2007 [-]), the resource provision element of the multi-component intervention comprised only a sunscreen sample; therefore the studies are very limited in terms of addressing the review question. Both studies assessed a reasonably similar SunSmart intervention which delivered information in several formats through parents, schools and primary care. Various incentives were provided including sunscreen samples. Both studies reported no benefit in observed use of shade or protective clothing. The shorter duration study found significant improvement in self-reported sunscreen use and protection of at least one body part from the sun by any means in under 11 year olds compared to control at one year follow-up (Dietrich 2000 [+]). The longer duration study found a significantly smaller reduction amongst adolescents in the proportion of their body covered by any means and in self-reported sunscreen use at two year follow-up compared to control (Olson 2007 [-]).

The studies are grouped below by type of resources provided. Studies providing sunscreen or clothing are discussed individually and the studies providing only sunscreen samples are discussed as a group.

Table 3: Summary of studies evaluating a multi-component intervention in community settings

Study details	Setting and population	Intervention (I) and Comparator (C)	Outcomes[‡]
Dietrich et al. 2000[24] Related paper Dietrich 1998[30] Cluster RCT *Validity* Internal + External +	School/day care and primary care settings in New Hampshire, USA Children aged 2 to 11 years in towns with the highest proportion of low income families	I: (i)School/day care settingreceived age- and grade-specific curriculum and 'free materials' for at least two class periods; (ii) Beach areas provided a sun protection poster with a daily update on predicted UV index for the day, sunscreen samples and educational pamphlets; (iii) In primary care settings an office system was set up to promote sun protection advice during patient visits, practice meetings for project staff, a sun protection manual, patient education material, and sunscreen samples. C: No intervention	• Sun protection practices *Use of sunscreen* *Use of shade* *Use of protective clothing, or hat* *Composite measure* ***(observed behaviours except sunscreen use)***
Glanz et al. 1998[28] Before and after *Validity* Internal - External -	Five public and privately sponsored outdoor recreation sites in Hawaii, USA 6 to 8 year old children, their parents and staff at field test sites for SunSmart	I: A four week education intervention to increase awareness, intentions, skills, and practices for skin cancer prevention. Included staff training; activities for children and their parents; incentives for children and staff (eg. sunscreen samples, t-shirts, and SunSmart hats, pencils magnets and lunch snacks; promotion of sunsafe environments and policies including behaviour monitoring score boards; and sunscreen dispenser and sun safety poster at each site. C: Not applicable	• Sun protection practices *Use of sunscreen* *Use of shade* *Use of protective clothing or hat* *Use of sunglasses* *Composite measure of behaviours* • Knowledge, attitudes, beliefs • Process and implementation • Other
Glanz et al. 2000[25] Related paper Glanz 2001[31] Cluster RCT *Validity* Internal - External -	14 outdoor recreation sites (Summer Fun programmes) on the island of Oahu, Hawaii, USA Children aged 6 to 8 years and their parents, and recreation leaders	I (Education plus environmental): Provision of information and incentives (eg. sunscreen samples, t-shirts, and hats) plus an environmental component including provision of sunscreen in large dispensers, sun safety posters, portable shade tents, and policy consultation with SunSmart staff. I(Education): Provision information and incentives, (eg. sunscreen samples, t-shirts, and hats) C: No intervention	• Sun protection practices *Use of sunscreen* *Use of shade* *Use of protective clothing or hat* *Use of sunglasses* *Composite measure of behaviours* • Knowledge, attitudes, beliefs • Process and implementation
Mayer 2001[27] Non-randomised controlled trial *Validity* Internal - External -	Visitors to the San Diego Zoo and to the San Diego Wild Animal Park, California, USA No population details provided	I: Provision of sun safety information and prompts, and coupons for discounted children's hats and sunscreen in zoo gift shops. C: No intervention	• Sun protection practices *Sales of sunscreen and hats* ***(objective measure)*** *Use of protective clothing or hat* ***(observed behaviour)*** • Process and implementation
Olson 2007[26] Cluster RCT *Validity* Internal - External -	10 communities in New Hampshire and Vermont, USA 10 schools (grade 6 to 8), 11 primary care practices, and athletic and recreation programmes in the	I: Adults received educational materials and sun protection reminders (eg. teachers received water bottles, pencils, tote bags; and coaches and lifeguards received lanyards, tote bags, and sunscreen samples). Included annual presentations to provide new messages and materials, and supplies of sun screen were replenished. SunSafe bookmarks were distributed	• Sun protection practices *Use of sunscreen* *Composite measure of behaviours* ***(observed behaviours except sunscreen use)***

	intervention communities	throughout libraries each intervention year, and sun protection posters were displayed in years two and three. Students received materials on protecting against the sun while having fun outdoors, including activities and incorporation of sun safety into school health fairs and inclusion of sun protection on school outdoor trip permission forms. C: Appeared to be no intervention (no details provided)	

[†]Self-report measures, unless otherwise indicated

Randomised and non-randomised controlled trials

Studies providing sun protection resources

Glanz 2000[25] ([-] quality): A cluster RCT assessed the effects of a multi-component intervention on children aged 6 to 8 years (n=383), their parents, and recreation leaders (n=127) at 14 outdoor recreation sites (Summer Fun programmes) on the island of Oahu, Hawaii, USA. The intervention was based on Social Cognitive Theory and Stages of Change, and included (i) training for recreation staff, activities and information for children and their families (ii) incentives (sunscreen samples, magnets, SunSmart logo t-shirts, and logo hats), and (iii) an environmental component consisting of making large dispensers of sunscreen available at sites, sun safety posters, portable shade tents, and policy consultation with SunSmart staff. Comparison groups included an education arm and a no intervention control arm. The education arm provided (i) staff training, activities and information, and (ii) incentives, but not the additional environmental items (findings for this arm were reported as part of the Phase I report).

The mean age of staff was 20.9 years, for children 7 years and for parents 38 years. The majority of parents were female, had at least some college education, and had household incomes over $20,000 per year. 20% of parents were classified as white. Skin types were reported for children using a skin cancer risk index (score 0 to 4): Education/environment 1.21; education 1.39; control 1.38. The majority of staff were Hawaiian, Japanese or mixed Asian ethnicity; 5% were white.

The main outcome of interest was parent-reported sun protective behaviours by children using a composite measure of five behaviours[d] (wearing a shirt with sleeves, wearing sunglasses, seeking shade, using sunscreen, and wearing a hat) with a possible score range of 1 to 20. Data on sunscreen use were reported individually, but data on the remaining four components of the composite measure were only presented as graphs and it was not possible to extract data from them. Only

[d] Responses were categorised on a scale of 1 to 4: usually, sometimes, rarely, never.

Environmental support and policy outcomes included scheduling activities to reduce sun exposure, providing shaded areas, providing sunscreen, requiring use of hats and shirts, and providing sun protection information to parents. Self-reported sunscreen use and sun protective behaviours using the composite measure of five behaviours were also assessed for recreation staff in addition to knowledge about skin cancer prevention, their sun protection habits, and perceived norms. Staff completed surveys and monitoring forms to measure the effects of the intervention on the site sun-protection policies and the extent of intervention implementation (score range 0 to 5).

There was a statistically significant improvement in childrens' sun protective behaviours (composite score) in the education/environment group compared to control, six weeks following the implementation of the intervention (adjusted mean difference in change 0.19, *SE 0.06; $p<0.01$), and improvement in the education group compared to control group (0.20, *SE 0.06; $p<0.001$), but no statistically significant difference between the education/environment and education only groups. There was no statistically significant difference in sunscreen use in the education/environment group compared to control though there was a significant increase for the education group compared to control (adjusted mean difference in change 0.16, *SE 0.08; $p<0.05$). The authors state that at three month follow-up differences between the groups narrowed except for sunscreen use. (*an assumption has been made that this figure is an SE as it is not explicitly stated in the paper)

At six week follow-up, there were no statistically significant differences in staff sun protection habits (composite score) between the education/environment and control group (mean difference in change 0.17, SE 0.12) or the education group (comparison not reported), though there was a significant difference between the education and control group (mean difference in change 0.37, SE 0.12; $p<0.05$) in favour of the education group. There was a statistically significant increase in staff use of sunscreen in the education/environment group compared with control at six weeks (adjusted mean difference in change 0.43, SE 0.22; $p<0.05$), but no statistically significant difference between the education and control group. There was a statistically significant improvement in staff perceived norms and in knowledge in both intervention groups compared to control after 6 weeks. There was a significant improvement in sun protection policies in the education/environment group compared with control; (mean difference in change 0.95, SE 0.39, $p<0.05$). These differences appeared to be maintained at 3 month follow-up.

86% of staff in the education/environment and education only groups reported giving sun safety messages to children; 89% encouraged children to be sun smart at home; and 77% went over the

ABCs of sun protection. There were no statistically significant differences between the education/environment and education only groups in levels of implementation.

Interpretation of this study is complicated by the fact that there were two forms of resource provision to participants. First there was resource provision in the form of incentives that included sunscreen samples, t-shirts and hats amongst other items. This was provided to both intervention groups therefore it is not possible to determine the contribution of provision of these items to outcome. Second, there was resource provision in the form of an environmental component to one group therefore it is possible to draw conclusions about the contribution of that component. However, the resource provision (sunscreen in large dispensers at the recreation sites plus portable shade tents) in this additional environmental component was also accompanied by enhanced information in the form of policy consultations with SunSmart staff and sun safety posters for the recreation area. Therefore it is not possible to unravel the effect of the resource provision and the other strands of the environmental component. However given the lack of benefit found with the additional environmental component it would seem reasonable and pragmatic to conclude that neither the resource provision nor the other environmental strands contributed any extra benefit.

The study had a number of limitations including an unclear method of randomisation, outcomes based on self-reported behaviours, and high rates of attrition, especially at 3 month follow-up. Given the ethnic make-up of the participants (20% of parents and 5% of staff were white), generalisability to the UK is unclear.

Mayer 2001,[27] ([-] quality): One non-randomised controlled trial assessed the effects of providing information and discounted coupons on sun protection behaviours. Participants were visitors to the San Diego Zoo and to the San Diego Wild Animal Park, California, USA. Details on participant characteristics were not reported, but during winter 8,721 participants were included (zoo n=5,418, park n=3,303) and during summer, 8,524 participants were included (zoo n=6,011, park n=2,513). The zoo was in a downtown area whilst the comparator site was in a relatively rural area 29 miles away. Both sites were operated by the same zoological society and sold similar items in the gift stores.

Visitors at the zoo received the six week intervention during winter and four week intervention during summer, which included provision of information sheets and activities, and coupons for discounted children's hats (11-17% discount in the form of $1.00 off hats ranging from $5.99 to $8.99) and sunscreen (10% discount in the form of $0.25 off $2.49 sunscreen) in the zoo gift shops.

Sunscreen and sun safety reminder signs were also provided. Visitors to the wild animal park did not receive any intervention.

Two methods were used to measure hat and sunscreen use; observations on hat use by children who appeared 12 years or younger were recorded as they exited the intervention/comparator site. In addition, sales of sunscreens and targeted hats at the zoo and park gift shops were monitored.

During winter, the odds of ideal hat use (i.e. flap, 2 or 3 inch brim, stroller/umbrella) were statistically significantly greater in the intervention group compared to the comparator group (OR: 1.84, 95% CI 1.13 to 2.98; p=0.01), but there were no statistically significant differences during the summer (p=0.46). Rates of ideal hat use, even in the intervention group remained fairly low after the intervention: 3.8% of children had ideal hat use following the winter zoo intervention and 13.3% following the summer intervention.

There were statistically significant increases in sunscreen sales at the intervention site compared to the comparator site during winter (p=0.011) and summer (p<0.001) and in hat sales during summer (p=0.007). During the winter 1,128 tubes of sunscreen and 1,518 hats were sold (67% and 48% respectively, purchased with discount coupons). During the summer 2,283 tubes of sunscreen and 3,162 hats were sold (68% and 47% respectively, purchased with discount coupons).

In both winter and summer, children aged 0-3 years wore ideal hats significantly more than children aged 4-9 years (OR 0.35, 95% CI 0.27 to 0.45; p<0.001 in winter and OR 0.22, 95% CI 0.19 to 0.26; p<0.001 in summer) and children aged 10-12 years (OR 0.44, 95% CI 0.30 to 0.65; p<0.001 in winter and OR 0.24, 95% CI 0.19 to 0.30; p<0.001 in summer). In both winter and summer, girls wore ideal hats significantly more than boys (OR 1.32, 95% CI 1.04 to 1.66; p=0.002 in winter and OR 1.39, 95% CI 1.21 to 1.60; p<0.001 in summer).

It is not possible to identify the effects of individual components of the intervention. Although the sites were well matched in respect to demographics, base rates of hat use and inventory of gift shop items, the intervention site was closer to the coast than the comparison site and experienced cooler temperatures. In addition the intervention was implemented at a single site only, therefore generalisability is unclear. It is also unclear how the sites were allocated to intervention and control and whether all visitors were observed during the allotted times, or if there was a selection process. The reliability of the methods used to measure sunscreen and hat use is unclear due to the lack of information. In addition, exit interviews indicated that a high proportion of visitors did not receive tip sheets or coupons (coupons being a main component of the intervention).

Studies providing sunscreen samples

In two studies, provision of sunscreen samples was the only element of the intervention that related to resource provision and both of these studies assessed a similar intervention known as SunSafe (Dietrich et al.,[24] [+]; Olson et al.,[26] [-] quality). The quality and interpretation of these studies are considered together at the end of this section.

Dietrich 2000[24] ([+] quality): A cluster RCT assessed the effects of a multi-component intervention promoting sun protection behaviour among children aged 2 to 9 years (extended to children aged 2 to 11 years at second follow-up) attending schools and day care centres, primary care practices, and recreation areas in ten towns with the highest proportion of low-income families, in New Hampshire.

Towns were selected into five pairs according to demographic characteristics and likelihood of similar weather patterns and then randomised to intervention (5 towns,) or no intervention control (5 towns). The intervention included provision of an age and grade specific curriculum covering at least two class periods; support to primary care practices to deliver sun protection advice during patient visits and provide educational material for patients; and in beach areas a sun protection poster with a daily predicted UV index and educational pamphlets. The resource provision element consisted of sunscreen samples at beaches and in primary care practices. Details of how these were distributed or volume provided to individuals was not reported. The intervention was delivered over a three month period in Spring with booster visits by researchers one year later.

Children in the intervention and control groups were comparable at baseline and follow up times in terms of age (categorised as less than five years or five years and over), gender, and the percentage with their own parent at the beach.

The outcomes assessed included the proportion of children at beaches protected with at least one body area protected by sunscreen, clothes or shade; proportion using shade; proportion protected by at least one item of clothing. Use of clothing and shade was assessed by observation and sunscreen use was based on adult caregiver report. Adults reporting on whether sunscreen was being used by their child were asked to produce the container. Field observers visited beaches in the 10 towns on days when the weather reports predicted that the temperature would exceed 72 degrees Fahrenheit (22 degrees Celsius) and showers or thick cloud were unlikely.

There was a greater increase in the proportion of children protecting at least one body area from the sun, using any method, from baseline to follow-up one year later in the intervention group compared to control and this was statistically significant (mean difference in change 0.12; p=0.03).

There was no significant difference between groups in use of shade or protective clothing, and use of these two resources was infrequent at both baseline and follow-up. There was greater use of sunscreen at follow-up in the intervention group, which was statistically significant for use on the back but not other body areas (mean difference in change 0.20; p=0.04)

Data relating to the secondary review questions were not reported.

Olson 2007,[26] ([-] quality: A second cluster RCT of the SunSafe intervention, implemented over a 3 year period assessed impact on sun protection practices in 1,927 adolescents (school grade 6 to 8) living in New Hampshire and Vermont, USA. The intervention was implemented at schools, athletic and recreation facilities, primary care practices, and other community venues.

Ten geographically distinct communities (20 miles apart) that had not previously participated in the SunSafe project were randomised to the intervention group or a no intervention control. The intervention was based on Bandura's Social Cognitive Theory, and the education sessions were based on Roger's Protection Motivation Theory. Adults at the various settings received educational materials and training which emphasised protecting themselves against the sun and being an effective role model and educator for adolescents. They also viewed skin damage under a UV-filtered light. SunSafe bookmarks were distributed throughout libraries in the summer of each intervention year, and sun protection posters were displayed in local stores in years two and three. Student materials and activities emphasised protection against the sun while having fun outdoors. Clinicians, teachers and coaches and lifeguards were provided with various aids and items to assist in counselling and for coaches and lifeguards this included sunscreen samples. There is reference to annual presentations providing new messages and materials, and supplies of sunscreen being replenished. It is unclear whether this refers to sunscreen samples or other sunscreen provision.

The primary outcome of interest was change in the mean percent of adolescents' body surface area protected from the sun by clothing, sunscreen or shade at one and two year follow-up. Trained observers visited pools/beaches between 11am and 3pm (June to August) on sunny, dry days to record clothing coverage (including use of hats and sunglasses) and shade protection. In addition, adolescents reported on their use of sunscreen on 4 body areas (face/neck, arms, legs, trunk) and corroborated this by producing the sunscreen bottle used.

The majority of participants were white and 57% were female. Almost all participants were in sixth grade at the start of the intervention (approximately 11 to 12 years old). Reported skin types appeared to be similar across the intervention and control group: rarely burn/always tan (41.7% in the intervention group and 40.1% in the control group); occasionally burn/often tan (30.3% in the

intervention group and 31.7% in the control group); usually burn/sometimes tan (20.6% in the intervention group and 19.0% in the control group); always burn/never tan (7.4% in the intervention group and 9.2% in the control group). Baseline comparisons showed differences between groups in the mean temperature when assessments were made at baseline and one year follow-up and differences in UV rating at all three assessment periods: there tended to be a higher proportion of outcome assessments for the intervention group undertaken when the UV rating was high (above 7) than the control group.

There was a statistically significant group by time interaction for the composite score at 2-year follow-up (coefficient 11.31, 95% CI: 4.5 to 18.13; p=0.001), but not at year 1 (p=0.35). There was a reduction in the mean proportion of body surface area covered both the intervention and control groups at 2 years from baseline, though the reduction was significantly less (p<0.01) in the intervention than the control group: a reduction of 8% in the intervention group (72%, SE 1.6 at baseline; 66%, SE 1.6 at year 2) compared to a 23% reduction in the control group (74%, SE 1.4 at baseline; 57%, SE 2.3 at year 2).

There were no significant differences between groups in use of protective clothing over time. Significantly more participants in the intervention group reported applying sunscreen to at least one body area at two year follow-up compared to control (47% versus 14%, p<0.001), though sunscreen use was significantly higher in the control group than the intervention group at one year follow-up (60% versus 47% respectively, p<0.01) and at baseline (66% versus 58% respectively, p<0.05).

The intervention was more effective than control in improving sun protection in girls compared to boys (coefficient 5.88, 95% CI: 0.84 to 10.92, p=0.022) and when the UV index was high (coefficient 7.04, 95% CI: 1.72 to 12.35, p=0.010).

A key limitation of both the SunSafe studies (Dietrich 2000; Olson 2007) is that resource provision was only in the form of a sunscreen sample. Both interventions consisted mainly of the provision of information and the studies were not designed to assess the effectiveness of provision of sun protective resources. It is of note, that there was no improvement in observed behaviours (use of clothing including hats and sunglasses) in either study, but there was for self-reported sunscreen use.

In addition, in one of these studies, further limitations were identified (Olson 2007[26] [-] quality); the population sample was not followed throughout the study and fewer observations were made over the two year follow-up. There is a real possibility that differences in the cohorts at the various time

periods may have biased the results and this may explain the contradictory findings for sunscreen use at two year follow-up compared to one year follow-up.

Other study designs

Glanz 1998[28] ([-] quality): A before and after study evaluated a four week multi-component intervention (SunSmart) delivered to 156 parents and their 6 to 8 year old children, and outdoor recreation staff (n=45) at five public and privately sponsored outdoor recreation sites in Hawaii, USA. The intervention included staff training, the provision of activities and information, and incentives such as sunscreen samples, magnets, t-shirts, insulated lunch sacks, and SunSmart hats. Sun safe environments and policies were promoted, and sunscreen dispensers and sun safety posters were provided at each site.

Parents and staff completed surveys at baseline and immediately after the four week intervention. The primary outcome of interest was the change in five sun protection practices (wearing a shirt with sleeves and/or a hat (recreation staff only), wearing sunglasses, seeking shade, using sunscreen) measured on a 4-point scale ranging from one to four ("rarely or never" to "always"). Each behaviour was assessed individually and also reported as part of a composite measure. In addition, parents, children, and staff were classified into one of four stages of change relating to sun protection habits, how long the habits had been practiced, and whether the respondent was thinking about or planning to take further steps towards sun protection.

The average age of staff was 20 years, but age was not reported for parents. Parents and staff were predominantly female (proportion not reported). Parents were mainly white or Asian/Pacific islanders (further details not reported), and staff were mainly Hawaiian (42.2%). The majority of parents were well educated and of middle or upper income, while 56% of staff reported that they had attended or graduated from college.

Longitudinal analysis (n=94 parents/children; 30 staff) showed no significant changes in sun protection practices among staff, but did show significant changes in sun protection practices among parents: baseline (SD) 12.7 (3.3); follow-up (SD) 13.4 (2.9) ($p<0.05$) and children: baseline 10.4 (2.8); follow-up 12.0 (2.6) ($p<0.01$). There were also significant changes in stage of change among parents: baseline 3.3 (1.0); follow-up 3.6 (0.7) ($p<0.05$) and children: baseline 3.6 (0.7); follow-up 3.8 (0.5) ($p<0.01$). Measurement of the individual components showed increases in the use of sunscreen among parents and children, and increased use of shade. Sunscreen use, hat wearing norms, and covering up when outside improved amongst staff.

Longitudinal analyses showed no significant changes in parental or staff knowledge, but did show significant changes in sun protection policies as reported by parents: baseline (SD) 0.8 (1.0); follow-up 1.6 (1.1) ($p<0.01$). 92.3% of staff reported presenting the sun safety messages using the stickers and SunSmart scoreboards (94.9%), 92.3% reviewed the ABCs of sun safety, and 89.7% encouraged children to be sun smart at home. Activities were rated favourably, and observations indicated that SunSmart activities were conducted often and were well received by children. Longitudinal and cross-sectional analyses showed no significant changes in parental stages of change.

Data relating to the secondary review questions were not reported.

One of the main limitations of this study was that sunscreen samples, t-shirts and hats were provided as incentives, and no details were provided about the sunscreen dispenser.

A non-experimental design was used to evaluate the intervention and the reliability of survey and observation methods was unclear. It is also unclear how the specific sites were chosen and how they compare with other similar settings, therefore limiting the generalisability of the findings.

Multi-component interventions in community settings

ER 4.14 None of the multi-component studies carried out in community settings (Dietrich 2000 [+]; Glanz 2000 [-]; Olson 2007 [-]; Mayer 2001 [-]; Glanz 1998 [-]) were designed specifically to assess the effect of the individual components that comprised the intervention. Therefore, where studies find an effect, it is not possible to determine the contribution of the various components.

ER 4.15 There was weak evidence from a single RCT (Glanz 2000 [-]) that adding sun protection resources plus other environmental components to an information intervention, delivered by recreation staff over a 6 week period, had limited benefit for self-reported sun protective behaviours. The RCT, conducted at outdoor recreation sites for 6 to 8 year olds in Hawaii, reported significantly better self-reported sun protection behaviours (composite measure) post-intervention and maintained at three month follow-up, for children (difference in change 0.19, SE 0.06; $p<0.01$), but not recreation staff, following information provision, incentives including sun protection resources, plus an environmental component (large dispensers of free sunscreen, portable shade tents, signage and policy consultations) compared to no intervention. The environmental plus information intervention did not appear to have any benefit over information alone (Glanz 2000 [-]). An additional before and after study conducted at Hawaii recreation sites reported a significant improvement in children ($p<0.01$) and parent ($p<0.05$), but not staff self-reported sun protection

practices (i.e. wearing a shirt with sleeves, wearing sunglasses, seeking shade, using sunscreen, wearing a hat) following a similar intervention of information provision and incentives plus provision of free sunscreen in dispensers (Glanz 1998 [-]).

ER 4.16 There was weak evidence from a non-randomised controlled trial that there was significantly increased ideal hat use in children who appeared to be 12 years or younger during the winter (OR 1.84, 95% CI: 1.13 to 2.98) but not summer, following provision of sun safety information and behaviour prompts at a zoo, plus discount coupons for the purchase of hats and sunscreen in the gift shop (Mayer 2001 [-]). Hat use was recorded by trained observers for children as they exited the intervention and comparator sites.

ER 4.17 There was mixed evidence within two RCTs (Olson 2007 [-]; Dietrich 2000 [+]) delivered in multiple American community settings including schools, primary care and recreational areas where the only resource provision element was sunscreen samples. The resource provision element (sunscreen samples) was so minimal that these studies provide little, if any evidence, about the provision of sun protection resources and are more informative about information provision. There was weak evidence from one of these studies (Olson 2007 [-]), targeted at adolescents, of a significant reduction in the proportion of observed body areas covered while at the beach and self-reported use of sunscreen two years after the introduction of the intervention, although the reduction was significantly smaller ($p<0.01$) in the intervention compared to control group. There were no significant differences between the two groups in observed use of sun protective clothing. There was moderate evidence from the second RCT (Dietrich 2000 [+]) providing a similar intervention to 11 year olds of statistically significant improvements in self-reported sunscreen use on the back ($p=0.04$) but not other body areas, and no observed differences in use of shade or protective clothing one year after a three month intervention.

ER 4.18 In relation to the secondary review questions, Glanz 2000 [-] stated that 86% of staff in the education/environment and education only arms reported giving sun safety messages to children; 89% encouraged children to be sun smart at home; and 77% went over the ABCs of sun protection. There were no statistically significant differences between the education/environment and education only groups in levels of implementation. Mayer 2001 [-] reported that in both winter and summer children aged 0-3 years wore ideal hats significantly more than children aged 4-9 years (OR 0.35, 95% CI 0.27 to 0.45; $p<0.001$ in winter and OR 0.22, 95% CI 0.19 to 0.26; $p<0.001$ in summer) and children aged 10-12 years (OR 0.44, 95% CI 0.30 to 0.65; $p<0.001$ in winter and OR 0.24, 95% CI 0.19 to 0.30; $p<0.001$ in summer). In both winter and summer, girls wore ideal hats significantly more than boys (OR 1.32, 95% CI 1.04 to 1.66; $p=0.002$ and OR 1.39, 95% CI 1.21 to 1.60; $p<0.001$

respectively). Olson 2007 [-] stated that the intervention was more effective than control in improving sun protection in girls compared to boys (coefficient 5.88, 95% CI: 0.84 to 10.92, p=0.022) and when the UV index was high (coefficient 7.04, 95% CI: 1.72 to 12.35, p=0.010).

Applicability

This evidence is only partially applicable to the UK setting. The studies were undertaken in countries with a warmer summer climate than the UK, and for some studies sunny winters. The benefit of implementation of any such interventions may be less in a UK setting.

Cost-effectiveness studies

One economic evaluation (Gordon 2009[29]) was carried out in a community setting. Summary details of the economic evaluation are presented in Table 4 and the full evidence table is provided in Appendix 7 (Table G).

Table 4: Summary of economic evaluation of a multi-component intervention

Study details	Setting and population	Intervention (I) and Comparator (C)	Outcomes
Gordon 2009[29] Cost-effectiveness analysis	Residents Nambour, Queensland, Australia	I: Water-resistant, broad-spectrum sunscreen with a sun protection factor of 15+; advice on application to the head, neck, arms and hands; and quarterly encouragement by nurses C: Usual discretionary use of sunscreen	• Incremental cost per skin cancer prevented • Cost • Number of basal and squamous cell carcinomas • Number of actinic keratoses
Validity Quality score: potentially serious limitations Applicability: Partially applicable			

Gordon 2009[29] (potentially serious limitations): evaluated the cost-effectiveness of a multi-component intervention which included the supply of water-resistant, broad spectrum sunscreen with a sun protection factor of 15+; advice on application to the head, neck, arms and hands; and quarterly encouragement by nurses to use the sunscreen. The comparator was usual discretionary use of sunscreen. The setting was the community of a township in Queensland, Australia and the population was the residents of the township.

The economic evaluation was based on a single clinical trial with 1,621 participants, carried out over a 5 year period. 15% of these were not active throughout the trial duration and the reasons for this were not reported. The measure of benefit was the number of skin cancers prevented. These included basal and squamous cell carcinomas on the head, neck, arms and hands. Skin cancer cases

confirmed in the first year were excluded as they were considered unrelated to the intervention. The intervention duration was 5 years and the skin cancer cases confirmed in one year of follow-up after cessation of the intervention were recorded. The time horizon of the economic evaluation was not stated but appeared to be 6 years. It is unclear whether the time horizon was sufficient to capture all the health benefits of the intervention. This approach is therefore likely to be conservative with respect to the intervention. The study perspective was stated to be societal, excluding productivity costs. This was justified on the grounds that skin cancers occur predominantly in older ages (supplementary file, http://www.nature.com/jid). The age distribution of the participants who developed skin cancer was not reported so it is not clear if this assumption was correct. The costs included programme costs for the provision of the sunscreen and health professional support, including any volunteer time; and participants' costs of purchasing sunscreen in the comparator group and the transport and time costs of visits to the doctor; and the costs of treating skin cancers and actinic keratoses. It is unclear if the cost of purchasing sunscreen in the first year after the trial was added to both groups (supplementary file, http://www.nature.com/jid). The price year was 2007. Discounting was not conducted, which was inappropriate given the time horizon of the study. The lack of discounting was favourable to the intervention. Resource use and unit costs were derived from the trial.

The incremental cost per skin cancer prevented for the intervention was US$3,041 in the base case. One-way and probabilistic sensitivity analyses were performed to evaluate parameter uncertainty. The results should have been presented in terms of an incremental cost-effectiveness ratio (ICER), as was done in the base case. However, the ICER was divided by the number of patients in the treatment arm, which cannot be interpreted in a meaningful way.

Cost-effectiveness studies - community setting

ER 4.19 One economic evaluation evaluated a multi-component intervention in a community setting which included the supply of water-resistant, broad spectrum sunscreen with a sun protection factor of 15+; advice on application to the head, neck, arms and hands; and quarterly encouragement by nurses to use the sunscreen. A number of limitations to the study methods were identified, which could have under- or overestimated the cost-effectiveness of the intervention. The incremental cost per skin cancer prevented indicated that the provision of free sunscreen (factor 15+), advice and regular encouragement to apply the sunscreen in a community setting in Australia was more effective and more costly than usual discretionary use of sunscreen. The lack of a quality-adjusted life-year (QALY) measure of benefit means that the cost-effectiveness ratio is not directly comparable to the NICE guidance on cost-effectiveness thresholds (Gordon 2009)[29]

There were potentially serious limitations to this study, which may change the cost-effectiveness conclusions.

Applicability

As the climate is significantly different in Australia compared to the UK and the awareness of skin cancer is likely to be higher, it is not clear that the population studied would respond to the intervention in the same way as a UK population.

3.4.3 Educational setting

Seven studies evaluated a multi-component intervention in a school setting: four RCTs ([e]Bauer 2005,[5] [+] quality; [f]Buller 1997,[32] [-] quality; Crane 1999[33] [-] quality; Gritz 2007,[34] [-] quality) and three non-randomised controlled studies ([g]Barankin 2001,[35] [-] quality; [h]Milne 2006,[36] [+] quality; Reding 1996,[37] [-] quality). Table 5 provides a summary of key study characteristics and the full evidence table is provided in Appendix 7 (Table D). Six of the seven studies reported sun protection

[e-h]These studies were also included in the Phase 1 report. They have been included here to ensure consistency within this report as other similar studies are included.

behaviour or sun exposure as an outcome; four of the studies used self-report measures only (Barankin 2001,[35] [-];Buller 1997,[32] [-];Crane 1999[33] [-];Gritz 2007,[34] [-]) and two used objective measures of sun exposure (nevi and/or suntan) plus self-report measures (Bauer 2005,[5] [+] quality; Milne 2006,[36] [+]) . Five studies reported knowledge or attitudes Barankin 2001,[35] [-];Buller 1997,[32] [-];Crane 1999[33] [-]; Gritz 2007,[34] [-];Reding 1996,[37] [-]). No cost-effectiveness studies were included that related to this setting.

None of the studies were undertaken in the UK; four were from USA (Gritz 2007; Buller 1997; Reding 1996; Crane 1999) and one from each of Canada (Barankin 2001), Australia (Milne 2006) and Germany (Bauer 2005). Three studies were in a preschool or daycare setting (Crane 1999; Gritz 2007; Bauer 2005) and four in a primary school setting (Reding 1996; Buller 1997; Milne 2006; Barankin 2001). There were no studies involving children beyond primary school. All of the interventions involved provision of information in conjunction with free sunscreen (three studies), sunscreen samples (three studies) or low-cost protective swimwear (one study). Only one study was specifically designed to assess the effect of adding provision of free resources to an information intervention (Bauer 2005, [+] quality). None of the remaining six studies were designed to assess the effectiveness of the provision of a sun protection resources component and none reported specific use of the items provided. In addition, all six remaining studies had methodological limitations, therefore their findings need to be treated with some caution.

Two of the three studies (Bauer 2005; Barankin 2001) assessing a multi-component intervention of information provision plus free sunscreen reported no statistically significant benefit when compared to the comparison or control group. A reasonably good quality RCT (Bauer 2005, [+] quality), specifically designed to assess the effect of adding provision of free sunscreen to information, found that education plus sunscreen over three years was not associated with better outcomes (including number of nevi and self-reported use of sunscreen or protective clothing) compared to education alone (single information session with or without three times yearly additional information) in preschool children. A non-randomised study, with several methodological limitations (Barankin 2001, [-] quality), found that an enhanced intervention of free sunscreen and provision of information to parents, in addition to provision of information to children in a classroom setting, was not associated with improved carer-reported outcomes (including sunscreen use and wearing protective clothing or hat, or sunglasses) for 9 to 10 year olds at 4 month follow-up compared to provision of information to children in a classroom setting alone. The third study (Gritz 2007, [-] quality), an RCT with several methodological limitations, reported that the provision of information for teachers and parents, free sunscreen for teachers to use on children at school and

sun protection curriculum for preschool children was associated with some improved staff and parent reported self-reported sun protective behaviours towards children.

A single, reasonable quality non-randomised controlled study, found that an intensive information intervention for 5 to 6 year olds and provision of low cost swimwear (Kidskin) had minimal benefits compared to a standard health education curriculum for development of nevi and sun protective behaviours in children 4 and 6 years later (Milne 2006, [+] quality).

In three studies (Buller 1997 [-]; Crane 1999 [-]; Reding 1996 [-]), the resource provision element of the multi-component intervention comprised only a sunscreen sample; therefore the studies are not informative about the effect of provision of sun protection resources. Two RCTs reported no or minimal benefits in self-reported sun protection behaviours following an information intervention in an education setting plus provision of a sunscreen sample in 9 to 10 year old children or the parents of preschool children (Buller 1997, [-] quality; Crane 1999, [-] quality). Buller 1997 reported some improvement in children's recognition of terminology and knowledge and in child reported parental behaviours and attitudes towards tanning. Crane 1999 reported no improvement in parent reported knowledge or sun protection practices towards their children. A third, non-randomised controlled study reported an increase in knowledge for 9 to 10 year olds following information sessions delivered by peer educators plus additional materials and a sunscreen sample for parents (Reding 1996, [-] quality).

The studies are grouped below by type of resources provided. Studies providing sunscreen or clothing are discussed individually and the studies providing only sunscreen samples are discussed as a group.

Table 5: Summary of studies evaluating a multi-component intervention delivered in an education setting

Study details	Setting and population	Intervention (I) and Comparator (C)	Outcomes[‡]
Barankin 2001[35] Non-randomised controlled study *Validity* Internal - External -	23 Grade 4 (UK year 5 approx) classes in 16 schools, Ontario, Canada 509, 9-10 year olds	I (Enhanced): One hour "Sun and the Skin" classroom presentation, activity book (as standard group), plus sunscreen provided prior to summer holiday, and letter with sun protection fact sheets sent to parents. I (Standard): One hour "Sun and the Skin presentation and activity book C: Activity book	• Sun protection practices *Use of sunscreen* *Use of protective clothing or hat* *Use of sunglasses* • Sun exposure *Absence of sunburns* • Knowledge, attitudes, beliefs
Bauer 2005[5] Cluster RCT	78 nursery schools in Stuttgart and Bochum, Germany	I (Enhanced): 3 hour education session and educational material 3 times per year (as education group) plus 800ml of SPF 25 sunscreen per year	• Sun protection practices *Use of sunscreen* *Use of protective clothing or hat*

	1887, 2 to 7 year olds *Validity* Internal + External +	I (Education): 3 hour education session and educational letter at Easter, Pentecost and summer holidays with detailed information on proper sunscreen use, sun protection and information brochures from public melanoma prevention campaigns. C: 3 hour education session	• Sun exposure *Time in sunny climates* *Time outdoors* *Sunburn* *Number of melanocytic nevi* ***(objective measure)***
Buller 1997[32] Cluster RCT *Validity* Internal – External +	16 fourth-grade classes in three primary schools Arizona, USA 318, 9 to 10 year olds	I (Classroom): One-hour lassroom based intervention derived from 'Sunny Days, Healthy Ways' programme. At the end of the lesson, students received certificates of acomplishment and bags with information for parents, sunscreen samples, and other solar protection literature. I (Sun safety fair): health educator-implemented activities based on lessons from the 'Sunny Days, Healthy Ways' prevention curriculum. Students received a certificate of accomplishment. (This arm was included in the phase I report) C: No intervention	• Sun protection practices Use of sunscreen Use of protective clothing or hat • Knowledge, attitudes, beliefs • Behavioural intentions
Crane 1999[33] RCT *Validity* Internal – External +	27 preschools and daycare centres, Colorado, USA 201 parents of preschool children	I: Information intervention for staff to help them improve skin cancer protection in their schools and reusable tote bag for parents containing sun protection brochures, learning activities to complete with child, a kitchen magnet and sunscreen samples. C: No intervention	• Sun protection practices *Use of sunscreen* *Use of protective clothing or hat* *Use of shade* • Knowledge, attitudes, beliefs • Outcomes were assessed in relation to the information intervention received by staff and directors. These are not reported here as only parents received a multi-component intervention
Gritz 2007[34] Related paper Gritz 2005[38] Cluster RCT *Validity* Internal - External -	20 preschools, Houston, USA Staff and parents	I: Training for staff, seven unit sun protection curriculum, 4 issue newsletter, and staff applied school supplied sunscreen to children, with parental consent or parent supplied sunscreen. Parents received information video, newsletter and two sun safety handbooks C: Standard education and a sun protection brochure, staff maintained usual routine and applied only sunscreen provided by parents	• Sun protection practices *Use of sunscreen* *Use of protective clothing* *Setting up shade* *Sun avoidance* • Knowledge, attitudes, beliefs • Process and implementation Other
Milne 2006[36] Related papers English 2005[39] Milne 2002[40] Milne 2001[41] Milne 2000[42] Milne 1999[43] Non-randomised controlled study *Validity* Internal + External -	33 schools primary schools, Perth, Australia 1623, 5 to 6 year olds	I (High): Sun protection curriculum including classroom based and home activities plus education materials provided during summer holidays and offered low-cost protective swimwear that covered trunk, upper arms and thighs. I (Moderate): Sun protection curriculum including classroom based and home activities (included in phase 1) C: Standard health education curriculum	• Sun protection practices *Use of sunscreen* *Use of shade* *Use of protective clothing or hat* • Sun exposure *Time spent outside* *Number of nevi* ***(objective measure)*** *Suntan* ***(objective measure)***
Reding 1996[37] Non-randomised controlled study	39 rural elementary schools, Wisconsin, USA 3,142 third grade children (UK Year 4 approx)	I: Two 30-40 minute education sessions over two days provided by trained peer facilitators plus posters, worksheets and handouts on sun protection. Children were provided with materials to take home including brochure for adult farmers,	• Knowledge

Validity Internal - External -	American Cancer Society information sheet and a sunscreen sample C: No intervention

†Self-report measures, unless otherwise indicated

Randomised and non-randomised controlled studies

Studies providing sun protection resources

Bauer 2005[5] ([+] quality): A cluster RCT evaluated the effectiveness of provision of information plus free sunscreen, targeted at parents of nursery school children in Stuttgart and Bochum, Germany, compared to provision of information alone over a three year period.

Seventy-eight public nursery schools were randomly allocated to one of three groups and parents of all children within centres were invited to participate. All three groups received a single 3 hour information session at the beginning of the study that included information on the risks of sun exposure, sun protective measures and application of sunscreen. It was not stated who delivered the intervention, presumably members of the research group. The education group (26 centres, 624 children) also received educational material three times per year for three years, at Easter, Pentecost and summer holidays. This provided more detailed information on sunscreen use and sun protection than the initial session and information brochures were also provided. The education plus sunscreen group (25 centres, 626 children) received the same information as the education group plus 800ml of SPF 25 sunscreen per year for 3 years. Parents were instructed to closely cover the sun exposed skin with a layer of sunscreen several times a day, from Spring to Autumn, when the sun was intense. They were asked to buy more sunscreen if they used up the free supply. The control group (27 centres, 637 children) received the initial information session only. The main outcome of interest was the number of newly developed melanocytic nevi over the three years.

All the children were defined as Caucasian, age ranged from 2 to 7 years old, 49% of children with a complete follow-up were female and 21% of mothers and 40% of fathers had a university degree. 12% with complete follow-up had skin classified as Fitzpatrick Type 1; the median number of nevi was 8 (interquartile range (IQR) 5 to 14); and the median number of previous sunburns was 0 (IQR 0 to 2). 74% had a history of holidays in sunny climates.

At three year follow-up, there was no statistically significant difference between the three groups in the number of new nevi (p=0.779) (Education plus sunscreen (n=465): median 27 (IQR 18 to 40); Education (n=369): median 26 (IQR 16 to 41); Control (n=398): median 27 (IQR 17 to 40))

There was no statistically significant difference between groups in the number of reported newly experienced sunburns (p=0.604): median 0 (IQR 0 to 1) for all three groups, overall 22% had experienced sunburn. There was also no statistically significant difference between participants in the proportion “almost always” using sunscreen, use of protective clothing or hats or amount of time spent in the sun while on holiday or the number of hours spent outside at home. There was a statistically significant difference between groups in the proportion using sunscreen at follow-up (p=0.003) but this does not seem clinically meaningful as all three groups had high reported sunscreen use (99.4% education plus sunscreen; 99.7% education; 98% control). Use of sun protective clothing was much lower across the three groups than sunscreen use; 12.3% for t-shirts, 12.4% for shorts, 11.6% for use of trunks and t-shirt and shorts and 7.7% for use of hats. Changes in the use of sun protective clothing between 1998 and 2001 were not statistically significant (t-shirts, p=0.53; shorts, p=0.99; trunks and t-shirt and shorts, p=0.98, and hats, p=0.63).

Data relating to the secondary review questions were not reported.

This is a reasonably good quality evaluation of a multi-component intervention, specifically designed to assess the individual contribution of information and provision of free sunscreen. Centres were randomised, all children were invited to participate, and there was an objective measure of sun exposure (number of nevi), performed by an assessor blinded to intervention group, in addition to self-report measures. However, although allocation to groups was by cluster, the analysis did not appear to take this into account, though, given there was no difference between groups for most outcomes, the intervention effect does not appear to have been overestimated. A key limitation of the study is the high loss-to follow-up in all three groups, though this was lowest in the education plus sunscreen group: 23% compared to 38% in the education group and 36% in the control group. Overall, children at higher risk of developing nevi were more likely to complete the study. The authors suggest that, as a result, the three groups may have become more alike in their sun protection practices, reflecting their concerns about the implications for sun exposure, and the intervention effect may have been underestimated. Reported sunscreen use for children was high at baseline making it difficult to detect any improvement on this outcome. It is unclear why loss to follow-up was lower in the education plus sunscreen group and how this may have influenced the results. The authors also suggest that inappropriate application of sunscreen may have reduced the effectiveness of the intervention. Unfortunately the use of the free sunscreen provided, for example the quantity used, was not assessed.

Barankin 2001[35] ([-] quality): evaluated the effectiveness of provision of information to 9 to 10 year old children in schools in Ontario, Canada plus free sunscreen plus information provided to parents compared to provision of information alone over a two month period.

Twenty-three classes from 16 schools participated. Non-randomised allocation was used: the first 16 classes were randomised to the enhanced intervention or standard intervention groups and the remaining classes to the control group. The enhanced intervention (8 classes, 170 children) consisted of a one hour presentation on sun protection from medical students to children and teachers, an activity book for children, sunscreen prior to the summer holiday (further details not provided), and a letter to parents encouraging them to ensure their children had appropriate sun protection plus sun protection factsheets. The standard intervention (8 classes, 191 children) consisted of the presentation and activity book and the control group (7 schools, 148 children) received the activity book only. Outcomes assessed at four month follow-up were children's sun protection practices, as reported by parents and teachers, sunburn and attitudes. Demographic details of the participants were not provided.

There was no statistically significant difference between groups at 4 month follow-up in the number of children without sunburns (as reported by parents): enhanced group, 40% at baseline, 51% at follow-up; standard group, 44% at baseline, 54% at follow-up, and control, 43% at baseline, 43% at follow-up. There was no statistically significant difference between groups in use of long-sleeved shirts and trousers at follow-up, based on parental report: the authors state that these were rarely used at baseline or follow-up (data not reported). Both parents and children reported high child use of at least a SPF 15 sunscreen at baseline (96% of parents and 90% of children) and follow-up and there were no differences between groups. Teacher surveys were not undertaken at 4 month follow-up. There was a reduction from baseline to follow-up in the number of children reporting that they wanted a tan in the enhanced group (33% to 4%, p=0.05), and in the standard group (31% to 16%, p value not reported), but not in the control group (23% to 21%, p value not reported).

Data relating to the secondary review questions were not reported.

This study was not designed to address the contribution of free sunscreen, as part of a multi-component intervention, on sun protective behaviours. The enhanced intervention differed from the standard intervention in two respects: (i) provision of free sunscreen and (ii) provision of information to parents and a letter encouraging them to protect their children from the sun. Indeed, the stated aim of the study was to assess the benefits of involving parents at home in a school-based programme. It is unclear how much sunscreen was provided as part of the intervention and

recipients' response to and use of the sunscreen. Allocation to groups was not randomised and the outcomes were based on self-reported behaviours, therefore, the results may be subject to bias. Additionally, loss to follow-up was high in the two intervention groups compared to control: 58% in the enhanced group, 56% in the standard group, and 21% in the control group. It is unclear why this happened.

Gritz 2007[34] ([-] quality): This cluster RCT assessed a two year intervention, based on Social Cognitive Theory consisting of training for staff plus a sun protection curriculum delivered to children, information for parents plus provision of study supplied sunscreen to children compared with standard education and information plus application of parent supplied sunscreen on children in preschools in Houston, USA.

20 schools were randomly assigned to the intervention and control groups: 10 in each group. Staff in the intervention schools received training (3 sessions ranging from 1 to 2.5 hours), an instructional video, newsletters, a sun protection curriculum and teachers guide. Teachers delivered the seven unit sun protection curriculum to children. Sunscreen was supplied to teachers for use on children using the playground or on field trips. It was applied following receipt of a signed consent form from parents; otherwise staff applied sunscreen provided by parents. Parents received an information video, newsletters and two sun safety handbooks. Control group staff received a skin cancer prevention brochure and were asked to maintain their usual routine of applying sunscreen provided by parents. Staff and parent behavioural outcomes were assessed at 12 and 24 months. Outcomes were self-reported and included use of sunscreen on children, sun avoidance, knowledge about sunscreen use, limiting sun exposure during midday and sun reflective surfaces, and psychosocial outcomes for staff and parents. The same parents and teachers were not followed throughout the study; cross-sectional surveys were undertaken at baseline (245 staff, 385 parents), 12 month (192 staff, 640 parents) and 24 month follow-up (225 staff and 694 parents).

Staff at baseline were predominantly female (97%), part of the teaching staff (75%) were African American (41%), Hispanic (20.1%) or white (36%). Parents at baseline were predominantly female, educated beyond high school (82%), white (62%) or African American (22%) and the mean age was 32 years (SD 6.2). The demographic details of the follow-up cohorts were broadly similar.

Staff in the intervention group had a statistically significant higher score (composite score) than staff in the comparison group on the Sunscreen Use Scale at 12 months (adjusted mean difference 5.73 (SE1.18), p=0.000, n=154) and 24 months (adjusted mean difference 7.41 (SE1.15), p=0.000, n=174) and the Sun Avoidance Scale (composite score) at both 12 months (adjusted mean difference 2.18

(SE 0.65), p=0.001, n=161) and 24 months (adjusted mean difference 3.85 (SE 0.85), p=0.000, n=192). Parents in the intervention group had a statistically significant higher score (composite) than parents in the comparison group on the Sunscreen Use Scale at 24 months (adjusted mean difference 0.96 (SE 0.44), p=0.03, n=643) and the Sun Avoidance Scale at 12 months (adjusted mean difference 0.54 (SE 0.26), p=0.039, n=596) but not 24 months. (All analyses adjusted for intraclass correlations, age, gender, ethnicity and education; the possible score range was 5 to 25 for all scales except the parents Sunscreen Use Scale which could range from 6 to 30).

Staff in the intervention group had a statistically significant higher composite score (score range 0 to 5) than staff in the comparison group on sun protection knowledge at 12 months (adjusted mean difference 1.00 (SE 0.21), p<0.001, n=177) and at 24 months (adjusted mean difference 0.63 (SE 0.25), p=0.011, n=218). Parents in the intervention group had a statistically significant higher composite score than parents in the comparision group on sun protection knowledge at 12 months (adjusted mean difference 0.42 (SE 0.10), p<0.001, n=590), but there was no statistically significant difference at 24 months. (Analyses adjusted for intraclass correlations and covariates, age, gender, ethnicity and education).

Only 56% of teachers at 12 months and 57% at 24 months reported having taught at least half the curriculum indicating that there were some problems implementing part of the intervention. However, possible barriers to implementation were not discussed.

It is not possible to estimate the contribution of provision of free sunscreen to outcome as the intervention and comparison group differed in terms of the intensity of the information provided as well as provision of sunscreen. Also, it is unclear how many parents consented to use of the school - supplied sunscreen for their children and how many continued to supply their own sunscreen.

The study had a number of important limitations. Only a small proportion of participants completed all three outcome assessments and the study is a series of cross-sectional assessments of different participants. Therefore, there may be unknown differences between participants in the follow-up cohorts compared to those at baseline, which may have influenced outcome. In addition, only self-reported behaviours were assessed.

Milne 2006[36] ([+] quality): evaluated the impact of provision of information in the classroom plus provision of information during summer holidays plus offering low cost sun protective swimwear, to 5 to 6 year olds attending schools within 30 km of Perth, Australia, compared to provision of information in the classroom alone and to the standard health education curriculum, over 4 years.

The 33 schools were allocated to groups in a non-random manner. Schools closest to the centre of Perth were assigned to the high intervention group (8 schools) and schools further away to the moderate intervention (11 schools) and control (14 schools). Participants in the control group received the standard 1985 Australian health education curriculum. The moderate and high intervention groups received a specifically designed sun protection curriculum for children including classroom and home-based activities encouraging sun protective behaviours. In addition, the high intervention group also received information materials during the summer holidays as well as an offer of low cost protective swimwear that covers the trunk, upper arms and thighs. The primary outcome for the study was number of nevi on the back at 4 and 6 year follow-up. Parents also completed a questionnaire on children's sun protective behaviours at 2 and 4 years follow-up. Each of the two intervention groups was compared to control. The results for the moderate intervention versus control were reported in Phase 1. The study did not compare the moderate and high intervention groups therefore only the results for the high intervention versus control are reported here.

At baseline, 48% of the participating 5 to 6 year olds were female. Only participants of European ancestry were included in the analysis. The proportion of Southern European participants varied across the groups: 5.4% in the control group, 10.6% in the moderate and 14.7 in the high groups. The proportion of parents with a tertiary education also varied: 25%, 45% and 49% in the control, moderate and high groups respectively. The propensity to burn and ability to tan were reasonably similar across groups: susceptibility to painful sunburn or severe sunburn with blisters was 54% in the control, 59% in the moderate and 54% in the high group.

At 6 year follow-up there was no statistically significant difference between groups for the primary outcome, number of back nevi, for the high intervention compared to control (ratio of change 0.89, 95% CI: 0.81 to 0.99; p=0.09).

There was a statistically significant difference between high intervention and control, at 6 year follow-up, for the number of chest nevi, assessed in boys only (ratio of change 0.82 (95% CI 0.74 to 0.91; p=0.0004), but not for face and arms for the whole group, or boys and girls separately. At four year follow-up there was no statistically significant difference between the high intervention and control group for any of the sites.

Regarding the other outcomes assessed, there were some statistically significant favourable differences for the high intervention group compared to control at two year follow-up but these were not sustained at 4 or 6 year follow-up. Uptake of the offer of low-cost sun protective swimwear

was not reported. There was greater use of swimwear covering the back and arms in the high intervention group compared to control at two year follow-up (OR 3.41, 95% CI: 2.14 to 5.45, p<0.001), 4 year follow-up (OR 1.53, 95% CI: 1.11 to 2.12, p=0.03) and 6 year follow-up (OR 0.75, 95% CI: 0.53 to 1.05, p=0.06), though the differences were progressively smaller and at 6 years were not statistically significant.

When boys and girls were considered separately, there was a statistically significant benefit in the high intervention group compared to control for boys (ratio of change 0.83, 95% CI 0.75 to 0.92, p=0.0009) but not girls (0.95, 95% CI: 0.83 to 1.08, p=0.7). The mean number of back nevi for boys was 3.8 at baseline and 10.2 at follow-up in the high intervention group and 3.5 at baseline and 11.4 at follow-upin the control group. However, this should be regarded with caution as it was not a pre-planned analysis and the finding may be spurious.

A key limitation of this study, in the context of the review question being addressed, is that it is not possible to determine the contribution of providing low cost swimwear. In addition, very few details were provided about this aspect of the intervention. It is unclear whether this was a one-off offer to parents or whether they could avail of it more than once throughout the programme as their child grew, whether there was a good choice of styles on offer and the size of the cost reduction available to them. In addition, uptake of the swimwear was not reported.

Overall this was a reasonable quality study with some limitations. In addition to high loss to follow-up (23% for nevi outcome at 6 years) the study was non-randomised and there were some baseline demographic differences between the groups possibly reflecting how schools were allocated based on proximity to Perth. However, possible confounding variables were adjusted for in the analysis. Additionally, an objective measure of sun exposure was used rather than relying solely on self-reported sun protective behaviours. The authors suggest that the lack of evidence of a favourable effect might be related to counting of nevi being an insensitive indicator of sun exposure within populations.

Studies providing sunscreen samples

Two RCTs (Buller 1997,[32] [-] quality; Crane 1999,[33] [-] quality) and one non-randomised controlled trial (Reding 1996,[37] [-] quality) all assessed a multi-component intervention for which the provision of resources involved only a sunscreen sample and none of them were designed to assess the effect of this element on outcome. Details were not provided about the size or number of sunscreen samples provided or participants' use of, or response to the samples. All three studies were

conducted in the USA. The quality and interpretation of these studies are considered together at the end of this section.

Buller 1997[32] ([-] quality) assessed provision of information to 9 to 10 year olds in a one hour session in a classroom setting, in Arizona, USA, plus provision of written information materials for parents, plus sunscreen samples compared to provision of information to parents and children at a sun safety fair and a no intervention control. (The comparison between the sun safety fair and the control group has been reported in phase 1). **Reding 1996[37] ([-] quality)** also targeted 9 to 10 year olds, from rural schools in Wisconsin, USA. Trained peer educators delivered two 30 to 40 minute information sessions to the children plus take home materials including an information brochure for adult farmers and a general information sheet plus a sunscreen sample. This was compared to a no intervention control. **Crane 1999[33] ([-] quality)** compared an information intervention, based on the Health Belief Model, for preschool staff to help them improve cancer protection in their schools plus provision of sun protection literature to parents of preschool children and activities to complete with their child plus a kitchen magnet and sunscreen samples to a no intervention control.

Buller (1997,[32] [-] quality) reported no statistically significant difference between a classroom intervention plus provision of information and sunscreen sample to parents, a sun safety fair and no intervention control for any of the child-reported sun protection behaviours post intervention. At three month follow-up there was a statistically significant difference between the three groups ($p<0.05$) for two questions, "I try to play outside early in the morning or late in the afternoon" and "In the summer I lay out in the sun to get a tan", with most benefit in the health fair group followed by classroom intervention and control. There was a statistically significant difference between the three groups post-intervention and at 3 month follow-up (all $p<0.05$) in children's recognition of terminology and knowledge using the Sunshine and Your Skin Questionnaire[i],with most benefit in the curriculum group followed by the sun safety fair and control, though the differences were very small. There were also statistically significant differences immediately after the intervention in child reported parental behaviours and attitudes towards tanning, though the difference between means was again very small.

Crane (1999,[33] [-] quality) reported no statistically significant difference in parent reported sun protection practices towards their children or knowledge, between an intervention comprising information materials for parents of preschool children plus sunscreen samples compared to no intervention (p values not reported).

[i] The Sunshine and Your Skin Questionnaire included a 10-item term recognition scale; a 35-item true/false knowledge scale addressing environmental factors, skin, and skin cancer; and 11 items that measured attitudes toward tanning, barriers to sunscreen use, and stylishness of tans.

Reding (1996,[37] [-] quality) reported a statistically significant ($p<0.001$) improvement in 9 to 10 year olds knowledge following an information intervention delivered by peer facilitators plus take home materials plus a sunscreen sample compared to no intervention post intervention and at 6 month follow-up. Sun protection behaviours were not assessed.

Data relating to the secondary review questions were not reported.

The key limitation of these studies is that provision of resources was only in the form of a sunscreen sample, and no further information was provided on this. The multi-component interventions in all three studies were predominantly provision of information and the studies did not aim to assess the effectiveness of provision of resources. The studies also had a number of important methodological limitations and their findings should be interpreted with caution.

multi-component interventions in educational settings

ER 4.20 There was moderate evidence from a single RCT (Bauer 2005 [+]) in nursery schools in Germany, that adding provision of sun protection resources to an information intervention (possibly delivered by the research team) did not result in improved sun protective behaviours. This RCT found no statistically significant reduction in number of observed new nevi ($p=0.779$), newly experienced self-reported sun burns and several self-reported sun protective behaviours ("almost always" using sunscreen, wear protective clothing or hats, or amount of time spent in the sun) obtained by adding 800 ml of free sunscreen per year to a 3 hour education session for parents of nursery school children (aged 2 to 7 years) plus educational material mailed three times per year for three years.

ER 4.21 None of the other studies (Barankin 2001 [-]; Gritz 2007 [-]; Milne 2006 [+]; Buller 1997 [-]; Crane 1999 [-]; Reding 1996 [-]) carried out in an educational setting were designed to assess the specific contribution of resource provision to outcome. Therefore, where studies find an effect, it is not possible to determine the contribution of the various components.

ER 4.22 There was contradictory evidence from two studies (Barankin 2001 [-]; Gritz 2007 [-]) relating to information provision combined with provision of free sunscreen. There was weak evidence from a Canadian non-randomised controlled study (Barankin 2001 [-] that provision of free sunscreen and information to parents of 9 to 10 year old children, in addition to provision of information by school staff in a classroom setting was not associated with a statistically significant reduction in the number of sunburns or increase in the use of sun protective clothing 4 months later

(Barankin 2001 [-]). The quantity of free sunscreen provided and recipients' response to, and use of, the sunscreen was not reported. The study did find a reduction from baseline to follow-up in the number of children wanting a tan (enhanced group, 33% to 4%, p=0.05; standard group, 31% to 16%, p value not reported), but not in the control group (23% to 21%, p value not reported). In contrast, there was weak evidence from an American RCT (Gritz 2007 [-]) that provision of information for teachers and parents, free sunscreen for teachers to use on children at school and a sun protection curriculum for preschool children significantly improved staff and parent reported sun protective behaviour towards the children. The adjusted mean difference on the sunscreen use scale for staff at 24 months was 7.41 (SE 1.15), (p=0.000, n=174); and 3.85 (SE 0.85), (p=0.000, n=192) on the sun avoidance scale at 24 months. For parents the adjusted mean difference on the sunscreen use scale at 24 months was 0.96 (SE 0.44), (p=0.03, n=643), but there was no statistically significant difference for the sun avoidance scale at 24 months. The extent of parental consent for use of the free sunscreen in school was not reported (Gritz 2007 [-]).

ER 4.23 There was moderate evidence from an Australian non-randomised controlled trial (Milne 2006 [+]) that an intensive information intervention for 5 to 6 year olds, provided by teachers in a classroom setting, and an offer of low cost swimwear for 5 to 6 year olds had minimal benefits compared to a standard health education curriculum for development of nevi. At 6 year follow-up there was no statistically significant difference between the two groups for the primary outcome number of back nevi, as assessed by trained observers, (ratio of change 0.89, 95% CI: 0.81 to 0.99; p=0.09) or number of nevi on the face or arms (p=0.2). There was a statistically significant reduction in the mean number of nevi on the chest (assessed in boys only) at 6 year follow-up (ratio of change 0.82 (95% CI 0.74 to 0.91; p=0.0004). Uptake of the offer of low-cost sun protective swimwear was not reported. There was greater parental reported use of swimwear for children that covered the back and arms in the intervention group compared to control at two year follow-up (OR 3.41, 95% CI: 2.14 to 5.45, p<0.001), 4 year follow-up (OR 1.53, 95% CI: 1.11 to 2.12, p=0.03) and 6 year follow-up (OR 0.75, 95% CI: 0.53 to 1.05, p=0.06), though the differences were progressively smaller and at 6 years were not statistically significant.

ER 4.24 In two RCTs (Buller 1997 [-]; Crane 1999 [-]) and one non randomised controlled study (Reding 1996 [-]) the resource provision was sunscreen samples only. And as this is such a minimal element of the intervention, it is unlikely to contribute in any meaningful way to the overall findings.

None of these studies contained evidence pertinent to the secondary review question.

Applicability

This evidence is only partially applicable to the UK setting. The studies were mainly undertaken in countries with a warmer summer climate than the UK. The benefit of any such interventions may be less in a UK setting, though the two studies from Canada and Germany may have greater applicability than the rest.

3.5.4 Healthcare setting

Two RCTs (Crane 2006,[44] [-] quality; Norman 2007,[45] [-] quality), one non-randomised controlled study (Bolognia 1991[j],[46] [-] quality) and two before and after studies (Franklin 2003,[47] [-] quality; Geller 1999,[48] [-] quality) evaluated a multi-component intervention in a healthcare setting. Table 6 provides a summary of key study characteristics and the full evidence table is provided in Appendix 7 (Table E). All five studies reported sun protection behaviour or sun exposure as an outcome; four of the studies used self-report measures only (Bolognia 1991,[46] [-]; Franklin 2003,[47] [-];Geller 1999,[48] [-]; Norman 2007,[45] [-]) and one used an objective measure of sun exposure (nevi) plus self-report measures of behaviour (Crane 2006,[44] [-]). One study reported knowledge and attitudes (Franklin 2003,[47] [-]). No cost-effectiveness studies were included that related to this setting.

All of the studies were undertaken in the USA, two in a maternity unit (Bolognia 1991; Geller 1999), one in a paediatric clinic (Franklin 2003) and two in a primary care setting (Norman 2007; Crane 2006). All of the interventions involved provision of information in conjunction with sun protection items such as sunscreen samples, sun hats and sunglasses. In four of the studies the intervention was targeted at parents of babies and in one study at adolescents. With the exception of the intervention for adolescents (Norman 2007), all involved a single contact for provision of information and resources. None of the studies were designed to evaluate the individual contribution of provision of sun protection items to outcome and none of the studies reported specific use of the items provided. In most of the studies sun protection items appeared to be provided as incentives or gifts rather than as a substantial part of the intervention. All of the studies had quality limitations, therefore the findings need to be treated with some caution.

The results of the studies were mixed, both within and across studies; some studies reported no benefit or deterioration associated with the intervention and others reported some benefits. In one

[j] This study was also included in the Phase 1 report. It has been included here to ensure consistency within this report as other similar studies are included.

RCT there was a slight deterioration in parents sun protective behaviours towards their child up to 36 months following the intervention (Crane 2006,[44] [-]), though the intervention group scored better than the control. There was also deterioration in knowledge reported in one before and after study and no improvement in parent's sun protective behaviours towards their baby following the intervention, though parents protective behaviours for themselves did improve (Franklin 2003,[47] [-]). The RCT evaluating an 18 month multi-component intervention, that included provision of a small amount of free sunscreen and an intensive information component for adolescents, reported a statistically significant improvement in self reported sun protective behaviours in the intervention group compared to a diet and lifestyle control group (Norman,[45] [-]).

In a non-randomised controlled study (Bolognia,[46] 1991 [-]), babies of parents receiving the intervention in a maternity unit had significantly less sun exposure at 7 month follow-up compared to control, however there were no significant differences between the groups in use of hats, pram hoods and loose-fitting clothing. A before and after study reported reasonably high levels of sun protective practices for babies 12 months after a multi-component intervention, though it is unclear whether this was a result of the intervention (Geller 1999,[48] [-]).

Most studies provided more than one sun protection resource to participants (e.g. sunscreen sample and hats) therefore the studies are grouped by study design only.

Table 6: Summary of studies evaluating a multi-component intervention delivered in a healthcare setting

Study details	Setting and population	Intervention (I) and Comparator (C)	Outcomes[†]
Bolognia 1991[46] Non-randomised controlled study *Validity* Internal - External -	Maternity unit New Haven, USA 275 mothers of newborn babies	I (high level) : Guidelines, information pamphlets and postcard with message to limit sun exposure plus "gifts" including sunscreen samples, baby sun hat and sun umbrella I (low level): Guidelines and a postcard C: No intervention	• Sun protection practices *Use of sunscreen* *Use of shade* *Use of protective clothing or hat* • Sun exposure *Time exposed to direct sun*
Crane 2006[44] Cluster RCT *Validity* Internal - External -	14 primary care practices Denver, USA 728 parents of babies	I: Sun protection advice and resource packs were provided to parents at each visit to Well-child clinic up to 36 months old. Resource packs included information leaflets and sun protection items for the babies including sunscreen samples, sunglasses and a sun hat. C: Usual care (discussion on use of sunscreen in children 6 months and older)	• Sun protection practices *Use of sunscreen* *Use of shade* *Use of protective clothing or hat* *Use of sunglasses* *Composite measure of behaviours* • Sun exposure *Use of shade* *Number of nevi* ***(objective measure)*** *Skin coloration* • Process and

			implementation
Franklin 2003[47] Before and after *Validity* Internal - External -	Five paediatric clinics Texas, USA 23 parents of six-month old babies	I: Information video played in clinic waiting room; verbal sun protection message from health professional; and gift bag (wide brimmed hat, SPF sunscreen samples; SPF 30 sunblock samples; white t-shirt with slogan; manufacturers' sunscreen coupon; and educational materials). C: Not applicable	• Sun protection practices *Use of sunscreen* *Use of shade* *Use of protective clothing or hat* *Use of sunglasses* *Composite measure of behaviours* • Sun exposure *Stay out of midday sun* • Knowledge, attitudes, beliefs
Geller 1999[48] Before and after *Validity* Internal - External -	Maternity unit Massachusetts, USA 187 mothers of newborn babies	I: Educational kits about sun protection including tip sheets, sun protection pamphlets, bibs, hats, magnets and sand pails with logo. Some mothers also received one-to-one sun protection advice. C: Not applicable	• Sun protection practices *Use of sunscreen* *Use of protective clothing or hat* • Sun exposure Hours in direct sunlight • Process and implementation
Norman 2007[45] RCT *Validity* Internal - External -	Primary care practices and participants homes California, USA 819 11 to 15 year olds	I:Interactive computer session to assess stage of change; printed tailored feedback; brief counseling from healthcare provider; four follow-up telephone assessments and feedback; 90ml bottle of SPF sunscreen with each feedback; intermittent tip sheets C: Physical activity and diet intervention	• Sun protection practices *Use of sunscreen* *Use of shade* *Use of protective clothing or hat* *Composite measure of behaviours* • Sun exposure *Use of shade and avoiding midday sun*

[†]Self-report measures, unless otherwise indicated

Randomised and non-randomised controlled trials

Norman 2007[45] ([-] quality): A RCT evaluated the impact, on self-reported sun protection behaviours, of a two year multi-component intervention for adolescents, with follow-up telephone contact, delivered in a primary care setting in the USA.

Participants were randomised to the intervention (n=395) or a physical activity and diet comparison group (n=424). Participants receiving the intervention completed a computerised SunSmart assessment (based on the Transtheoretical Model) prior to meeting with their physician at the beginning of the study and at 12 months. Based on the information provided, they received a tailored report on their stage of change, self-efficacy and the processes of change. The physician received the same report which informed a 2-3 minute counseling session. At 3, 6, 15 and 18 months participants were contacted by a counselor and completed the same assessment by telephone. They were mailed a tailored report following each assessment and a 90ml bottle of SP15 sunscreen. Self-reported sun-protection behaviours were assessed using a composite measure based on the frequency of engaging in seven behaviours related to use of shade, avoiding the midday sun and use

of sunscreen[k]. The effect of the intervention on progressing participants who were classified as being at the preaction stage of change, to a later stage was also assessed. Outcome was assessed at 6, 12 and 24 months.

Fifty-three percent of the participants were female, the mean age was 12.7 years (SD 1.3) and most commonly their ethnicity was defined as white (58%). Skin sun sensitivity was classified as moderate for 44% and high for 25%. The highest household educational level was fairly evenly distributed from lowest to highest; 34% had no high school to associate's degree. All participants were from families with healthcare insurance.

There was a statistically significant greater improvement in sun protection behaviours over time (composite score) in the intervention group compared to the control group (mixed model repeated measures model: parameter estimate 2.36 (95% CI 0.79 to 3.94; p=0.003). (Between group differences for each of the assessment periods are only available on a small scale graph). Adolescents in the intervention group were significantly (p<0.05) more likely to respond that they "often" or "always" avoided the midday sun, limited exposure to midday sun, used sunscreen, used at least SPF15 sunscreen on the face, and used at least SPF 15 sunscreen on all sun exposed areas, but not wearing a shirt or staying in the shade. At 24 months there were more participants in the intervention group (25%) in the action or maintenance stage of change than the control group (15%): odds ratio 1.74; 95% CI 1.13 to 2.68; p<0.01.

Data relating to the secondary review questions were not reported

A limitation of this study is that the provision of free sunscreen is not a substantial component of the intervention and it is not possible to determine its individual contribution to outcome. The intervention was an intensive educational intervention tailored to participants' stage of change. The primary outcome measure related to the frequency of several sun protection behaviours; response to and use of the free sunscreen provided was not assessed.

The study had a number of methodological limitations that may have introduced bias. It was unclear how randomisation was performed and 28% of participants did not complete all follow-up assessments. In addition to the limitations of self-report measures of behaviour, the authors also highlight the small to moderate intervention effect. The generalisability of the results is unclear. Less

[k] A 7-item scale including the following: (i) How often do you wear a shirt? (ii) how often do you stay in the shade? (iii) how often do you avoid the sun during the midday hours? (iv) how often do you limit your exposure to the sun during the midday hours? (v) how often do you use a sunscreen? (vi) how often do you use a sunscreen with an SPF of 15 or more on your face? (vii) how often do you use a sunscreen with an SPF of 15 or more on all your sun-exposed areas? Each item was scored on a 5-point Likert scale from 1 (never) to 5 (always).

than half of contacted households participated in the study and it is unclear whether participants were representative of those contacted. Participants received incentives of $10, $15, $20 and $40 for completing each of the assessments (which were part of the intervention) therefore the study may underestimate the potential dropout from such an intervention.

Crane 2006[44] ([-] quality): A cluster RCT evaluated a multi-component intervention delivered to 728 parents of young babies attending Wellchild clinics, USA, for their child's 2, 6, 12 and 36 month health assessments.

Fourteen primary care practices within a US managed care organization (MCO) were randomised to the intervention (n=363 participants) or a usual care control group (n=365 participants). The intervention was based on the Health Belief Model and the information, expert and legitimate power of healthcare providers. To prompt healthcare providers to deliver the intervention, guidance alerts and recommended messages were placed in medical records and recommended messages were also placed in examination rooms. At each visit to the Wellchild clinic parents received verbal guidance from staff on protecting their child from the sun and an age-specific sun protection tips sheet. They also received sun-protection and promotional items; at first visit they received a tote bag, logo sunhat, a fridge magnet and Skin Cancer Foundation brochures; at 6 months two 0.3 ounce sunscreen samples; and at 12 months UV protective sunglasses for the baby. Self-reported sun-protection strategies used for their child were assessed using a composite measure based on the frequency of engaging in seven behaviours related to use of shade, sunscreen, sun protective clothing, hat and sunglasses[l] at 12, 24 and 36 months. The possible score ranged from 7 (no strategies ever used) to 28 (all strategies always used). Number of skin nevi and skin colouration were also assessed at 36 months.

98% of the participating parents were female, the majority had at least some college or technical school education and two thirds had a family income of at least $35,000. Approximately three quarters of the participating babies and their mothers were classified as having fair or medium white skin.

There was a statistically significant difference (p=0.049) over time between the intervention and control group: there was a decline in self-reported sun protection behaviours (composite score) in both groups, but the intervention group declined slightly less than the control group (12 months

[l] Parents were asked whether they 'always, frequently, seldom or never' use seven sun protection strategies for their child between 11am and 3pm: (i) stay inside, (ii) stay in the shade, (iii) use clothing that covers most of the arms and legs, (iv) use sunscreen with SPF ≥15, (v) use a hat, (vi) limit time in the sun, and (vii) use sunglasses.

mean score intervention 18.55; control 18.40, not significant; 24 months mean score intervention 18.52; control 18.05, p=0.04; 36 months mean score intervention 18.18; control 17.71, p=0.049).

There was no statistically significant difference between the two groups for any of the individual sun protective behaviours assessed (staying inside, using clothing to cover the arms and legs, using at least SPF 15 sunscreen), using a hat, limiting time in the sun and using sunglasses), with the exception of use of shade and there was a decline in this behaviour for both groups.

Exit interviews with 10 to 20% of parents and yearly surveys with parents found that more participants in the intervention group were provided with sun protection advice by their healthcare provider than in the control group. Receipt of advice about sunscreen use was much more common than advice about avoiding midday sun, using shade and using sun protective clothing and hats but the study did not explore reasons for this.

Only 38% of children had a skin examination and those who participated had parents who were older, more highly educated, had higher incomes and were more likely to be non-Hispanic whites than those who did not participate. There was no statistically significant difference between the intervention and control group for skin colour or number of nevi.

A limitation of this study is that it is not possible to determine the individual contribution of providing free sun protection items to outcome. Sunscreen provision was in the form of two small samples, details about the style of hat were not provided, except that it had a logo and specific use of the individual items was not assessed.

Full details of method of randomisation were not reported and loss to follow-up was high, 40% at 36 months. The high loss at follow-up was mainly due to participants leaving the MCO rather than the study per se, therefore, it is unclear whether an underestimate or an overestimate of the intervention effect is more likely. Attempts were made to use objective outcome measures of sun exposure (skin colouration and number of nevi), however, this outcome was assessed for only 38% of participants and is unlikely to be reliable. The generalisability of the results is unclear. In addition to the high loss to follow-up, just over half of eligible families were invited to participate and it is unclear whether those contacted were similar to the total group.

Bolognia 1991,[46] ([-] quality): One non-randomised controlled trial assessed the effect of different methods of providing information to 275 mothers of newborn babies about sun exposure to the babies approximately seven months later. Participants were from a single maternity unit in USA.

Parents were assigned to one of three groups in consecutive periods. They were allocated to a high level intervention group (sun protection guidelines, pamphlets prepared by two agencies, and "gifts" in the form of sunscreen samples for mother and other family members, baby sun hat and sun umbrella); low level intervention (guidelines and a reminder postcard to limit sun exposure) and a no intervention control group. At follow-up mothers completed a questionnaire by telephone assessing sun protection practices with their babies.

Mothers age ranged from 14 to 41 years, 98% were over 20 years old and 94% were classified as white. Further details were not provided, though the authors state that the three groups were similar in terms of parental occupation, daycare attendance, family size and hair and eye colour.

For most outcomes, statistical comparisons were not made between the two interventions. It was inappropriate to carry out further analysis on the data to investigate whether the differences between the two intervention groups were statistically significant due to discrepancies in reporting: the authors stated there were 275 babies and 275 mothers in the study but the number of participants in the results table was greater than this (e.g. in one analysis there were 294 babies).

Compared to the control group, fewer babies in the high level intervention group (which included sun protection items) spent five hours or more in direct sunlight per week ($p<0.001$): 96 babies spent no time in the sun and two spent five hours or more. In the control group zero babies spent no time in direct sun and 99 babies spent five hours or more per week in direct sun. The authors stated there were no statistically significant differences between the high level intervention, low level intervention and control groups in the use of hats (86%, 90% and 96% respectively); pram hoods (48%, 42%, 49%); umbrellas (10%, 8%, 5%) and loose-fitting clothing (7%, 3%, 2%). Fewer mothers in the high intervention group spent five or more hours in direct sunlight ($p<0.001$). Findings were similar for amount of time in direct sunlight without sunscreen and amount of time outdoors.

Data relating to the secondary review questions were not reported.

In the context of the question being addressed, a limitation of this study is that it is not possible to determine the individual contribution of providing free sun protection items to outcome: as well as receiving sun protection resources, participants in the high intervention group also received additional information. Response to and use of the specific sun protection items provided was not assessed.

Allocation to groups was not randomised and the majority of outcomes were based on self-reported behaviours therefore the results may be subject to bias, most likely in the direction of overestimating the effect of the intervention. In addition the results may also be subject to error as

the number of participants reported in the results was greater than the number who were reported to participate in the study.

Before and after studies

Franklin 2003[47] ([-] quality): One small before and after study assessed the effectiveness of an information intervention combined with provision of a gift bag containing sun protection resources on the sun protection behaviours of 23 parents attending one of five paediatric clinics in the USA with their 6 month old babies.

Fifty seven parents attending for their child's Wellchild or six month immunization were approached to take part and one year follow-up data was obtained for 23 parents. The intervention consisted of a Slip! Slap! Slop! Video played randomly in the waiting room of four of the clinics and a gift bag provided by staff in conjunction with a verbal sun protection message to seek shade, avoid the midday sun, use of SPF 15 sunscreen, a hat, sunglasses and protective clothing. The bag contained a wide brimmed logo hat, samples of SPF 15 sunscreen, samples of SPF 30 sunblock, a white logo t-shirt, a manufacturers sunscreen coupon and educational materials. The majority of participants were female, at least 20 years old, were white non-Hispanic, had an income of at least $21,000 and had completed at least some college education. Sun protection practices and sun exposure were assessed using self-reported behaviours[m] obtained by telephone interview as well as knowledge, attitudes and beliefs.

The authors defined a statistically significant result as $p<0.10$ in this study, but we have used the conventional $p\leq0.05$ here. There was a statistically significant improvement in the overall sun protection measures (composite measure) used by parents for themselves ($p=0.038$) but not for their children ($p=0.13$), from baseline to one year follow-up. The mean composite score increased from 3.1 (SD 1.34) at baseline to 4.0 (SD1.84) at follow-up on a scale ranging from 1 (rarely engaged) to 9 (highly engaged). Apart from avoiding the midday sun ($p=0.03$ for parents and $p=0.043$ for children), there was no statistically significant improvement in individual sun protective practices (wear sunscreen or sunblock, apply sunscreen at least 30 minutes before going outdoors, wear a wide-brimmed hat, wear a long sleeve shirt, long pants, or skirt, use an umbrella, seek shade when

[m] Sun protection practices included nine protective behaviours: (i) wear sunscreen or sunblock, (ii) apply sunscreen at least 30 minutes before going outdoors, (iii) wear a wide-brimmed hat, (iv) wear a long sleeve shirt, long pants, or skirt, (v) use an umbrella, (vi) seek shade when possible, (vii) wear sunglasses with UV protection, (viii) reapply sunscreen every two hours, (ix) stay out of the midday sun. Each response was given an additive score ranging from 1 (rarely engage in sun protective practices) to 9 (highly engage in sun protective practices).

possible, wear sunglasses with UV protection, reapply sunscreen every two hours) based on a conventional p value of ≤0.05. Parental knowledge of areas of the skin that should be protected from the sun deteriorated from baseline to follow-up. The before and after study design, the high knowledge scores at baseline and the possible measurement error, suggest that, what appears to be improvement may be regression to the mean.

Data relating to the secondary review questions were not reported.

This is a small, poor quality before and after study, carried out as a pilot and the findings are unlikely to be reliable or generalisable. The effect of providing a gift bag containing sun protection resources in addition to provision of information is unclear.

Geller 1999[48] ([-] quality): One before and after study assessed the effectiveness of provision of information and hats to 187 mothers, less than 24 hours after delivery of their baby at a maternity unit in the USA, on their sun protection practices 12 months later.

The information was provided in the form of tip sheets, sun protection pamphlets and, for some mothers, through one to one discussions with a healthcare provider. They were also provided with hats, bib magnets and sand buckets. Demographic details about the population were not provided. Sun protection practices were assessed using a 12 item self-report questionnaire completed over the telephone.

Outcome data at 12 months were available for 136 mothers. 84% (n=114) reported that they had followed advice to not use sunscreen on their babies when they were under 6 months old; 89% that their baby always or almost always wore a hat in direct sunlight; 90% (n=122) stated that their child spent less than three hours in direct sunlight per week; and 13% (n=18) reported that their child had been sunburned once in the previous year.

88% of mothers said that receiving educational material within 24 hours of having their baby was a "good time" to receive this type of information. 64% of mothers stated that the information they were given at the maternity unit was their only source of sun protection information from a provider over the year.

This is a poor quality before and after study and it is unclear whether the sun protection behaviours are a consequence of the intervention or whether mothers would have engaged in these sun protection behaviours without the intervention. In addition, the impact of providing the hat is also unclear as the study did not assess response to, or use of the hat provided.

Multi-component interventions in healthcare settings

ER 4.25 None of the multi-component studies carried out in healthcare settings (Norman 2007 [-]; Crane 2006 [-]; Bolognia 1991 [-]; Franklin 2003 [-]; Geller 1999 [-]) were designed specifically to assess the effect of the individual components that comprised the intervention. Therefore, where studies find an effect, it is not possible to determine the contribution of the various components.

ER 4.26 There was weak evidence from a single US RCT (Norman 2007 [-]) of a statistically significant benefit in self-reported sun protection behaviours (composite score) amongst adolescents (aged 11 to 15 years) following an intensive information intervention tailored to individual stage of change, delivered in primary care and via telephone by a counselor, plus provision of four 90ml bottles of SPF 15 sunscreen over 18 months. Mixed model repeated measures parameter estimate 2.36 (95% CI 0.79 to 3.94, p=0.003).

ER 4.27 There was contradictory evidence from four US studies (Crane 2006 [-]; Bolognia 1991 [-]; Franklin 2003 [-]; Geller 1999 [-]) regarding the effectiveness of multi-component interventions for parents of young babies (birth to 4 years of age), delivered in healthcare settings, in changing their self-reported sun protective behaviours towards their babies and their own sun protection practices. The resource component of the interventions generally included multiple items such as sunscreen samples, sun hats and sunglasses. There was weak evidence from one RCT (Crane 2006 [-]) of a decline in sun protective behaviours (composite score) following a multi-component intervention, though decline was less in the intervention group than control (12 months mean score: intervention 18.55, control 18.40, not significant; 24 months mean score: intervention 18.52, control 18.05, p=0.04; 36 months mean score: intervention 18.18, control 17.71, p=0.049). There was weak evidence from a non-randomised controlled trial (Bolognia 1991 [-]) of significantly more mothers and babies spending no time in direct or midday sun and less time outdoors in the intervention group compared to control (p<0.001) and from a before and after study (Franklin 2003 [-]) of increased avoidance of the midday sun amongst parents (p=0.03) and children (p=0.043) parents overall sun protective behaviours (p=0.038); both studies used self-report measures. However, Bolognia [-] reported no statistically significant benefit for other sun protective behaviours (use of hats, pram hoods, umbrellas, loose-fitting clothing) and Franklin [-] reported no statistically significant improvement in the overall sun protection measures (composite measure) for children or in individual sun protective behaviours apart from avoiding the midday sun (related to wearing of sunscreen, sun protective clothing and sunglasses and seeking shade). Franklin (2003 [-]) also found that parental knowledge of areas of the skin that should be protected from the sun deteriorated from baseline to follow-up. There was very weak evidence from a before and after study of high sun

protective behaviours after one-to-one sun protection advice plus information and a gift pack that included hats (89% of mothers reported that their baby always or almost always wore a hat in direct sunlight; 90% (n=122) stated that their child spent less than three hours in direct sunlight per week; and 13% (n=18) reported that their child had been sunburned once in the previous year (Geller 1999 [-]).

ER 4.28 In relation to the secondary review questions, Crane 2006 [-]reported that exit interviews with 10 to 20% of parents and yearly surveys with parents showed that more participants in the intervention group were provided with sun protection advice by their healthcare provider than in the control group. Receipt of advice about sunscreen use was much more common than advice about avoiding midday sun, using shade and using sun protective clothing and hats but the study did not explore reasons for this. Only 38% of children had a skin examination and those who participated had parents who were older, more highly educated, had higher incomes and were more likely to be non-Hispanic whites than those who did not participate. There was no statistically significant difference between the intervention and control group for skin colour or number of nevi (Crane 2006).

ER 4.29 Geller 1999 [-] reported that 88% of mothers said that receiving educational material within 24 hours of having their baby was a "good time" to receive this type of information. 64% of mothers stated that they information they were given at the maternity unit was their only source of sun protection information from a provider over the year.

Applicability

The evidence regarding adolescents has limited applicability in the UK as the study was undertaken in California, which has a much warmer summer climate, and a much longer warm, sunny season. The benefit of such an intervention is likely to be less in a UK setting. The evidence from studies of parents of young babies has similar limitations due to climate differences.

3.5.5 Work setting

One cluster RCT (Mayer 2007,[49] [+] quality) and one non-randomised controlled trial (Azizi 2000;[4] [–] quality) assessed the impact of multi-component interventions on sun protection behaviours. Table 7 provides a summary of key study characteristics and the full evidence tables are provided in Appendix 7 (Table F). Both studies measured self-reported behaviours. Azizi also used an objective measure of sunscreen use (number of sunscreen packages used) and Mayer an objective measure of

sun exposure (skin colour). Knowledge and attitudes were not reported. No cost-effectiveness studies were included that related to this setting.

The RCT (Mayer 2007,[49] [+] quality) was conducted in male postal outdoor workers from postal service stations located in different counties of Southern California, USA, and the non-randomised trial was conducted in Israel (a non-OECD country) in outdoor workers from a national water resource company. In both studies, employees were provided with sun protection items (sunscreen and hats, with the non-randomised study also providing sunglasses). The non-randomised controlled trial was conducted in two waves, with the sun protection items provided in the second wave (one year after the first wave).

Both studies indicated some increase in sun protection behaviours in the intervention groups. However, there was also some improvement in the control groups, which cannot be explained. The use of objective measures did not clearly support the self-reported findings as no statistically significant differences were found using the colorimeter in the RCT (Mayer 2007[49] [+]) and inventories of sunscreen use in the non-randomised controlled study (Azizi 2000[4] [–]) showed only a 30% use of total volume of sunscreens in the group receiving the complete intervention. This non-randomised controlled study is likely to have been subject to certain bias due to the assessment tools used, withdrawals, and potential contamination between intervention groups. The RCT was generally well conducted with no important sources of bias identified, although it is not possible to identify the most effective intervention components.

Table 7: Summary of studies evaluating a multi-component intervention delivered in a work setting

Study details	Setting and population	Intervention (I) and Comparator (C)	Outcomes[†]
Azizi et al. 2000[4] Non-randomised controlled trial *Validity* Internal - External -	Four water units, Israel (a non-OECD country) Male outdoor workers (mean age 42 years)	I: Training and education in the first wave, training and education plus provision of personal sun-protective gear (wide brimmed hats, standard sunglasses, and topical sunscreens) in the second wave. C: Partial: training and education in the first wave, then personal sun-protective gear (wide brimmed hats, standard sunglasses, and topical sunscreens) only in the second wave. Minimal: no intervention in the first wave, then education and skin examinations in the second wave.	• Sun protection practices *Use of sunscreen* ***(self-report and objective measure)*** • Sun exposure *Length of time in sun or time when exposed, and proportion of skin exposed* • Other *Skin self examination*
Mayer et al. 2007[49]	70 US postal service stations in Southern California, USA	I: Provision of protective hats and sunscreen, visual reminders, and brief educational sun safety messages.	• Sun protection practices *Use of sunscreen* *Use of protective clothing*

Related paper Mayer 2009[50] Cluster RCT *Validity* Internal + External +	3,387 letter carriers (mean age 43 years)	C: Delayed intervention; received two year evaluation procedures only, then received the intervention (as above) over a one year period.	*or hat* • Sun exposure *Skin colour **(objective measure)*** • Process and implementation

[†]Self-report measures, unless otherwise indicated

Randomised Controlled Trial

Mayer 2007[49] ([+] quality): One cluster RCT assessed the impact of a sun safety intervention on the occupational use of wide-brim hats and sunscreen by male Postal Service letter carriers in the US (mean age 43 years). Mean daily temperatures at each evaluation period ranged from 23°C to 41°C for the different geographic areas, and postal workers spent an average of 3.9 hours working outdoors daily. The majority of participants were non-Latino white (51.3%), and had worked for the US postal service for an average of 12.4 years. Intervention and control groups were comparable at baseline in terms of age, gender, level of sun sensitivity, race/ethnicity, history of skin cancer, average number of daily hours worked outdoors, and level of education. They were also comparable on sunscreen use and wide-brim hat use at baseline after adjusting for clustering.

Seventy US postal service stations were randomised; 35 to the intervention group (n=1,257) and 35 to the control group (n=1,405). The intervention group received protective hats and discounts on replacement hats, sunscreen (SPF 30) bottles and 12-ounce bottles for each postal worker, visual cues (eg. poster, water bottles), and brief educational sun safety messages. The control group participated in the two year evaluation and then received the intervention (as above) over a one year period. Station participation was ensured by the local postmaster and USPS district manager, but participation by the postal workers was voluntary.

The primary outcome measure was the change in use of sunscreen and wide-brim hats over the previous five working days, measured by self-report questionnaires at 3-months, 1-, and 2-years. The amount of sunscreen removed from the communal bottles at each station was measured at each time point by a research assistant, and postal carriers were observed for clothing worn during mail delivery times. The secondary outcome was the assessment of two dimensions of skin colour on each participants face (right and left cheeks, and forehead), using a colorimeter to quantify levels of tan. Dimension L* quantifies colour on a scale from black to white, with higher scores indicating lighter skin (ie. less tanned); dimension b* quantifies colour on a scale from blue to yellow, with higher scores indicating a yellower colour (ie. more tanned skin).

There was a statistically significant increase in the use of sunscreen by postal workers in the intervention group compared to control group at all time periods (p=0.018). At 3-month follow-up, the odds of sunscreen use was 2.8 times greater in the intervention group compared to controls; OR 2.78 (95% CI: 2.20 to 3.51). At 1- and 2-years this benefit had reduced slightly, but was still statistically significant; 1 year OR 2.11 (95% CI: 1.68 to 2.65), 2 years OR 2.03 (95% CI: 1.60 to 2.58). There was no statistically significant group by time interaction for use of a wide-brim hat up to 2 years (OR not reported), but this was significant at 3-year follow-up (p<0.001). There was a statistically significant difference between intervention and control groups with the intervention group having a higher rate of hat use; OR 2.88 (95% CI: 2.31 to 3.61, p<0.001). At 3-year follow-up (when the control group received the intervention) the differences for hat use remained significant for the intervention group; OR 1.44 (95% CI: 1.12 to 1.85), but sunscreen use was similar between the two groups; OR 1.08 (95% CI: 0.85 to 1.36).

There was no statistically significant group by time interaction, or differences by treatment group for face L* colour dimension. However, there was a significant group by time interaction for face b* colour dimension (p=0.009) which suggests the intervention group had greater reductions in skin tan over time compared to controls.

*A*djustments for age, gender, and race/ethnicity did not significantly alter the results. An exploratory analysis indicated that with each additional education session attended, there was a 21% increase in reporting “always” wearing a wide-brimmed hat (OR 1.21, 95% CI 1.06 to 1.38, p=0.005) and a similar increase in sunscreen use (OR 1.18, 95% CI 1.03 to 1.34, p=0.017).

This was a good quality study with adequate follow-up, although it was unclear how randomisation was conducted. Other potential sources of bias were kept to a minimum. Postal workers and data collectors were blind to allocation, and outcomes were assessed on an intention to treat (ITT) basis. In addition to the self-report measures, more objective methods were used (observation, weighing of sunscreen, colorimeter measures). Although these objective methods are likely to be more reliable than self-report behaviours, there was some inconsistency between the two colour dimensions and it is possible that the measure was not sufficiently sensitive to measure actual changes in UVR protective behaviours among adults with high levels of sun exposure.

The authors highlighted the limitations with the colorimeter data and acknowledged that inferences could not be made about which intervention components were the most effective. The intervention was tailored to the specific needs and occupational culture of USPS letter carriers and may be generalisable to other postal stations within the USA, but may not be generalisable to all outdoor

occupations. The authors suggest that further research is needed to determine which intervention strategies are effective in which outdoor occupational groups, and to evaluate the effects of the availability of hats and sunscreen both with and without educational sessions.

Non-Randomised Controlled Trial

Azizi 2000[4] ([–] quality): One non-randomised controlled study was conducted in Israel, a non-OECD country, over a 20 month period and assessed the impact of a graded intensity intervention programme on permanent outdoor workers from the Israeli National Water Resource Company. The majority of workers were men (68%), with approximately half categorised as blue-collar maintenance workers and the other half categorised as white-collar engineers, electricians and supervisors. The mean age of employees was 42 years (ranging between 23 and 63 years). Baseline characteristics were similar among intervention groups, but there were more senior outdoor workers in the complete group compared to partial and minimal groups. The majority of employees in each intervention group reported that their skin was sometimes susceptible to sunburn. In all three intervention groups, employees were reported to be of eastern origin (fathers born in Africa/Asia). Daily temperatures at the four sites were not reported.

All employees at the four water units were invited to participate in the study. Participants received complete, partial, or minimal intervention in two waves, one year apart. Thirty seven workers (one water unit) were allocated to the complete group which included training of safety officers, a health education session and brochures, and skin examinations in the first wave. In the second wave, workers received the above, plus provision of personal sun-protective gear (wide brimmed hats, standard sunglasses, and topical sunscreens). Two water units (n=72) were allocated to the partial intervention group; the first wave was similar to that of the complete group. There was a protocol deviation in the second wave as local managers provided employees in this group with personal sunscreen packages due to requests from the workers. The minimal intervention programme was administered to one water unit (n=35) which included no intervention in the first wave, with provision of a health education session, educational brochures, and skin examinations in the second wave.

The primary outcomes of interest were the change in use of sunscreen, length of time spent in the sun, and the proportion of skin exposed to the sun (in accordance with the site-specific dress habits for a typical working day). The secondary outcome was the change in rate of skin self-examination for signs of skin cancer. Change was measured using self-report questionnaires, and the number of sunscreen packages used by employees was recorded using an inventory. One hundred and forty

four of 280 workers (68%) completed all study assessments and were included in the analysis. Sunscreen use at baseline was comparable between groups.

There was a statistically significant increase in all three groups at interim- compared to pre-test, with no evidence of between group differences. A further significant increase was reported at post-test among the complete and partial groups (+80% and +52%, respectively, p values not reported). Inventories reported a 30% use of total volume of sunscreens in the complete group, with statistically significantly lower use of sunscreen in the minimal group compared to other groups (interim- to post-test $p<0.01$). There was a statistically significant difference in the sun-exposed skin area at post-test, with the complete intervention group reporting 25% less than the partial group ($p<0.05$). All three groups had a 17% to 37% drop in the range of daily occupation solar ultraviolet radiation exposure dose ($p<0.05$), and there were no significant between group differences. The complete intervention group showed the greatest increase in skin self-examination from pre-test to post-test, with the minimal group showing a rate 35% lower than the other groups at interim- and post-test ($p<0.05$).

Further analyses indicated that a lower mean daily occupational solar ultraviolet radiation exposure dose at post-test was associated with more extensive intervention, higher level of education, and lower seniority in outdoor occupation.

This study had a number of key limitations, which is reflected in the internal and external quality scores (both [-]). It was unclear how water units were assigned to each intervention group which means that bias may have been introduced. It was unclear whether the selected population was representative of the general population; differences between responders to the study and non-responders were identified, with non-responders having lower levels of education, a higher rate of smoking, and a lower rate of previous sunburn episodes (all $p<0.01$). Some outcomes were assessed via self-report measures, and it was unclear whether groups receiving personal sun-protection gear adhered to wearing the clothing. Other limitations include the protocol deviation in the partial intervention group, lack of ITT analyses, and the high proportion of workers that did not complete the study (>20%). Furthermore, the statistical analyses were limited to the use of t-tests to compare outcomes from one group against each, rather than an alternative method such as ANOVA, which would have enabled differences across all three groups to be assessed.

Multi-component interventions in work settings

ER 4.30 Neither of the multi-component studies carried out in work settings (Mayer 2007 [+]; Azizi

2000 [-]) were designed specifically to assess the effect of the individual components that comprised the intervention. Therefore, where studies find an effect, it is not possible to determine the contribution of the various components.

ER 4.31 There was moderate evidence from one cluster RCT (Mayer 2007 [+]) conducted in the USA, that provision of information plus sun protective resources, delivered by health educators, improves sun protective behaviours in outdoor workers. There was higher self-reported sunscreen use, which was sustained, though somewhat reduced, at two year follow-up (OR 2.03, 95% CI: 1.60 to 2.58) and greater self-reported hat use amongst American postmen over a two year period (OR 2.88 95% CI: 2.31 to 3.61), following brief educational messages, visual reminders and provision of protective hats and sunscreen. These findings were corroborated by research assistants' direct observations, and partially supported by an objective measure of suntan (dimensions of skin colour were assessed by trained data collectors using colorimeters). A three year follow-up found that increased hat use was sustained but not sunscreen use, but delivery of the intervention to the comparison group had already started when the follow-up was carried out.

ER 4.32 There was weak evidence from a non randomised controlled trial (Azizi 2000 [-]) conducted over a 20 month period in a non-OECD country (Israel) of a statistically significant reduction in sun-exposed skin amongst outdoor workers. Workers received complete, partial, or minimal intervention in two waves, one year apart, including safety officer training, provision of information or personal sun-protective gear (wide brimmed hats, standard sunglasses, and topical sunscreen), or skin examinations. The amount of sunscreen used was recorded using an inventory. At the end of the intervention the complete intervention group reported 25% less sun-exposed skin area compared to a partial intervention group ($p<0.05$), and inventories reported a 30% use of total volume of sunscreens in the complete group, with significantly lower use of sunscreen in the minimal group compared to other groups ($p<0.01$).

ER 4.33 In relation to the secondary review questions, Mayer 2007 [+] reported exploratory analyses to evaluate whether number of educational sessions attended impacted on the outcomes. With each additional education session attended, there was a 21% increase in the odds of reporting "always" wearing a wide-brimmed hat (OR 1.21, 95% CI 1.06 to 1.38, $p=0.005$) and a similar increase in sunscreen use (OR 1.18, 95% CI 1.03 to 1.34, $p=0.017$). Azizi 2000 [-] found that a lower mean daily occupational solar ultraviolet radiation exposure dose at post-test was associated with more extensive intervention, higher level of education, and lower seniority in outdoor occupation.

Applicability

This evidence is only partially applicable to the UK setting as the studies were undertaken in countries with a warmer summer climate. The benefit of any such interventions may be less in a UK setting, though the evidence may be applicable to people who spend long periods outdoors as part of their occupation.

4. Discussion and conclusions

The effectiveness and cost-effectiveness of provision of sun protection resources and environmental changes for primary prevention of skin cancer attributable to UV exposure were evaluated. The specific interventions of interest were provision of sun protection resources, such as sunscreen and sun protective clothing; changes to the natural or built environment, such as provision of shade or timing of outdoor activities; and multicomponent interventions combining resource provision with environmental changes or either or both of these in combination with information provision. This constituted a second phase of work to underpin development of guidance by NICE on the the provision of information, physical changes to the natural and built environment, and provision of sun protection resources for the prevention of primary skin cancer. The first phase of work included evidence reviews on the provision of information as a single intervention.

Scope and limitations of the evidence

Thirty studies assessing effectiveness and only one assessing cost-effectiveness were identified. The studies were undertaken in a wide variety of settings; at beaches and pools, community, education, healthcare and work settings. Despite the range of settings, there were no studies identified that were undertaken in outdoor sports settings such as cricket or jogging clubs. None of the included studies were from the UK and most were from countries with a different climate to that in the UK, predominantly longer, hotter summer periods and warmer year round climates in some cases. The majority of studies were undertaken in the USA including the states of Arizona, Colorado, California and New Hampshire. Given the climate in Australia, there was a surprisingly small number of studies (3 studies) from this country. Overall, at best, the evidence is likely to be only partially applicable to a UK setting. Interventions evaluated in countries with hotter climates may have a lesser benefit when implemented in the UK.

The body of evidence on single component resource provision or environmental interventions was very limited. There were three studies that assessed provision of shade and none that assessed resource provision as a single intervention. The majority of studies evaluated multi-component interventions that combined information provision with provision of sun-protection resources or shade. The overall body of evidence on multi-component interventions had some significant limitations. The majority of the studies were not designed specifically to assess the effect of the individual components that comprised the intervention. In most studies, the multi-component intervention was compared to no intervention. Therefore, where studies found an effect, it was not

possible to determine the contribution of the various components. Additionally, in several of the studies classified as multi-component, the resource provision was a very minor component of the intervention. In particular this applied to studies where the only “resource provision” was sunscreen samples which appeared to be mainly given as incentives (in a similar way to provision of pens or keyrings) rather than as part of the actual intervention being evaluated. The size of the sunscreen sample provided was usually not reported. Even in those studies were the resource provision seemed more substantial, such as provision of t-shirts and hats, very little information was provided on the design of the items other than that they displayed the project logo or a sunsafe message. For example, in most instances it was unclear what sun-protection factor the t-shirts offered and whether they were long sleeved or short sleeved or whether the hats provided were suitably designed to offer maximum sun protection. This lack of information about the resource component, together with the lack of outcome measurement relating to participants’ use of, or views about the resource, suggests that resource provision was not considered, in the majority of muticomponent studies, to be an integral element of the intervention being evaluated. Overall there was a dearth of evidence addressing the specific question of interest in the review: the effectiveness of sun protection resources or shade either with or without information provision in preventing first occurrence of skin cancer attributable to UV exposure.

An additional limitation of the evidence was the lack of data on the most important outcome, development of primary skin cancer. However, this was expected and the review question was underpinned by a logic model which links interventions targeted at reducing UV exposure to short-term outcomes such as increased knowledge about how to protect against exposure and/or changes in attitudes (such as to having a suntan) and or/changes in behaviour (such as avoiding UV exposure during peak hours). In the longer term, these changes in knowledge, attitudes and behaviour may reduce the incidence of overexposure to UV radiation which may reduce the number of cases of exposure related skin cancers. The majority of studies reported sun protective behaviours rather than relying on knowledge and attitudes alone; however with the exception of a small number of studies that observed participants’ sun-protective behaviours (albeit in a limited way in some of the studies), the majority of behavioural outcome measures were self-reported. This introduces the possibility of participants overestimating how much they engage in sun-protective behaviours in relation to themselves or in particular to their children. Observed behaviours, using robust methods are likely to provide a more reliable assessment of behaviours than self-report. Other approaches in a few studies included objective measures of sun exposure including skin colour and dosimeters to assess UV exposure. Three studies assessed the number of new nevi following the intervention.

Acquired melanocytic nevi has been identified as an important risk factor for developing melanoma.[51]

Potential adverse consequences of interventions were explicitly addressed in only two studies: one assessed whether there was any vandalism of the newly provided shade sails or any injuries (Dobbinson 2009[6]) and the other whether physical activity levels were the same in the intervention and control settings (Boldemann 2006[7]). None of the studies providing sunscreen assessed whether this impacted on the length of time spent in the sun. There is a suggestion that increased use of sunscreen with high SPF may be associated with increased length of time spent in the sun. [52]

There was also a lack of evidence addressing the secondary review questions related to factors that impact on the effectiveness of the interventions of interest and barriers or facilitators to their provision or use.

Overview of the evidence

The three studies assessing provision of shade suggest that children and adolescents use appropriately placed shade (Dobbinson 2009;[6] Boldemann 2006;[7] Boldeman 2004[8]). One good quality RCT from Australia found that adolescents in Years 7 to 12 used rather than avoided newly provided sail shades at secondary schools, during the lunch period (Dobbinson 2009[6]). An average of approximately three more students used a newly shaded site at the intervention schools compared to the control schools where no shade sails were provided. Although this was a fairly small effect, small improvements may be important. The authors suggested that optimal use of the shade areas may have been limited by friendship groups avoiding encroaching on other students' space. Further research is required to assess the impact of different seating arrangements, size of sails and use of multiple sails within a school. Two observational studies from Sweden reported an association between availability of natural shade in preschool play areas and reduced UV exposure for the children (Boldemann 2006;[7] Boldeman 2004[8]). However, the impact on longer term outcomes such as skin cancer or changes to skin associated with increased risk of skin cancer is unclear. Overall, the evidence from these studies is likely to be applicable to nursery schools and schools in the UK where outside areas used are exposed to full sun, though it is unclear whether shaded areas such as those in the Australian study would have a similar usage in a cooler climate such as the UK. No studies were identified that assessed provision of shade in other settings

There was only one multi-component study designed to assess the effect of adding provision of sun-protection resources to an information intervention (Bauer 2005[5]). This three year RCT, targeted at parents of nursery school children in Germany compared education plus provision of free sunscreen

to education only and a no intervention control. An enhanced intervention consisting of a three hour education/information session for parents and written information provided three times per year plus 800ml of SPF 25 sunscreen per year was compared to education only (three hour education/information session for parents and written information provided three times per year) and a control group that received the three hour information session only. There was no benefit in this study from the addition of free sunscreen to information provision in terms of the number of new nevi, the number of self-reported newly experienced sunburns, the proportion of participants "almost always" using sunscreen or use of sun protective clothing. Overall this was a reasonably good quality study though loss to follow-up was fairly high, with children at higher risk of developing nevi being more likely to complete the study. The authors suggest that as a result, the three groups may have become more alike in their sun protection practices, reflecting their concerns about implications for sun exposure, which may have resulted in an underestimation of the treatment effect.

There were three other three-arm studies where an enhanced arm including provision of resources and information provision/education was compared to information provision/education alone and with no intervention (Glanz 2000[25]), a minimal information provision (Barankin 2001[35]) or a standard health education curriculum (Milne 2006[36]). The resource provision components were provision of sunscreen in large dispensers and portable shade tents at outdoor recreation sites in Hawaii (Glanz 2000[25]), free sunscreen prior to the summer holidays to school children in Ontario, Canada (Barankin 2001[35]), and an offer of low-cost protective swimwear for 5 to 6 year old children at schools in Perth, Australia (Milne 2006[36]). Participants in the enhanced arms were also provided with additional information, to that received by the information only group, therefore it was not possible to unravel the contribution of the resource provision from the additional information. There was no or limited benefit from the enhanced information provision plus resource provision on self-reported sun protective behaviours in any of the three studies or, in one of the studies using objective measures of number of nevi and suntan (Milne 2006[36]). It would therefore seem reasonable to conclude that neither the resource provision nor the additional information provision contributed any extra benefit. However, these studies had some methodological limitations therefore it is not possible to confidently conclude that resource provision is not an effective intervention.

It is not possible to draw conclusions about the effectiveness of adding provision of sun protection resources to an information intervention from the remaining studies included. As outlined above, these studies were not designed specifically to assess the effect of the individual components that comprised the intervention. The evidence from these evaluations was mixed (both within and

between studies), with some reporting positive effects of the interventions and others not. There was considerable variability between the studies in the content of both the information and resource provision elements of the interventions; and in the intensity and duration of the interventions making it difficult to determine the source of the conflicting evidence. There was also conflicting evidence within several studies, with positive effects for some outcomes but not others.

The one cost-effectiveness study found that the incremental cost per skin cancer prevented suggested that that the provision of free SPF 15+ sunscreen, advice and regular encouragement to apply sunscreen in a community setting in Australia was more effective and more costly than usual discretionary use of sunscreen (Gordon 2009[29]). The incremental cost per skin cancer prevented for the intervention was $3,041 (price year 2007) in the base case. The lack of a quality-adjusted life-year (QALY) measure of benefit means that the cost-effectiveness ratio was not directly comparable to the NICE guidance on cost-effectiveness thresholds. There were potentially serious limitations to the study, which may change the cost-effectiveness thresholds. In addition, the effectiveness data came from an RCT investigating the effectiveness of sunscreen per se rather than addressing the question of interest to this review which is about the effectiveness of different methods for the provision of sun protection resources. Therefore, for the purposes of this review, the effectiveness of sunscreen in preventing skin cancer is assumed. The costs involved in providing sunscreen outside the context of a trial assessing the effectiveness of sunscreen per se are likely to be different.

Research recommendations

There is a clear need for high quality research to assess the effectiveness and cost-effectiveness of provision of sun protection resources or changes to the natural or built environment, either alone or in conjunction with education/information provision. Taking a UK perspective, there is a strong need for research undertaken in the UK, across settings and populations. There might be benefit in achieving a consensus amongst researchers, practitioners and policymakers as to priority groups and settings (e.g. outside workers, children's playgrounds) given the dearth of evidence relating to any UK population groups and settings.

Ideally, long-term outcomes relating to the number of primary skin cancers should be assessed. However, long-term outcome assessment within the context of RCTs is not always feasible given practical and funding restraints. A consensus is required as to the most appropriate proxy outcomes and how they should be measured. Consideration needs to be given to the appropriateness of the different measures of sun exposure related skin changes such as objective measures of depth of suntan and development of melanocytic nevi. Reliance on self-reported sun protective behaviours

alone should be avoided and, where possible be replaced by or supplemented with robust behavioural observation. The reliability of self-reported measures can be assessed against more objective measures such as observed behaviour or objective measures of sun exposure (e.g. UV dosimeters) in the context of RCTs. Regardless of the specific outcome measure used, medium and long-term follow-up is required. Short-term outcomes such as those assessed at the end of a single summer season are likely to have very limited generalisability as they give no indication of the maintenance of any changes into the next summer season. Future evaluations should also systematically assess potentially adverse consequences of interventions, for example, the effect of shade areas in schools on children's activity levels and the effect of providing high SPF sunscreen on other sun protective behaviours such as amount of time spent in direct sun. Current reporting standards should be followed; the CONSORT statement for randomised studies,[53] and the TREND statement for non-randomised studies.[54]

Where multicomponent interventions are being evaluated the trials need to be designed so that the contribution of the individual components can be assessed and appropriate intermediate outcomes measured. For example, if sunscreen is provided at the poolside, then the amount of sunscreen used needs to be recorded. Current guidance on developing complex interventions, feasibility assessment and evaluation should be followed.[55]

Conclusion

Overall the evidence on the effects of provision of sun protection resources or changes to the natural or built environment, either alone or in conjunction with information provision is very limited making it difficult to provide clear implications for practice. Few studies were designed to properly address the review question and none were undertaken in a UK setting. There is a clear need for high quality research, undertaken in a UK setting assessing the effectiveness and cost effectiveness of these interventions in a range of settings and with specific population groups.

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(*main included study; **paper related to main included study)

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Appendix 1a: Search strategies

ASSIA

Searched via CSA Illumina

Search date=25th August 2009

Records retrieved=91 records

Search strategy

((((skin within3 cancer*) or (skin within 3 neoplasm*) or (skin within 3 oncolog*)) or ((skin within 3 malignan*) or (skin within 3 tumor*) or (skin within 3 tumour*)) or ((skin within 3 carcinoma*) or (skin within 3 adenocarcinoma*))) or((melanoma or nonmelanoma or nevus) or (nevi or naevi or mole) or moles) or((sunburn* or (sun burn*) or tanning) or ((sun tan*) or suntan* or (sun damag*)) or (sundamag* or (sun within 3 expos*) or (solar within 3 damag*)) or ((solar within 3 expos*) or photodamag* or (photo damag*)) or ((ultraviolet within 2 radiat*) or (uv within 2 radiat*) or (solar within 2 radiat*)) or ((ultraviolet within 2 irradiat*) or (uv within 2 irradiat*) or (solar within 2 irradiat*)) or ((ultraviolet ray*) or (ultra violet ray*) or (uv ray*)) or ((solar ray*) or (ultraviolet within 2 expos*) or (uv within 2 expos*))) or(((ultra violet within 2 radiat*) or (ultra violet within 2 irradiat*) or (ultra violet within 2 expos*)) or (ultra violet within 2 ray*))) and((((radiat* within 2 protect*) or (irradiat* within 2 protect*) or (sun within 2 protect*)) or ((solar within 2 protect*) or sunsafe* or (sun safe*)) or (photoprotect* or (photo protect*) or sunscreen*) or ((sun screen*) or sunblock* or (sun block*)) or (lipblock* or (lip block*) or lipbalm*) or (lip balm*)) or((clothing or clothe* or uniform*) or (hat or hats or pants) or (sleeve* or sunglasses or (sun glasses))) or(((environment* within 3 intervention*) or (environment* within 3 chang*) or (environment* within 3 improv*)) or ((environment* within 3 condition*) or (environment* within 3 safe*) or (environment* within 3 protect*)) or ((environment* within 3 design*) or (environment* within 3 planning) or (environment* within 3 build*)) or ((environment* within 3 built) or (environment within 3 structur*) or (physical within 3 environment*)) or ((physical within 3 landscape*) or (protective within 3 structur*) or (protective within 3 build*)) or ((protective within 3 built) or (protective within 3 shelter*) or (architectur* within 3 chang*)) or ((architectur* within 3 improv*) or (architectur* within 3 safe*) or (architectur* within 3 design*)) or ((architectur* within 3 structur*) or (architectur* within 3 construct*) or (building* within 3 chang*)) or ((building* within 3 improv*) or (building* within 3 safe*) or (building* within 3 design*)) or ((building* within 3 structur*) or (building*within 3 construct*))) or((shade or shaded or shady) or (shelter* or canopy or canopies) or (canopied or awning* or plant) or (plants or tree or trees) or (foliage or vegetation)) or(((lunch time*) or lunchtime* or (lunch break*)) or (midday or noon or (middle within 3 day)) or ((time within 3 day) or morning* or afternoon*)))

Bibliomap: EPPI-Centre database of health promotion research

Searched via EPPI website http://eppi.ioe.ac.uk/webdatabases/Intro.aspx?ID=7

Search date=2nd September 2009

Records retrieved=130

Search strategy

1	Freetext: "skin cancer*"	62
2	Freetext: "skin neoplasm*"	0
3	Freetext: "skin neoplasm*"	0
4	Freetext: "skin malignan*"	0
5	Freetext: "skin malignan*"	0
6	Freetext: "skin tumor*"	0
7	Freetext: "skin tumor*"	0
8	Freetext: "skin tumour*"	0
9	Freetext: "skin tumour*"	0
10	Freetext: "skin carcinoma*"	0
11	Freetext: "skin carcinoma*"	0
12	Freetext: "skin adenocarcinoma*"	0
13	Freetext: "melanoma "	56
14	Freetext: "melanoma "	56
15	Freetext: nonmelanoma	2
16	Freetext: nonmelanoma	2
17	Freetext: "squamous cell*"	4
18	Freetext: "squamous cell*"	4
19	Freetext: "basal cell*"	6
20	Freetext: "basal cell*"	6
21	Freetext: "nevus" OR "nevi" OR "naevi" OR "mole" OR "moles"	20
22	Freetext: "nevus" OR "nevi" OR "naevi" OR "mole" OR "moles"	20

23	Freetext: "sunburn*" OR "ultraviolet" OR "solar"	70
24	Freetext: "sunburn*" OR "ultraviolet" OR "solar"	70
25	1 OR 13 OR 22 OR 23	130

Campbell Collaboration Library of Systematic Reviews

Searched via http://www.campbellcollaboration.org/library.php

Search date=19th August 2009

Records retrieved=0

Search strategy

Cancer [in title] OR [skin] in title

CINAHL

Searched via EBSCO

Search date=August 24, 2009
Records retrieved=2016 records

Search strategy

S1 (MH "Skin Neoplasms+") 2748
S2 (MH "Carcinoma, Basal Cell 445
S3 (MH "Carcinoma, Squamous Cell") 3138
S4 (MH "Nevi and Melanomas") 4
S5 TX (skin N3 cancer*) or (skin N3 neoplas*) or (skin N3 oncolog*) or skin N3 malignan*) or (skin N3 tumor*) or (skin N3 tumour*) or (skin N3 carcinoma*) or (skin N3 adenocarcinoma*) 3325
S6 TX (melanoma* or nonmelanoma*) or TX "basal cell carcinoma*" or TX "basal cell cancer*" or TX "basal cell epithel*" or TX "squamous cell carcinoma*" or TX "squamous cell cancer*" or TX "squamous cell epithel*" or TX (NMSC or BCC or SCC) or TX (nevus or nevi or naevi) or TX (mole or moles) 5600
S7 (MH "Sunburn+") 518
S8 (MH "Ultraviolet Rays 866
S9 TX (sunburn* or "sun burn*" or tanning or "sun tan*" or suntan*) or TX ("sun damag*" or sundamag* or (sun N2 expos*)) or TX ((solar N2 damag*) or (solar N2 expos*)) 1084
S10 TX photodamag* or "photo damag 31
S11 TX ultraviolet N2 radiat* or TX "ultra violet" N2 radiat* or TX uv N2 radiat* or TX solar N2 radiat* 251
S12 TX ultraviolet N2 irradiat* or TX "ultra violet" N2 irradiat* or TX uv N2 irradiat* or TX solar N2 irradiat* 78
S13 TX ("ultraviolet ray*" or "ultra violet ray*" or "uv ray*" or "solar ray*") or TX ultraviolet N2 expos* or TX "ultra violet" N2 expos* or TX uv N2 expos* 991
S14 S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 10429
S15 (MH "Radiation-Protective Agents") 68

S16 (MH "Sunscreening Agents") 800
S17 (MH "Protective Clothing") 1578
S18 (MH "Eye Protective Devices") 288
S19 TX radiat* N2 protect* or TX irradiat* N2 protect* or TX sun N2 protect* or TX solar N2 protect* or TX (sunsafe* or "sun safe*") or TX (photoprotect* or "photo protect*") or TX (sunscreen* or "sun screen*" or sunblock* or "sun block*" or lipblock* or "lip block*" or lipbalm* or "lip balm*") or TX (clothing or clothe* or uniform* or hat or hats or pants or sleeve* or sunglasses or "sun glasses") 17568
S20 (MH "Environment+") 36476
S21 (MH "Architecture+") 5557
S22 TX environment* N3 intervention* or TX environment* N3 chang* or TX environment* N3 improv* or TX environment* N3 condition* or TX environment* N3 safe* or TX environment* N3 protect* 7627
s23 TX environment* N3 design* or TX environment* N3 planning or TX environment* N3 build* or TX environment* N3 built or TX environment* N3 structur* 1416
S24 TX physical N3 environment* or TX physical N3 landscap* or TX protectiv* N3 structur* or TX protectiv* N3 build* or TX protectiv* N3 built or TX protectiv* N3 shelter* 1654
S25 TX architectur* N3 chang* or TX architectur* N3 improve* or TX architectur* N3 safe* or TX architectur* N3 design* or TX architectur* N3 structure* or TX architectur* N3 construct* 209
S26 TX building* N3 chang* or TX building* N3 improve* or TX building* N3 safe* or TX building* N3 design* or TX building* N3 structure* or TX building* N3 construct* 660
S27 TX (shade or shaded or shady or shelter*) or TX (canopy or canopied or canopies or awning*) or TX (plant or plants or tree or trees or foliage or vegetation) or TX ("lunch time" or lunchtime or "lunch break" or midday or noon) or TX middle N2 day or TX time N2 day or TX (morning or afternoon) 22969
S28 S15 or S16 or S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24 or S25 or S26 or S27
S29 S14 and S28
S30 TX SunWise or SunSmart or "Pool Cool" or Kidskin
S31 S29 or S30 2091
S32 S29 or S30 Limiters - Publication Year from: 1990-2009

Clinical Trials Register

Searched via http://clinicaltrials.gov/ct2/home

Search date=7th September 2009

Records retrieved= 8 studies

Search strategy

skin cancer OR skin neoplasms OR skin malignancies OR skin tumors OR skin tumours OR skin carcinomas OR skin adenocarcinomas OR melanomas OR nonmelanomas | sunscreen OR sunblock OR sun protect

Cochrane CENTRAL Register of Controlled Trials

Searched via Cochrane Library 2009 issue 3

Search date=24th August 2009

Records retrieved= 335

Search strategy

#1	MeSH descriptor Skin Neoplasms explode all trees	850
#2	MeSH descriptor Melanoma explode all trees	825
#3	MeSH descriptor Carcinoma, Basal Cell explode all trees	168
#4	MeSH descriptor Carcinoma, Squamous Cell explode all trees	1627
#5	MeSH descriptor Nevus explode all trees	43
#6	(skin NEAR/3 (cancer* or neoplas* or oncolog* or malignan* or tumor* or tumour* or carcinoma* or adenocarcinoma*)):ti or (skin NEAR/3 (cancer* or neoplas* or oncolog* or malignan* or tumor* or tumour* or carcinoma* or adenocarcinoma*)):ab	393
#7	(melanoma* or nonmelanoma*):ti or (melanoma* or nonmelanoma*):ab or "basal cell" NEAR/2 (carcinoma* or cancer*):ti or "basal cell" NEAR/2 (carcinoma* or cancer*):ab	1614
#8	"basal cell" NEAR/2 epithel*:ti or "basal cell" NEAR/2 epithel*:ab or "squamous cell" NEAR/2 (carcinoma* or cancer*):ti or "squamous cell" NEAR/2 (carcinoma* or cancer*):ab	1275
#9	"squamous cell" NEAR/2 epithel*:ti or "squamous cell" NEAR/2 epithel*:ab or (NMSC or BCC or SCC):ti or (NMSC or BCC or SCC):ab	239
#10	(nevus or nevi or naevi):ti or (nevus or nevi or naevi):ab or (mole or moles):ti or (mole or moles):ab	118
#11	MeSH descriptor Sunburn, this term only	121
#12	MeSH descriptor Ultraviolet Rays, this term only	393
#13	(sunburn* or "sun burn*" or tanning or "sun tan*" or suntan"):ti or (sunburn* or "sun burn*" or tanning or "sun tan*" or suntan"):ab or "sun damag*" or sundamag* or (sun NEAR/2 expos*):ti or "sun damag*" or sundamag* or (sun NEAR/2 expos*):ab	450
#14	(solar NEAR/2 damag*) or (solar NEAR/2 expos*):ti or (solar NEAR/2 damag*) or (solar NEAR/2 expos*):ab or (photodamag* or "photo damag*"):ti or (photodamag* or "photo damag*"):ab	167

#15	(ultraviolet NEAR/2 radiat*) or ("ultra violet" NEAR/2 radiat*) or (uv NEAR/2 radiat*) or (solar NEAR/2 radiat*):ti or (ultraviolet NEAR/2 radiat*) or ("ultra violet" NEAR/2 radiat*) or (uv NEAR/2 radiat*) or (solar NEAR/2 radiat*):ab or (ultraviolet NEAR/2 irradiat*) or ("ultra violet" NEAR/2 irradiat*) or (uv NEAR/2 irradiat*) or (solar NEAR/2 irradiat*):ti or (ultraviolet NEAR/2 irradiat*) or ("ultra violet" NEAR/2 irradiat*) or (uv NEAR/2 irradiat*) or (solar NEAR/2 irradiat*):ab	467
#16	"ultraviolet ray*" or "ultra violet ray*" or "uv ray*" or "solar ray*":ti or "ultraviolet ray*" or "ultra violet ray*" or "uv ray*" or "solar ray*":ab or (ultraviolet NEAR/2 expos*) or (ultra violet NEAR/2 expos*) or (uv NEAR/2 expos*):ti or (ultraviolet NEAR/2 expos*) or (ultra violet NEAR/2 expos*) or (uv NEAR/2 expos*):ab	175
#17	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16)	5369
#18	MeSH descriptor Radiation Protection, this term only	83
#19	MeSH descriptor Sunscreening Agents, this term only	144
#20	MeSH descriptor Protective Clothing, this term only	138
#21	MeSH descriptor Eye Protective Devices, this term only	37
#22	(radiat* NEAR/2 protect*) OR (irradiat* NEAR/2 protect*):ti or (radiat* NEAR/2 protect*) OR (irradiat* NEAR/2 protect*):ab or (sun NEAR/2 protect*) or (solar NEAR/2 protect*):ti or (sun NEAR/2 protect*) or (solar NEAR/2 protect*):ab	194
#23	(sunsafe* or "sun safe*" OR photoprotect* or "photo protect*"):ti or (sunsafe* or "sun safe*" OR photoprotect* or "photo protect*"):ab or (sunscreen* or "sun screen*" or sunblock* or "sun block*" or lipblock* or "lip block*" or lipbalm* or "lip balm*"):ti or (sunscreen* or "sun screen*" or sunblock* or "sun block*" or lipblock* or "lip block*" or lipbalm* or "lip balm*"):ab	321
#24	(clothing or clothe* or uniform* or hat or hats or pants or sleeve* or sunglasses or "sun glasses"):ti or (clothing or clothe* or uniform* or hat or hats or pants or sleeve* or sunglasses or "sun glasses"):ab	2063
#25	MeSH descriptor Environment Design explode all trees	34

#26	MeSH descriptor Environment, this term only	185
#27	MeSH descriptor Architecture as Topic explode all trees	112
#28	(environment* NEAR/3 (intervention* or chang* or improv* or condition* or safe or safer or safety or protect*)):ti or (environment* NEAR/3 (intervention* or chang* or improv* or condition* or safe or safer or safety or protect*)):ab or (environment* NEAR/3 (design* or planning or build or built or structur*)):ti or (environment* NEAR/3 (design* or planning or build or built or structur*)):ab	671
#29	(physical NEAR/3 (environment* or landscap*)):ti or (physical NEAR/3 (environment* or landscap*)):ab or (protectiv* NEAR/3 (structur* or build* or built or shelter*)):ti or (protectiv* NEAR/3 (structur* or build* or built or shelter*)):ab	71
#30	(architectur* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ti or (architectur* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ab or (building* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ti or (building* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ab	65
#31	(shade or shaded or shady or shelter* or canopy or canopied or canopies or awning*):ti or (shade or shaded or shady or shelter* or canopy or canopied or canopies or awning*):ab or (plant or plants or tree or trees or foliage or vegetation):ti or (plant or plants or tree or trees or foliage or vegetation):ab	1678
#32	"lunch time" or lunchtime or "lunch break" or midday or noon or (middle NEAR/2 day) or (time NEAR/2 day) or morning or afternoon:ti or "lunch time" or lunchtime or "lunch break" or midday or noon or (middle NEAR/2 day) or (time NEAR/2 day) or morning or afternoon:ab	11755
#33	(#18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32)	16945
#34	#17 AND #33	293
#35	(#17 AND #33)	382
#36	(SunWise or SunSmart or "Pool Cool" or Kidskin):ti or (SunWise or SunSmart or "Pool Cool" or Kidskin):ab	13

#37 (#35 OR #36) 382

#38 (#37), from 1990 to 2009 344

Conference Proceedings Citation Index- Science (CPCI-S)

Searched via Web of Science on Web of Knowledge

Search date = 7th September 2009

Records retrieved=225

Search Strategy

10 225 #9 AND #4

Databases=CPCI-S Timespan=1990-2009

9 76,091 #8 OR #7 OR #6 OR #5

Databases=CPCI-S Timespan=1990-2009

8 53,879 TI=((shade OR shaded OR shady OR shelter* OR canopy OR canopies OR canopied OR awning* OR plant OR plants OR tree OR trees OR foliage OR vegetation OR (lunch time*) OR lunchtime* OR (lunch break*) OR midday OR noon OR (middle SAME day) OR (time SAME day) OR morning* OR afternoon*))

Databases=CPCI-S Timespan=1990-2009

7 3,609 TI=((architectur* SAME chang*) OR (architectur* SAME improv*) OR (architectur* SAME safe*) OR (architectur* SAMEdesign*) OR (architectur* SAME structur*) OR (architectur* SAME construct*) OR (building* SAME chang*) OR (building* SAME improv*) OR (building* SAME safe*) OR (building* SAME design*) OR (building* SAME structur*) OR (building* SAME construct*))

Databases=CPCI-S Timespan=1990-2009

6 9,972 TI=((environment* SAME intervention*) OR (environment* SAME chang*) OR (environment* SAME improv*) OR (environment* SAME condition*) OR (environment* SAME safe*) OR (environment* SAME protect*) OR (environment* SAME design*) OR (environment* SAME planning) OR (environment* SAME build*) OR (environment* SAME built) OR (environment SAME structur*) OR (physical SAME environment*) OR (physical SAME landscape*) OR(protective SAME structur*) OR (protective SAME build*) OR (protective SAME built) OR (protective SAME shelter*))

Databases=CPCI-S Timespan=1990-2009

5 9,129 TI=((radiat* SAME protect*) OR (irradiat* SAME protect*) OR (sun SAME protect*) OR (solar SAME protect*) OR sunsafe* OR (sun SAME safe*) OR photoprotect* OR (photo SAME protect*) OR sunscreen* OR (sun SAME screen*) OR sunblock* OR (sun SAME block*) or lipblock* OR (lip SAME

block*) OR lipbalm OR (lip SAME balm*) OR clothing OR clothe* OR uniform* OR hat OR hats OR pants OR sleeve* OR sunglasses OR (sun SAME glasses))

Databases=CPCI-S Timespan=1990-2009

4 11,380 #3 OR #2 OR #1

Databases=CPCI-S Timespan=1990-2009

3 36 TI=((ultra violet SAME radiat*) OR (ultra violet SAME irradiat*) OR (ultra violet SAME expos*) OR (ultra violet SAME ray*))

Databases=CPCI-S Timespan=1990-2009

2 10,340 TI=(melanoma OR nonmelanoma OR nevus OR nevi OR naevi OR mole OR moles OR sunburn* OR (sun SAME burn*) OR tanning OR (sun SAME tan*) OR suntan* OR (sun SAME damag*) OR (sundamag*) OR (sun SAME expos*) OR (solar SAME damag*) OR (solar SAME expos*) OR photodamag* or (photo SAME damag*) OR (ultraviolet SAME radiat*) OR (uv SAME radiat*) OR (solar SAME radiat*) OR (ultraviolet SAME irradiat*) OR (uv SAME irradiat*) OR (solar SAME irradiat*) OR (ultraviolet ray*) OR (ultra violet ray*) OR (uv ray*) OR (solar ray*) OR (ultraviolet SAME expos*) OR (uv SAME expos*))

Databases=CPCI-S Timespan=1990-2009

1 1,207 TI=((skin SAME cancer) OR (skin SAME neoplasm*) OR (skin SAME oncolog*) OR (skin SAME malignan*) OR (skin SAME tumor*) OR (skin SAME tumour*) OR (skin SAME carcinoma*) OR (skin SAME adenocarcinoma*))

Databases=CPCI-S Timespan=1990-2009

DARE Database of Abstracts of Reviews of Effects

Searched via Cochrane Library 2009 issue 3

Search date=24th August 2009

Records retrieved= 5

Search strategy

ID	Search
#1	MeSH descriptor **Skin Neoplasms** explode all trees
#2	MeSH descriptor **Melanoma** explode all trees
#3	MeSH descriptor **Carcinoma, Basal Cell** explode all trees
#4	MeSH descriptor **Carcinoma, Squamous Cell** explode all trees

#5	MeSH descriptor **Nevus** explode all trees
#6	(skin NEAR/3 (cancer* or neoplas* or oncolog* or malignan* or tumor* or tumour* or carcinoma* or adenocarcinoma*)):ti or (skin NEAR/3 (cancer* or neoplas* or oncolog* or malignan* or tumor* or tumour* or carcinoma* or adenocarcinoma*)):ab
#7	(melanoma* or nonmelanoma*):ti or (melanoma* or nonmelanoma*):ab or "basal cell" NEAR/2 (carcinoma* or cancer*):ti or "basal cell" NEAR/2 (carcinoma* or cancer*):ab
#8	"basal cell" NEAR/2 epithel*:ti or "basal cell" NEAR/2 epithel*:ab or "squamous cell" NEAR/2 (carcinoma* or cancer*):ti or "squamous cell" NEAR/2 (carcinoma* or cancer*):ab
#9	"squamous cell" NEAR/2 epithel*:ti or "squamous cell" NEAR/2 epithel*:ab or (NMSC or BCC or SCC):ti or (NMSC or BCC or SCC):ab
#10	(nevus or nevi or naevi):ti or (nevus or nevi or naevi):ab or (mole or moles):ti or (mole or moles):ab
#11	MeSH descriptor **Sunburn**, this term only
#12	MeSH descriptor **Ultraviolet Rays**, this term only
#13	(sunburn* or "sun burn*" or tanning or "sun tan*" or suntan"):ti or (sunburn* or "sun burn*" or tanning or "sun tan*" or suntan"):ab or "sun damag*" or sundamag* or (sun NEAR/2 expos*):ti or "sun damag*" or sundamag* or (sun NEAR/2 expos*):ab
#14	(solar NEAR/2 damag*) or (solar NEAR/2 expos*):ti or (solar NEAR/2 damag*) or (solar NEAR/2 expos*):ab or (photodamag* or "photo damag*"):ti or (photodamag* or "photo damag*"):ab
#15	(ultraviolet NEAR/2 radiat*) or ("ultra violet" NEAR/2 radiat*) or (uv NEAR/2 radiat*) or (solar NEAR/2 radiat*):ti or (ultraviolet NEAR/2 radiat*) or ("ultra violet" NEAR/2 radiat*) or (uv NEAR/2 radiat*) or (solar NEAR/2 radiat*):ab or (ultraviolet NEAR/2 irradiat*) or ("ultra violet" NEAR/2 irradiat*) or (uv NEAR/2 irradiat*) or (solar NEAR/2 irradiat*):ti or (ultraviolet NEAR/2 irradiat*) or ("ultra violet" NEAR/2 irradiat*) or (uv NEAR/2 irradiat*) or (solar NEAR/2 irradiat*):ab

#16	"ultraviolet ray*" or "ultra violet ray*" or "uv ray*" or "solar ray*":ti or "ultraviolet ray*" or "ultra violet ray*" or "uv ray*" or "solar ray*":ab or (ultraviolet NEAR/2 expos*) or (ultra violet NEAR/2 expos*) or (uv NEAR/2 expos*):ti or (ultraviolet NEAR/2 expos*) or (ultra violet NEAR/2 expos*) or (uv NEAR/2 expos*):ab
#17	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16)
#18	MeSH descriptor **Radiation Protection**, this term only
#19	MeSH descriptor **Sunscreening Agents**, this term only
#20	MeSH descriptor **Protective Clothing**, this term only
#21	MeSH descriptor **Eye Protective Devices**, this term only
#22	(radiat* NEAR/2 protect*) OR (irradiat* NEAR/2 protect*):ti or (radiat* NEAR/2 protect*) OR (irradiat* NEAR/2 protect*):ab or (sun NEAR/2 protect*) or (solar NEAR/2 protect*):ti or (sun NEAR/2 protect*) or (solar NEAR/2 protect*):ab
#23	(sunsafe* or "sun safe*" OR photoprotect* or "photo protect*"):ti or (sunsafe* or "sun safe*" OR photoprotect* or "photo protect*"):ab or (sunscreen* or "sun screen*" or sunblock* or "sun block*" or lipblock* or "lip block*" or lipbalm* or "lip balm*"):ti or (sunscreen* or "sun screen*" or sunblock* or "sun block*" or lipblock* or "lip block*" or lipbalm* or "lip balm*"):ab
#24	(clothing or clothe* or uniform* or hat or hats or pants or sleeve* or sunglasses or "sun glasses"):ti or (clothing or clothe* or uniform* or hat or hats or pants or sleeve* or sunglasses or "sun glasses"):ab
#25	MeSH descriptor **Environment Design** explode all trees
#26	MeSH descriptor **Environment**, this term only
#27	MeSH descriptor **Architecture as Topic** explode all trees
#28	(environment* NEAR/3 (intervention* or chang* or improv* or condition* or safe or safer or safety or protect*)):ti or (environment* NEAR/3 (intervention* or chang* or improv* or condition* or safe or safer or safety or protect*)):ab or (environment* NEAR/3 (design* or planning or build or built or structur*)):ti or (environment* NEAR/3 (design* or

	planning or build or built or structur*)):ab
#29	(physical NEAR/3 (environment* or landscap*)):ti or (physical NEAR/3 (environment* or landscap*)):ab or (protectiv* NEAR/3 (structur* or build* or built or shelter*)):ti or (protectiv* NEAR/3 (structur* or build* or built or shelter*)):ab
#30	(architectur* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ti or (architectur* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ab or (building* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ti or (building* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ab
#31	(shade or shaded or shady or shelter* or canopy or canopied or canopies or awning*):ti or (shade or shaded or shady or shelter* or canopy or canopied or canopies or awning*):ab or (plant or plants or tree or trees or foliage or vegetation):ti or (plant or plants or tree or trees or foliage or vegetation):ab
#32	"lunch time" or lunchtime or "lunch break" or midday or noon or (middle NEAR/2 day) or (time NEAR/2 day) or morning or afternoon:ti or "lunch time" or lunchtime or "lunch break" or midday or noon or (middle NEAR/2 day) or (time NEAR/2 day) or morning or afternoon:ab
#33	(#18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32)
#34	#17 AND #33
#35	(#17 AND #33)
#36	(SunWise or SunSmart or "Pool Cool" or Kidskin):ti or (SunWise or SunSmart or "Pool Cool" or Kidskin):ab
#37	(#35 OR #36)
#38	(#37), from 1990 to 2009

Database of promoting health effectiveness reviews (DoPHER)
Searched via EPPI website http://eppi.ioe.ac.uk/webdatabases/Intro.aspx?ID=7

Search date=2nd September 2009

Records retrieved=21

Search strategy one=Focus of the report: skin cancer

Search strategy two below

13	Freetext “skin cancer”
5	Freetext: "skin neoplasm*"
7	Freetext: "skin malignan*"
9	Freetext: "skin tumor*"
11	Freetext: "skin tumour*"
12	Freetext: "skin carcinoma*"
13	Freetext: "skin adenocarcinoma*"
14	Freetext: melanoma*
15	Freetext: "nonmelanoma*"
16	Freetext: "squamous cell*"
18	Freetext: "basal cell*"
20	Freetext: "nevus" OR "nevi" OR "naevi" OR "mole" OR "moles"
21	Freetext: "sunburn" OR "ultraviolet" OR "solar"
22	4 OR 5 OR 7 OR 9 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 18 OR 20 OR 21

Econlit

1969 to August 2009

Search date=3rd September 2009

Records retrieved=8

Strategy:

1 (skin adj3 (cancer$ or neoplas$ or oncolog$ or malignan$ or tumo?r$ or carcinoma$ or adenocarcinoma$)).ti,ab. (12)

2 (melanoma$ or nonmelanoma$).ti,ab. (9)

3 (basal cell adj2 (carcinoma$ or cancer$)).ti,ab. (0)

4 (basal cell adj2 epithel$).ti,ab. (0)

5 (squamous cell adj2 (carcinoma$ or cancer$)).ti,ab. (0)

6 (squamous cell adj2 epithel$).ti,ab. (0)

7 (NMSC or BCC or SCC).ti,ab. (40)

8 (nevus or nevi or naevi).ti,ab. (0)

9 (mole or moles).ti,ab. (8)

10 (sunburn$ or sun burn$ or tanning or sun tan$ or suntan$).ti,ab. (17)

11 (sun damag$ or sundamag$ or (sun adj2 expos$)).ti,ab. (1)

12 ((solar adj2 damag$) or (solar adj2 expos$)).ti,ab. (3)

13 (photodamag$ or photo damag$).ti,ab. (0)

14 ((ultraviolet adj2 radiat$) or (ultra violet adj2 radiat$) or (uv adj2 radiat$) or (solar adj2 radiat$)).ti,ab. (21)

15 ((ultraviolet adj2 irradiat$) or (ultra violet adj2 irradiat$) or (uv adj2 irradiat$) or (solar adj2 irradiat$)).ti,ab. (2)

16 (ultraviolet ray$ or ultra violet ray$ or uv ray$ or solar ray$).ti,ab. (1)

17 ((ultraviolet adj2 expos$) or (ultra violet adj2 expos$) or (uv adj2 expos$)).ti,ab. (4)

18 or/1-17 (106)

19 (radiat$ adj2 protect$).ti,ab. (9)

20 (irradiat$ adj2 protect$).ti,ab. (0)

21 ((sun adj2 protect$) or (solar adj2 protect$)).ti,ab. (3)

22 (sunsafe$ or sun safe$).ti,ab. (1)

23 (photoprotect$ or photo protect$).ti,ab. (0)

24 (sunscreen$ or sun screen$ or sunblock$ or sun block$ or lipblock$ or lip block$ or lipbalm$ or lip balm$).ti,ab. (1)

25 (clothing or clothe$ or uniform$ or hat or hats or pants or sleeve$ or sunglasses or sun glasses).ti,ab. (4757)

26 (environment$ adj3 (intervention$ or chang$ or improv$ or condition$ or safe or safer or safety or protect$)).ti,ab. (4682)

27 (environment$ adj3 (design$ or planning or build or built or structur$)).ti,ab. (966)

28 (physical adj3 (environment$ or landscap$)).ti,ab. (187)

29 (protectiv$ adj3 (structur$ or build$ or built or shelter$)).ti,ab. (7)

30 (architectur$ adj3 (chang$ or improv$ or safe or safer or safety or design$ or structur$ or construct$)).ti,ab. (105)

31 (building$ adj3 (chang$ or improv$ or safe or safer or safety or design$ or structur$ or construct$)).ti,ab. (300)

32 (shade or shaded or shady).ti,ab. (52)

33 (canopy or canopied or canopies or awning$).ti,ab. (12)

34 (plant or plants or tree or trees or foliage or vegetation).ti,ab. (6590)

35 (lunch time or lunchtime or lunch break or midday or noon or (middle adj2 day) or (time adj2 day) or morning or afternoon).ti,ab. (381)

36 or/19-35 (17566)

37 18 and 36 (8)

38 limit 37 to yr="1990 - 2010" (8)

39 from 38 keep 1-8 (8)

EMBASE
1980 to 2009 Week 33
Searched via OvidSP
Search date=19th August 2009
Records retrieved=5799

Search Strategy:

1 exp skin cancer/ (53806)
2 exp skin tumor/ (87669)
3 exp melanoma/ (52751)
4 basal cell carcinoma/ (9220)
5 squamous cell carcinoma/ (41123)
6 exp nevus/ (9164)
7 (skin adj3 (cancer$ or neoplas$ or oncolog$ or malignan$ or tumo?r$ or carcinoma$ or adenocarcinoma$)).ti,ab. (16831)
8 (melanoma$ or nonmelanoma$).ti,ab. (51520)
9 (basal cell adj2 (carcinoma$ or cancer$)).ti,ab. (6668)
10 (basal cell adj2 epithel$).ti,ab. (382)
11 (squamous cell adj2 (carcinoma$ or cancer$)).ti,ab. (39070)
12 (squamous cell adj2 epithel$).ti,ab. (226)
13 (NMSC or BCC or SCC).ti,ab. (9529)

14 (nevus or nevi or naevi).ti,ab. (8339)
15 (mole or moles).ti,ab. (9620)
16 sunburn/ (1789)
17 exp ultraviolet spectrophotometry/ (14432)
18 ultraviolet rays.ti,ab. (170)
19 ultraviolet radiation/ (30164)
20 sun exposure/ (5340)
21 (sunburn$ or sun burn$ or tanning or sun tan$ or suntan$).ti,ab. (2507)
22 (sun damag$ or sundamag$ or (sun adj2 expos$)).ti,ab. (3736)
23 ((solar adj2 damag$) or (solar adj2 expos$)).ti,ab. (702)
24 (photodamag$ or photo damag$).ti,ab. (1379)
25 ((ultraviolet adj2 radiat$) or (ultra violet adj2 radiat$) or (uv adj2 radiat$) or (solar adj2 radiat$)).ti,ab. (9767)
26 ((ultraviolet adj2 irradiat$) or (ultra violet adj2 irradiat$) or (uv adj2 irradiat$) or (solar adj2 irradiat$)).ti,ab. (11625)
27 (ultraviolet ray$ or ultra violet ray$ or uv ray$ or solar ray$).ti,ab. (387)
28 ((ultraviolet adj2 expos$) or (ultra violet adj2 expos$) or (uv adj2 expos$)).ti,ab. (4737)
29 or/1-28 (257025)
30 exp radiation protection/ (10373)
31 exp sunscreen/ (11497)
32 protective clothing/ (4019)
33 eye protective device/ (174)
34 (radiat$ adj2 protect$).ti,ab. (3218)
35 (irradiat$ adj2 protect$).ti,ab. (294)
36 ((sun adj2 protect$) or (solar adj2 protect$)).ti,ab. (1461)
37 (sunsafe$ or sun safe$).ti,ab. (87)
38 (photoprotect$ or photo protect$).ti,ab. (1276)
39 (sunscreen$ or sun screen$ or sunblock$ or sun block$ or lipblock$ or lip block$ or lipbalm$ or lip balm$).ti,ab. (2473)
40 (clothing or clothe$ or uniform$ or hat or hats or pants or sleeve$ or sunglasses or sun glasses).ti,ab. (69426)
41 environmental planning/ (2635)
42 work environment/ or environment/ or social environment/ (29305)
43 architecture/ (1273)
44 (environment$ adj3 (intervention$ or chang$ or improv$ or condition$ or safe or safer or safety or protect$)).ti,ab. (28846)
45 (environment$ adj3 (design$ or planning or build or built or structur$)).ti,ab. (3129)
46 (physical adj3 (environment$ or landscap$)).ti,ab. (2527)
47 (protectiv$ adj3 (structur$ or build$ or built or shelter$)).ti,ab. (214)
48 (architectur$ adj3 (chang$ or improv$ or safe or safer or safety or design$ or structur$ or construct$)).ti,ab. (2317)
49 (building$ adj3 (chang$ or improv$ or safe or safer or safety or design$ or structur$ or construct$)).ti,ab. (1521)
50 (shade or shaded or shady or shelter$).ti,ab. (3916)
51 (canopy or canopied or canopies or awning$).ti,ab. (1445)
52 (plant or plants or tree or trees or foliage or vegetation).ti,ab. (157823)
53 (lunch time or lunchtime or lunch break or midday or noon or (middle adj2 day) or (time adj2 day) or morning or afternoon).ti,ab. (31116)
54 or/30-53 (348698)
55 29 and 54 (11314)
56 human/ (6585403)

57 55 and 56 (6328)
58 (SunWise or SunSmart or Pool Cool or Kidskin).ti,ab. (42)
59 57 or 58 (6335)
60 limit 59 to yr="1990 -Current" (5799)

Enviroline
Searched via Dialog online
Searched date=9th September 2009
Record titles downloaded =1135
Full records retrieved=0

Strategy

Set	Items	Description
1	229	SKIN(3N)(CANCER? OR NEOPLAS? OR ONCOLOG? OR MALIGNAN? OR TUMOR? OR TUMOUR? OR CARCINOMA? OR ADENOCARCINOMA?)/TI,AB,DE
2	76	MELANOMA? OR NONMELANOMA?/TI,AB,DE
3	8	(BASAL(W)CELL)(2N)CARCINOMA?/TI,AB,DE
4	1	(BASAL(W)CELL)(2N)CANCER?/TI,AB,DE
5	0	(BASAL(W)CELL)(2N)EPITHEL?/TI,AB,DE
6	35	(SQUAMOUS(W)CELL)(2N)CARCINOMA?/TI,AB,DE
7	5	(SQUAMOUS(W)CELL)(2N)CANCER?/TI,AB,DE
8	0	(SQUAMOUS(W)CELL)(2N)EPITHEL?/TI,AB,DE
9	11	NMSC OR BCC OR SCC/TI,AB,DE
10	0	NEVUS OR NEVI OR NAEVI/TI,AB,DE
11	253	MOLE OR MOLES/TI,AB,DE
12	147	SUNBURN? OR SUN(W)BURN? OR TANNING OR SUN(W)TAN? OR SUNTAN?/TI,AB,DE
13	33	SUN(W)DAMAG? OR SUNDAMAG? OR SUN(2N)EXPOS?/TI,AB,DE
14	78	SOLAR(2N)DAMAG? OR SOLAR(2N)EXPOS?/TI,AB,DE

15	6	PHOTODAMAG? OR PHOTO(W)DAMAG?/TI,AB,DE
16	4879	ULTRAVIOLET(2N)RADIAT? OR (ULTRA(W)VIOLET)(2N)RADIAT? OR UV(2N)RADIAT? OR SOLAR(2N)RADIAT?/TI,AB,DE
17	559	ULTRAVIOLET(2N)IRRADIAT? OR (ULTRA(W)VIOLET)(2N)IRRADIAT? OR UV(2N)IRRADIAT? OR SOLAR(2N)IRRADIAT?/TI,AB,DE
18	27	ULTRAVIOLET(W)RAY? OR ULTRA(W)VIOLET(W)RAY? OR UV(W)RAY? OR SOLAR(W)RAY?/TI,AB,DE
19	324	ULTRAVIOLET(2N)EXPOS? OR ULTRA(W)VIOLET(2N)EXPOS? OR UV(2N)EXPOS?/TI,AB,DE
20	5721	S1:S19
21	384	PROTECT?(W)CLOTH?/TI,AB,DE
22	2253	RADIAT?(2N)PROTECT?/TI,AB,DE
23	7	IRRADIAT?(2N)PROTECT?/TI,AB,DE
24	23	SUN(2N)PROTECT? OR SOLAR(2N)PROTECT?/TI,AB,DE
25	0	SUNSAFE? OR SUN SAFE?/TI,AB,DE
26	12	PHOTOPROTECT? OR PHOTO(W)PROTECT?/TI,AB,DE
27	32	SUNSCREEN? OR SUN(W)SCREEN? OR SUNBLOCK? OR SUN(W)BLOCK? OR LIPBLOCK? OR LIP(W)BLOCK? OR LIPBALM? OR LIP(W)BALM?/TI,AB,DE
28	3085	CLOTHING OR CLOTHE? OR UNIFORM? OR HAT OR HATS OR PANTS OR SLEEVE? OR SUNGLASSES OR SUN(W)GLASSES/TI,AB,DE
29	443	PHYSICAL(3W)(ENVIRONMENT? OR LANDSCAP?)/TI,AB,DE
30	19	PROTECTIV?(3W)(STRUCTUR? OR BUILD? OR BUILT OR SHELTER?)/TI,AB,DE
31	143	ARCHITECTUR?(3N)(CHANG? OR IMPROV? OR SAFE OR SAFER OR SAFETY OR

		DESIGN? OR STRUCTUR? OR CONSTRUCT?)/TI,AB,DE
32	2561	BUILDING?(3N)(CHANG? OR IMPROV? OR SAFE OR SAFER OR SAFETY OR DESIGN? OR STRUCTUR? OR CONSTRUCT?)/TI,AB,DE
33	1466	SHADE OR SHADED OR SHADY OR SHELTER?/TI,AB,DE
34	2680	CANOPY OR CANOPIED OR CANOPIES OR AWNING?/TI,AB,DE
35	73993	PLANT OR PLANTS OR TREE OR TREES OR FOLIAGE OR VEGETATION/TI,AB,DE
36	1225	LUNCH(W)TIME OR LUNCHTIME OR LUNCH(W)BREAK OR MIDDAY OR NOON OR (MIDDLE(2W)DAY) OR (TIME(2W)DAY) OR MORNING OR AFTERNOON/TI,AB,DE
37	83364	S21:S36
38	1370	S20 AND S37
39	0	SUNWISE OR SUNSMART OR POOL COOL OR KIDSKIN/TI,AB,DE
40	1370	S38 OR S39
41	290553	PY=1990:2009
42	1135	S40 AND S41

ERIC
Searched via CSA Illumina
Search date=25th August 2009
Records retrieved=44records

Strategy
126
126
#15 ((((skin within3 cancer*) or (skin within 3 neoplasm*) or (skin within 3 oncolog*)) or ((skin within 3 malignan*) or (skin within 3 tumor*) or (skin within 3 tumour*)) or ((skin within 3 carcinoma*) or (skin within 3 adenocarcinoma*))) or((melanoma or nonmelanoma or nevus) or (nevi or naevi or mole) or moles) or((sunburn* or (sun burn*) or tanning) or ((sun tan*) or suntan* or (sun

damag*)) or (sundamag* or (sun within 3 expos*) or (solar within 3 damag*)) or ((solar within 3 expos*) or photodamag* or (photo damag*)) or ((ultraviolet within 2 radiat*) or (uv within 2 radiat*) or (solar within 2 radiat*)) or ((ultraviolet within 2 irradiat*) or (uv within 2 irradiat*) or (solar within 2 irradiat*)) or ((ultraviolet ray*) or (ultra violet ray*) or (uv ray*)) or ((solar ray*) or (ultraviolet within 2 expos*) or (uv within 2 expos*))) or(((ultra violet within 2 radiat*) or (ultra violet within 2 irradiat*) or (ultra violet within 2 expos*)) or (ultra violet within 2 ray*))) and((((radiat* within 2 protect*) or (irradiat* within 2 protect*) or (sun within 2 protect*)) or ((solar within 2 protect*) or sunsafe* or (sun safe*)) or (photoprotect* or (photo protect*) or sunscreen*) or ((sun screen*) or sunblock* or (sun block*)) or (lipblock* or (lip block*) or lipbalm*) or (lip balm*)) or((clothing or clothe* or uniform*) or (hat or hats or pants) or (sleeve* or sunglasses or (sun glasses))) or(((environment* within 3 intervention*) or (environment* within 3 chang*) or (environment* within 3 improv*)) or ((environment* within 3 condition*) or (environment* within 3 safe*) or (environment* within 3 protect*)) or ((environment* within 3 design*) or (environment* within 3 planning) or (environment* within 3 build*)) or ((environment* within 3 built) or (environment within 3 structur*) or (physical within 3 environment*)) or ((physical within 3 landscape*) or (protective within 3 structur*) or (protective within 3 build*)) or ((protective within 3 built) or (protective within 3 shelter*) or (architectur* within 3 chang*)) or ((architectur* within 3 improv*) or (architectur* within 3 safe*) or (architectur* within 3 design*)) or ((architectur* within 3 structur*) or (architectur* within 3 construct*) or (building* within 3 chang*)) or ((building* within 3 improv*) or (building* within 3 safe*) or (building* within 3 design*)) or ((building* within 3 structur*) or (building*within 3 construct*))) or((shade or shaded or shady) or (shelter* or canopy or canopies) or (canopied or awning* or plant) or (plants or tree or trees) or (foliage or vegetation)) or(((lunch time*) or lunchtime* or (lunch break*)) or (midday or noon or (middle within 3 day)) or ((time within 3 day) or morning* or afternoon*)))

HMIC Health Management Information Consortium

< July 2009 >

Searched via OvidSP

Search date=27th August 2009

Records retrieved=182 records

Search Strategy:

1 neoplasms/ (325)

2 (skin adj3 (cancer$ or neoplas$ or oncolog$ or malignan$ or tumo?r$ or carcinoma$ or adenocarcinoma$)).ti,ab. (342)

3 (melanoma$ or nonmelanoma$).ti,ab. (210)

4 (basal cell adj2 (carcinoma$ or cancer$)).ti,ab. (18)

5 (basal cell adj2 epithel$).ti,ab. (1)

6 (squamous cell adj2 (carcinoma$ or cancer$)).ti,ab. (108)

7 (squamous cell adj2 epithel$).ti,ab. (0)

8 (NMSC or BCC or SCC).ti,ab. (11)

9 (nevus or nevi or naevi).ti,ab. (8)

10 (mole or moles).ti,ab. (17)

11 exp Radiation/ (1504)

12 (sunburn$ or sun burn$ or tanning or sun tan$ or suntan$).ti,ab. (61)

13 (sun damag$ or sundamag$ or (sun adj2 expos$)).ti,ab. (84)

14 ((solar adj2 damag$) or (solar adj2 expos$)).ti,ab. (4)

15 (photodamag$ or photo damag$).ti,ab. (0)

16 ((ultraviolet adj2 radiat$) or (ultra violet adj2 radiat$) or (uv adj2 radiat$) or (solar adj2 radiat$)).ti,ab. (106)

17 ((ultraviolet adj2 irradiat$) or (ultra violet adj2 irradiat$) or (uv adj2 irradiat$) or (solar adj2 irradiat$)).ti,ab. (4)

18 (ultraviolet ray$ or ultra violet ray$ or uv ray$ or solar ray$).ti,ab. (2)

19 ((ultraviolet adj2 expos$) or (ultra violet adj2 expos$) or (uv adj2 expos$)).ti,ab. (36)

20 or/1-19 (2391)

21 (radiat$ adj2 protect$).ti,ab. (214)

22 (irradiat$ adj2 protect$).ti,ab. (0)

23 ((sun adj2 protect$) or (solar adj2 protect$)).ti,ab. (54)

24 (sunsafe$ or sun safe$).ti,ab. (22)

25 (photoprotect$ or photo protect$).ti,ab. (0)

26 (sunscreen$ or sun screen$ or sunblock$ or sun block$ or lipblock$ or lip block$ or lipbalm$ or lip balm$).ti,ab. (30)

27 (clothing or clothe$ or uniform$ or hat or hats or pants or sleeve$ or sunglasses or sun glasses).ti,ab. (1365)

28 environment/ (766)

29 built environment/ (59)

30 architecture/ (92)

31 (environment$ adj3 (intervention$ or chang$ or improv$ or condition$ or safe or safer or safety or protect$)).ti,ab. (2050)

32 (environment$ adj3 (design$ or planning or build or built or structur$)).ti,ab. (666)

33 (physical adj3 (environment$ or landscap$)).ti,ab. (476)

34 (protectiv$ adj3 (structur$ or build$ or built or shelter$)).ti,ab. (6)

35 (architectur$ adj3 (chang$ or improv$ or safe or safer or safety or design$ or structur$ or construct$)).ti,ab. (180)

36 (building$ adj3 (chang$ or improv$ or safe or safer or safety or design$ or structur$ or construct$)).ti,ab. (1593)

37 (shade or shaded or shady).ti,ab. (38)

38 (canopy or canopied or canopies or awning$).ti,ab. (12)

39 (plant or plants or tree or trees or foliage or vegetation).ti,ab. (1669)

40 (lunch time or lunchtime or lunch break or midday or noon or (middle adj2 day) or (time adj2 day) or morning or afternoon).ti,ab. (578)

41 or/21-40 (9124)

42 41 and 20 (288)

43 limit 42 to yr="1990 -Current" (182)

Health Technology Assessment database

Searched via Cochrane Library 2009 issue 3

Search date=24th August 2009

Records retrieved= 1

ID	Search
#1	MeSH descriptor **Skin Neoplasms** explode all trees
#2	MeSH descriptor **Melanoma** explode all trees
#3	MeSH descriptor **Carcinoma, Basal Cell** explode all trees
#4	MeSH descriptor **Carcinoma, Squamous Cell** explode all trees
#5	MeSH descriptor **Nevus** explode all trees
#6	(skin NEAR/3 (cancer* or neoplas* or oncolog* or malignan* or tumor* or tumour* or carcinoma* or adenocarcinoma*)):ti or (skin NEAR/3 (cancer* or neoplas* or oncolog* or malignan* or tumor* or tumour* or carcinoma* or adenocarcinoma*)):ab
#7	(melanoma* or nonmelanoma*):ti or (melanoma* or nonmelanoma*):ab or "basal cell" NEAR/2 (carcinoma* or cancer*):ti or "basal cell" NEAR/2 (carcinoma* or cancer*):ab

#8	"basal cell" NEAR/2 epithel*:ti or "basal cell" NEAR/2 epithel*:ab or "squamous cell" NEAR/2 (carcinoma* or cancer*):ti or "squamous cell" NEAR/2 (carcinoma* or cancer*):ab
#9	"squamous cell" NEAR/2 epithel*:ti or "squamous cell" NEAR/2 epithel*:ab or (NMSC or BCC or SCC):ti or (NMSC or BCC or SCC):ab
#10	(nevus or nevi or naevi):ti or (nevus or nevi or naevi):ab or (mole or moles):ti or (mole or moles):ab
#11	MeSH descriptor **Sunburn**, this term only
#12	MeSH descriptor **Ultraviolet Rays**, this term only
#13	(sunburn* or "sun burn*" or tanning or "sun tan*" or suntan"):ti or (sunburn* or "sun burn*" or tanning or "sun tan*" or suntan"):ab or "sun damag*" or sundamag* or (sun NEAR/2 expos*):ti or "sun damag*" or sundamag* or (sun NEAR/2 expos*):ab
#14	(solar NEAR/2 damag*) or (solar NEAR/2 expos*):ti or (solar NEAR/2 damag*) or (solar NEAR/2 expos*):ab or (photodamag* or "photo damag*"):ti or (photodamag* or "photo damag*"):ab
#15	(ultraviolet NEAR/2 radiat*) or ("ultra violet" NEAR/2 radiat*) or (uv NEAR/2 radiat*) or (solar NEAR/2 radiat*):ti or (ultraviolet NEAR/2 radiat*) or ("ultra violet" NEAR/2 radiat*) or (uv NEAR/2 radiat*) or (solar NEAR/2 radiat*):ab or (ultraviolet NEAR/2 irradiat*) or ("ultra violet" NEAR/2 irradiat*) or (uv NEAR/2 irradiat*) or (solar NEAR/2 irradiat*):ti or (ultraviolet NEAR/2 irradiat*) or ("ultra violet" NEAR/2 irradiat*) or (uv NEAR/2 irradiat*) or (solar NEAR/2 irradiat*):ab
#16	"ultraviolet ray*" or "ultra violet ray*" or "uv ray*" or "solar ray*":ti or "ultraviolet ray*" or "ultra violet ray*" or "uv ray*" or "solar ray*":ab or (ultraviolet NEAR/2 expos*) or (ultra violet NEAR/2 expos*) or (uv NEAR/2 expos*):ti or (ultraviolet NEAR/2 expos*) or (ultra violet NEAR/2 expos*) or (uv NEAR/2 expos*):ab
#17	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16)
#18	MeSH descriptor **Radiation Protection**, this term only

#19	MeSH descriptor **Sunscreening Agents**, this term only
#20	MeSH descriptor **Protective Clothing**, this term only
#21	MeSH descriptor **Eye Protective Devices**, this term only
#22	(radiat* NEAR/2 protect*) OR (irradiat* NEAR/2 protect*):ti or (radiat* NEAR/2 protect*) OR (irradiat* NEAR/2 protect*):ab or (sun NEAR/2 protect*) or (solar NEAR/2 protect*):ti or (sun NEAR/2 protect*) or (solar NEAR/2 protect*):ab
#23	(sunsafe* or "sun safe*" OR photoprotect* or "photo protect*"):ti or (sunsafe* or "sun safe*" OR photoprotect* or "photo protect*"):ab or (sunscreen* or "sun screen*" or sunblock* or "sun block*" or lipblock* or "lip block*" or lipbalm* or "lip balm*"):ti or (sunscreen* or "sun screen*" or sunblock* or "sun block*" or lipblock* or "lip block*" or lipbalm* or "lip balm*"):ab
#24	(clothing or clothe* or uniform* or hat or hats or pants or sleeve* or sunglasses or "sun glasses"):ti or (clothing or clothe* or uniform* or hat or hats or pants or sleeve* or sunglasses or "sun glasses"):ab
#25	MeSH descriptor **Environment Design** explode all trees
#26	MeSH descriptor **Environment**, this term only
#27	MeSH descriptor **Architecture as Topic** explode all trees
#28	(environment* NEAR/3 (intervention* or chang* or improv* or condition* or safe or safer or safety or protect*)):ti or (environment* NEAR/3 (intervention* or chang* or improv* or condition* or safe or safer or safety or protect*)):ab or (environment* NEAR/3 (design* or planning or build or built or structur*)):ti or (environment* NEAR/3 (design* or planning or build or built or structur*)):ab
#29	(physical NEAR/3 (environment* or landscap*)):ti or (physical NEAR/3 (environment* or landscap*)):ab or (protectiv* NEAR/3 (structur* or build* or built or shelter*)):ti or (protectiv* NEAR/3 (structur* or build* or built or shelter*)):ab
#30	(architectur* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ti or (architectur* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ab or (building*

	NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ti or (building* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ab
#31	(shade or shaded or shady or shelter* or canopy or canopied or canopies or awning*):ti or (shade or shaded or shady or shelter* or canopy or canopied or canopies or awning*):ab or (plant or plants or tree or trees or foliage or vegetation):ti or (plant or plants or tree or trees or foliage or vegetation):ab
#32	"lunch time" or lunchtime or "lunch break" or midday or noon or (middle NEAR/2 day) or (time NEAR/2 day) or morning or afternoon:ti or "lunch time" or lunchtime or "lunch break" or midday or noon or (middle NEAR/2 day) or (time NEAR/2 day) or morning or afternoon:ab
#33	(#18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32)
#34	#17 AND #33
#35	(#17 AND #33)
#36	(SunWise or SunSmart or "Pool Cool" or Kidskin):ti or (SunWise or SunSmart or "Pool Cool" or Kidskin):ab
#37	(#35 OR #36)
#38	(#37), from 1990 to 2009

Inside Conferences

Searched via Dialog Online

Search date=7th September 2009

Record titles downloaded=639

Full records downloaded=54

Search strategy

s skin(3n)(cancer? or neoplas? or oncolog? or malignan? or tumor? or tumour? or carcinoma? or adenocarcinoma?)/ti,ab,de

s melanoma? or nonmelanoma?/ti,ab,de
s (basal(w)cell)(2n)carcinoma?/ti,ab,de
s (basal(w)cell)(2n)cancer?/ti,ab,de
s (basal(w)cell)(2n)epithel?/ti,ab,de
s (squamous(w)cell)(2n)carcinoma?/ti,ab,de
s (squamous(w)cell)(2n)cancer?/ti,ab,de
s (squamous(w)cell)(2n)epithel?/ti,ab,de
s NMSC or BCC or SCC/ti,ab,de
s nevus or nevi or naevi/ti,ab,de
s mole or moles/ti,ab,de
s sunburn? or sun(w)burn? or tanning or sun(w)tan? or suntan?/ti,ab,de
s sun(w)damag? or sundamag? or sun(2n)expos?/ti,ab,de
s solar(2n)damag? or solar(2n)expos?/ti,ab,de
s photodamag? or photo(w)damag?/ti,ab,de
s ultraviolet(2n)radiat? or (ultra(w)violet)(2n)radiat? or uv(2n)radiat? or solar(2n)radiat?/ti,ab,de
s ultraviolet(2n)irradiat? or (ultra(w)violet)(2n)irradiat? or uv(2n)irradiat? or solar(2n)irradiat?/ti,ab,de
s ultraviolet(w)ray? or ultra(w)violet(w)ray? or uv(w)ray? or solar(w)ray?/ti,ab,de
s ultraviolet(2n)expos? or ultra(w)violet(2n)expos? or uv(2n)expos?/ti,ab,de
s s1:s19
s protect?(w)cloth?/ti,ab,de
s radiat?(2n)protect?/ti,ab,de
s irradiat?(2n)protect?/ti,ab,de
s sun(2n)protect? or solar(2n)protect?/ti,ab,de
s sunsafe? or sun safe?/ti,ab,de
s photoprotect? or photo(w)protect?/ti,ab,de
s sunscreen? or sun(w)screen? or sunblock? or sun(w)block? or lipblock? or lip(w)block? or lipbalm? or lip(w)balm?/ti,ab,de
s clothing or clothe? or uniform? or hat or hats or pants or sleeve? or sunglasses or sun(w)glasses/ti,ab,de
s environment?(3n)(intervention? or chang? or improv? or condition? or safe or safer or safety or protect?)/ti,ab,de
s environment?(3n)(design? or planning or build or built or structur?)/ti,ab,de
s physical(3n)(environment? or landscap?)/ti,ab,de
s protectiv?(3n)(structur? or build? or built or shelter?)/ti,ab,de
s architectur?(3n)(chang? or improv? or safe or safer or safety or design? or structur? or construct?)/ti,ab,de
s building?(3n)(chang? or improv? or safe or safer or safety or design? or structur? or construct?)/ti,ab,de
s shade or shaded or shady or shelter?/ti,ab,de
s canopy or canopied or canopies or awning?/ti,ab,de
s plant or plants or tree or trees or foliage or vegetation/ti,ab,de
s lunch(w)time or lunchtime or lunch(w)break or midday or noon or (middle(2w)day) or (time(2w)day) or morning or afternoon/ti,ab,de
s s21:s38
s s20 and s39
s SunWise or SunSmart or Pool Cool or Kidskin/ti,ab,de
s s40 or s41
s py=1990:2009
s s42 and s43

MEDLINE(R) <1950 to August Week 1 2009>

Searched via Ovid SP

Search date=19th August 2009

Records retrieved=5590

Search Strategy:

1 exp skin neoplasms/ (78386)

2 exp melanoma/ (59391)

3 exp carcinoma basal cell/ (11885)

4 exp carcinoma squamous cell/ (83592)

5 Nevus/ (4091)

6 (skin adj3 (cancer$ or neoplas$ or oncolog$ or malignan$ or tumo?r$ or carcinoma$ or adenocarcinoma$)).ti,ab. (20315)

7 (melanoma$ or nonmelanoma$).ti,ab. (60855)

8 (basal cell adj2 (carcinoma$ or cancer$)).ti,ab. (7166)

9 (basal cell adj2 epithel$).ti,ab. (632)

10 (squamous cell adj2 (carcinoma$ or cancer$)).ti,ab. (45031)

11 (squamous cell adj2 epithel$).ti,ab. (315)

12 (NMSC or BCC or SCC).ti,ab. (10403)

13 (nevus or nevi or naevi).ti,ab. (10022)

14 (mole or moles).ti,ab. (12856)

15 sunburn/ (1867)

16 ultraviolet rays/ (54265)

17 (sunburn$ or sun burn$ or tanning or sun tan$ or suntan$).ti,ab. (2835)

18 (sun damag$ or sundamag$ or (sun adj2 expos$)).ti,ab. (3810)

19 ((solar adj2 damag$) or (solar adj2 expos$)).ti,ab. (796)

20 (photodamag$ or photo damag$).ti,ab. (1605)

21 ((ultraviolet adj2 radiat$) or (ultra violet adj2 radiat$) or (uv adj2 radiat$) or (solar adj2 radiat$)).ti,ab. (11727)

22 ((ultraviolet adj2 irradiat$) or (ultra violet adj2 irradiat$) or (uv adj2 irradiat$) or (solar adj2 irradiat$)).ti,ab. (15914)

23 (ultraviolet ray$ or ultra violet ray$ or uv ray$ or solar ray$).ti,ab. (1100)

24 ((ultraviolet adj2 expos$) or (ultra violet adj2 expos$) or (uv adj2 expos$)).ti,ab. (5706)

25 or/1-24 (297741)

26 Radiation Protection/ (14281)

27 Sunscreening Agents/ (2904)

28 Protective Clothing/ (3981)

29 Eye Protective Devices/ (1291)

30 (radiat$ adj2 protect$).ti,ab. (4385)

31 (irradiat$ adj2 protect$).ti,ab. (443)

32 ((sun adj2 protect$) or (solar adj2 protect$)).ti,ab. (1462)

33 (sunsafe$ or sun safe$).ti,ab. (112)

34 (photoprotect$ or photo protect$).ti,ab. (1607)

35 (sunscreen$ or sun screen$ or sunblock$ or sun block$ or lipblock$ or lip block$ or lipbalm$ or lip balm$).ti,ab. (2429)

36 (clothing or clothe$ or uniform$ or hat or hats or pants or sleeve$ or sunglasses or sun glasses).ti,ab. (83483)

37 exp Environment Design/ (2098)

38 Environment/ (34834)

39 exp Architecture as Topic/ (19223)

40 (environment$ adj3 (intervention$ or chang$ or improv$ or condition$ or safe or safer or safety or protect$)).ti,ab. (35489)

41 (environment$ adj3 (design$ or planning or build or built or structur$)).ti,ab. (3842)

42 (physical adj3 (environment$ or landscap$)).ti,ab. (3255)

43 (protectiv$ adj3 (structur$ or build$ or built or shelter$)).ti,ab. (315)

44 (architectur$ adj3 (chang$ or improv$ or safe or safer or safety or design$ or structur$ or construct$)).ti,ab. (2839)

45 (building$ adj3 (chang$ or improv$ or safe or safer or safety or design$ or structur$ or construct$)).ti,ab. (1789)

46 (shade or shaded or shady or shelter$).ti,ab. (7145)

47 (canopy or canopied or canopies or awning$).ti,ab. (2134)

48 (plant or plants or tree or trees or foliage or vegetation).ti,ab. (214065)

49 (lunch time or lunchtime or lunch break or midday or noon or (middle adj2 day) or (time adj2 day) or morning or afternoon).ti,ab. (35488)

50 or/26-49 (450451)

51 25 and 50 (10502)

52 Humans/ (10934611)

53 51 and 52 (6866)

54 (SunWise or SunSmart or Pool Cool or Kidskin).ti,ab. (45)

55 53 or 54 (6868)

56 limit 55 to yr="1990 -Current" (5590)

NHS EED database

Searched via Cochrane Library 2009 issue 3

Search date=24th August 2009

Records retrieved=2

ID	Search
#1	MeSH descriptor **Skin Neoplasms** explode all trees
#2	MeSH descriptor **Melanoma** explode all trees
#3	MeSH descriptor **Carcinoma, Basal Cell** explode all trees
#4	MeSH descriptor **Carcinoma, Squamous Cell** explode all trees
#5	MeSH descriptor **Nevus** explode all trees
#6	(skin NEAR/3 (cancer* or neoplas* or oncolog* or malignan* or tumor* or tumour* or carcinoma* or adenocarcinoma*)):ti or (skin NEAR/3 (cancer* or neoplas* or oncolog* or malignan* or tumor* or tumour* or carcinoma* or adenocarcinoma*)):ab
#7	(melanoma* or nonmelanoma*):ti or (melanoma* or nonmelanoma*):ab or "basal cell" NEAR/2 (carcinoma* or cancer*):ti or "basal cell" NEAR/2 (carcinoma* or cancer*):ab
#8	"basal cell" NEAR/2 epithel*:ti or "basal cell" NEAR/2 epithel*:ab or "squamous cell" NEAR/2 (carcinoma* or

	cancer*):ti or "squamous cell" NEAR/2 (carcinoma* or cancer*):ab
#9	"squamous cell" NEAR/2 epithel*:ti or "squamous cell" NEAR/2 epithel*:ab or (NMSC or BCC or SCC):ti or (NMSC or BCC or SCC):ab
#10	(nevus or nevi or naevi):ti or (nevus or nevi or naevi):ab or (mole or moles):ti or (mole or moles):ab
#11	MeSH descriptor **Sunburn**, this term only
#12	MeSH descriptor **Ultraviolet Rays**, this term only
#13	(sunburn* or "sun burn*" or tanning or "sun tan*" or suntan"):ti or (sunburn* or "sun burn*" or tanning or "sun tan*" or suntan"):ab or "sun damag*" or sundamag* or (sun NEAR/2 expos*):ti or "sun damag*" or sundamag* or (sun NEAR/2 expos*):ab
#14	(solar NEAR/2 damag*) or (solar NEAR/2 expos*):ti or (solar NEAR/2 damag*) or (solar NEAR/2 expos*):ab or (photodamag* or "photo damag*"):ti or (photodamag* or "photo damag*"):ab
#15	(ultraviolet NEAR/2 radiat*) or ("ultra violet" NEAR/2 radiat*) or (uv NEAR/2 radiat*) or (solar NEAR/2 radiat*):ti or (ultraviolet NEAR/2 radiat*) or ("ultra violet" NEAR/2 radiat*) or (uv NEAR/2 radiat*) or (solar NEAR/2 radiat*):ab or (ultraviolet NEAR/2 irradiat*) or ("ultra violet" NEAR/2 irradiat*) or (uv NEAR/2 irradiat*) or (solar NEAR/2 irradiat*):ti or (ultraviolet NEAR/2 irradiat*) or ("ultra violet" NEAR/2 irradiat*) or (uv NEAR/2 irradiat*) or (solar NEAR/2 irradiat*):ab
#16	"ultraviolet ray*" or "ultra violet ray*" or "uv ray*" or "solar ray*":ti or "ultraviolet ray*" or "ultra violet ray*" or "uv ray*" or "solar ray*":ab or (ultraviolet NEAR/2 expos*) or (ultra violet NEAR/2 expos*) or (uv NEAR/2 expos*):ti or (ultraviolet NEAR/2 expos*) or (ultra violet NEAR/2 expos*) or (uv NEAR/2 expos*):ab
#17	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16)
#18	MeSH descriptor **Radiation Protection**, this term only
#19	MeSH descriptor **Sunscreening Agents**, this term only

#20 MeSH descriptor **Protective Clothing**, this term only

#21 MeSH descriptor **Eye Protective Devices**, this term only

#22 (radiat* NEAR/2 protect*) OR (irradiat* NEAR/2 protect*):ti or (radiat* NEAR/2 protect*) OR (irradiat* NEAR/2 protect*):ab or (sun NEAR/2 protect*) or (solar NEAR/2 protect*):ti or (sun NEAR/2 protect*) or (solar NEAR/2 protect*):ab

#23 (sunsafe* or "sun safe*" OR photoprotect* or "photo protect*"):ti or (sunsafe* or "sun safe*" OR photoprotect* or "photo protect*"):ab or (sunscreen* or "sun screen*" or sunblock* or "sun block*" or lipblock* or "lip block*" or lipbalm* or "lip balm*"):ti or (sunscreen* or "sun screen*" or sunblock* or "sun block*" or lipblock* or "lip block*" or lipbalm* or "lip balm*"):ab

#24 (clothing or clothe* or uniform* or hat or hats or pants or sleeve* or sunglasses or "sun glasses"):ti or (clothing or clothe* or uniform* or hat or hats or pants or sleeve* or sunglasses or "sun glasses"):ab

#25 MeSH descriptor **Environment Design** explode all trees

#26 MeSH descriptor **Environment**, this term only

#27 MeSH descriptor **Architecture as Topic** explode all trees

#28 (environment* NEAR/3 (intervention* or chang* or improv* or condition* or safe or safer or safety or protect*)):ti or (environment* NEAR/3 (intervention* or chang* or improv* or condition* or safe or safer or safety or protect*)):ab or (environment* NEAR/3 (design* or planning or build or built or structur*)):ti or (environment* NEAR/3 (design* or planning or build or built or structur*)):ab

#29 (physical NEAR/3 (environment* or landscap*)):ti or (physical NEAR/3 (environment* or landscap*)):ab or (protectiv* NEAR/3 (structur* or build* or built or shelter*)):ti or (protectiv* NEAR/3 (structur* or build* or built or shelter*)):ab

#30 (architectur* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ti or (architectur* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ab or (building* NEAR/3 (chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ti or (building* NEAR/3

	(chang* or improv* or safe or safer or safety or design* or structur* or construct*)):ab
#31	(shade or shaded or shady or shelter* or canopy or canopied or canopies or awning*):ti or (shade or shaded or shady or shelter* or canopy or canopied or canopies or awning*):ab or (plant or plants or tree or trees or foliage or vegetation):ti or (plant or plants or tree or trees or foliage or vegetation):ab
#32	"lunch time" or lunchtime or "lunch break" or midday or noon or (middle NEAR/2 day) or (time NEAR/2 day) or morning or afternoon:ti or "lunch time" or lunchtime or "lunch break" or midday or noon or (middle NEAR/2 day) or (time NEAR/2 day) or morning or afternoon:ab
#33	(#18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32)
#34	#17 AND #33
#35	(#17 AND #33)
#36	(SunWise or SunSmart or "Pool Cool" or Kidskin):ti or (SunWise or SunSmart or "Pool Cool" or Kidskin):ab
#37	(#35 OR #36)
#38	(#37), from 1990 to 2009

NTIS
Searched via Dialog
Search date=7th September 2009
Full records retrieved=1083
Full records retrieved=3

Strategy

? s skin(3n)(cancer? or neoplas? or oncolog? or malignan? or tumor? or tumour? or carcinoma? or adenocarcinoma?)/ti,ab,de

13277 SKIN/TI,AB,DE
20960 CANCER?/TI,AB,DE
12431 NEOPLAS?/TI,AB,DE
762 ONCOLOG?/TI,AB,DE
5165 MALIGNAN?/TI,AB,DE

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      10636  TUMOR?/TI,AB,DE
        377  TUMOUR?/TI,AB,DE
       2700  CARCINOMA?/TI,AB,DE
        385  ADENOCARCINOMA?/TI,AB,DE
S1     546  SKIN(3N)(CANCER? OR NEOPLAS? OR ONCOLOG? OR MALIGNAN? OR
            TUMOR? OR TUMOUR? OR CARCINOMA? OR
            ADENOCARCINOMA?)/TI,AB,DE

? s melanoma? or nonmelanoma?/ti,ab,de

        444  MELANOMA?
          4  NONMELANOMA?/TI,AB,DE
S2      445  MELANOMA? OR NONMELANOMA?/TI,AB,DE

? s (basal(w)cell)(2n)carcinoma?/ti,ab,de

       2091  BASAL/TI,AB,DE
      54039  CELL/TI,AB,DE
       2700  CARCINOMA?/TI,AB,DE
S3       38  (BASAL(W)CELL)(2N)CARCINOMA?/TI,AB,DE

? s (basal(w)cell)(2n)cancer?/ti,ab,de

       2091  BASAL/TI,AB,DE
      54039  CELL/TI,AB,DE
      20960  CANCER?/TI,AB,DE
S4        9  (BASAL(W)CELL)(2N)CANCER?/TI,AB,DE

? s (basal(w)cell)(2n)epithel?/ti,ab,de

       2091  BASAL/TI,AB,DE
      54039  CELL/TI,AB,DE
       3446  EPITHEL?/TI,AB,DE
S5        5  (BASAL(W)CELL)(2N)EPITHEL?/TI,AB,DE

? s (squamous(w)cell)(2n)carcinoma?/ti,ab,de

        252  SQUAMOUS/TI,AB,DE
      54039  CELL/TI,AB,DE
       2700  CARCINOMA?/TI,AB,DE
S6      134  (SQUAMOUS(W)CELL)(2N)CARCINOMA?/TI,AB,DE

? s (squamous(w)cell)(2n)cancer?/ti,ab,de

        252  SQUAMOUS/TI,AB,DE
      54039  CELL/TI,AB,DE
      20960  CANCER?/TI,AB,DE
S7        6  (SQUAMOUS(W)CELL)(2N)CANCER?/TI,AB,DE

? s (squamous(w)cell)(2n)epithel?/ti,ab,de

        252  SQUAMOUS/TI,AB,DE
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        54039  CELL/TI,AB,DE
         3446  EPITHEL?/TI,AB,DE
   S8       4  (SQUAMOUS(W)CELL)(2N)EPITHEL?/TI,AB,DE

? s NMSC or BCC or SCC/ti,ab,de

            3  NMSC
          924  BCC
          803  SCC/TI,AB,DE
   S9    1729  NMSC OR BCC OR SCC/TI,AB,DE

? s nevus or nevi or naevi/ti,ab,de

           27  NEVUS
           20  NEVI
            1  NAEVI/TI,AB,DE
  S10      35  NEVUS OR NEVI OR NAEVI/TI,AB,DE

? s mole or moles/ti,ab,de

         3438  MOLE
          486  MOLES/TI,AB,DE
  S11    3759  MOLE OR MOLES/TI,AB,DE

? s sunburn? or sun(w)burn? or tanning or sun(w)tan? or suntan?/ti,ab,de

           35  SUNBURN?
         9039  SUN
        29967  BURN?
            2  SUN(W)BURN?
          310  TANNING
         9039  SUN
        47277  TAN?
            3  SUN(W)TAN?
            7  SUNTAN?/TI,AB,DE
  S12     349  SUNBURN? OR SUN(W)BURN? OR TANNING OR SUN(W)TAN? OR
               SUNTAN?/TI,AB,DE

? s sun(w)damag? or sundamag? or sun(2n)expos?/ti,ab,de

         9039  SUN
        52019  DAMAG?
            0  SUN(W)DAMAG?
            0  SUNDAMAG?
         8880  SUN/TI,AB,DE
        81973  EXPOS?/TI,AB,DE
           68  SUN/TI,AB,DE(2N)EXPOS?/TI,AB,DE
  S13      68  SUN(W)DAMAG? OR SUNDAMAG? OR SUN(2N)EXPOS?/TI,AB,DE

? s solar(2n)damag? or solar(2n)expos?/ti,ab,de

        60684  SOLAR
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        52019  DAMAG?
          304  SOLAR(2N)DAMAG?
        57705  SOLAR/TI,AB,DE
        81973  EXPOS?/TI,AB,DE
          304  SOLAR/TI,AB,DE(2N)EXPOS?/TI,AB,DE
   S14    589  SOLAR(2N)DAMAG? OR SOLAR(2N)EXPOS?/TI,AB,DE

? s photodamag? or photo(w)damag?/ti,ab,de

           14  PHOTODAMAG?
         4469  PHOTO/TI,AB,DE
        51636  DAMAG?/TI,AB,DE
            2  PHOTO/TI,AB,DE(W)DAMAG?/TI,AB,DE
   S15     16  PHOTODAMAG? OR PHOTO(W)DAMAG?/TI,AB,DE

? s ultraviolet(2n)radiat? or (ultra(w)violet)(2n)radiat? or uv(2n)radiat? or solar(2n)radiat?/ti,ab,de

        22693  ULTRAVIOLET
       221465  RADIAT?
         8552  ULTRAVIOLET(2N)RADIAT?
         7580  ULTRA
          855  VIOLET
       221465  RADIAT?
           67  ULTRA(W)VIOLET(2N)RADIAT?
         7142  UV
       221465  RADIAT?
          899  UV(2N)RADIAT?
        57705  SOLAR/TI,AB,DE
       171284  RADIAT?/TI,AB,DE
         9576  SOLAR/TI,AB,DE(2N)RADIAT?/TI,AB,DE
   S16   17469  ULTRAVIOLET(2N)RADIAT? OR (ULTRA(W)VIOLET)(2N)RADIAT? OR
              UV(2N)RADIAT? OR SOLAR(2N)RADIAT?/TI,AB,DE

? s ultraviolet(2n)irradiat? or (ultra(w)violet)(2n)irradiat? or uv(2n)irradiat? or
solar(2n)irradiat?/ti,ab,de

        22693  ULTRAVIOLET
        34986  IRRADIAT?
          542  ULTRAVIOLET(2N)IRRADIAT?
         7580  ULTRA
          855  VIOLET
        34986  IRRADIAT?
           20  ULTRA(W)VIOLET(2N)IRRADIAT?
         7142  UV
        34986  IRRADIAT?
          440  UV(2N)IRRADIAT?
        57705  SOLAR/TI,AB,DE
        34737  IRRADIAT?/TI,AB,DE
          299  SOLAR/TI,AB,DE(2N)IRRADIAT?/TI,AB,DE
   S17    1192  ULTRAVIOLET(2N)IRRADIAT? OR (ULTRA(W)VIOLET)(2N)IRRADIAT?
              OR UV(2N)IRRADIAT? OR SOLAR(2N)IRRADIAT?/TI,AB,DE
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? s ultraviolet(w)ray? or ultra(w)violet(w)ray? or uv(w)ray? or solar(w)ray?/ti,ab,de

        22693  ULTRAVIOLET
        74646  RAY?
           81  ULTRAVIOLET(W)RAY?
         7580  ULTRA
          855  VIOLET
        74646  RAY?
            6  ULTRA(W)VIOLET(W)RAY?
         7142  UV
        74646  RAY?
           19  UV(W)RAY?
        57705  SOLAR/TI,AB,DE
        73597  RAY?/TI,AB,DE
           23  SOLAR/TI,AB,DE(W)RAY?/TI,AB,DE
   S18    123  ULTRAVIOLET(W)RAY? OR ULTRA(W)VIOLET(W)RAY? OR UV(W)RAY?
             OR SOLAR(W)RAY?/TI,AB,DE

? s ultraviolet(2n)expos? or ultra(w)violet(2n)expos? or uv(2n)expos?/ti,ab,de

        22693  ULTRAVIOLET
        82624  EXPOS?
          350  ULTRAVIOLET(2N)EXPOS?
         7580  ULTRA
          855  VIOLET
        82624  EXPOS?
            8  ULTRA(W)VIOLET(2N)EXPOS?
         7115  UV/TI,AB,DE
        81973  EXPOS?/TI,AB,DE
          253  UV/TI,AB,DE(2N)EXPOS?/TI,AB,DE
   S19    558  ULTRAVIOLET(2N)EXPOS? OR ULTRA(W)VIOLET(2N)EXPOS? OR
             UV(2N)EXPOS?/TI,AB,DE

? s s1:s19

   S20   25055  S1:S19

? s protect?(w)cloth?/ti,ab,de

       104246  PROTECT?/TI,AB,DE
         7887  CLOTH?/TI,AB,DE
   S21   3278  PROTECT?(W)CLOTH?/TI,AB,DE
? s radiat?(2n)protect?/ti,ab,de

       171284  RADIAT?/TI,AB,DE
       104246  PROTECT?/TI,AB,DE
   S22   10570  RADIAT?(2N)PROTECT?/TI,AB,DE

? s irradiat?(2n)protect?/ti,ab,de

        34737  IRRADIAT?/TI,AB,DE
       104246  PROTECT?/TI,AB,DE
```

S23 218 IRRADIAT?(2N)PROTECT?/TI,AB,DE

? s sun(2n)protect? or solar(2n)protect?/ti,ab,de

9039 SUN
128547 PROTECT?
27 SUN(2N)PROTECT?
57705 SOLAR/TI,AB,DE
104246 PROTECT?/TI,AB,DE
319 SOLAR/TI,AB,DE(2N)PROTECT?/TI,AB,DE
S24 344 SUN(2N)PROTECT? OR SOLAR(2N)PROTECT?/TI,AB,DE

? s sunsafe? or sun safe?/ti,ab,de

0 SUNSAFE?
0 SUN SAFE?/TI,AB,DE
S25 0 SUNSAFE? OR SUN SAFE?/TI,AB,DE

? s photoprotect? or photo(w)protect?/ti,ab,de

27 PHOTOPROTECT?
4469 PHOTO/TI,AB,DE
104246 PROTECT?/TI,AB,DE
0 PHOTO/TI,AB,DE(W)PROTECT?/TI,AB,DE
S26 27 PHOTOPROTECT? OR PHOTO(W)PROTECT?/TI,AB,DE

? s sunscreen? or sun(w)screen? or sunblock? or sun(w)block? or lipblock? or lip(w)block? or lipbalm? or lip(w)balm?/ti,ab,de

32 SUNSCREEN?
9039 SUN
28112 SCREEN?
6 SUN(W)SCREEN?
3 SUNBLOCK?
9039 SUN
25762 BLOCK?
4 SUN(W)BLOCK?
0 LIPBLOCK?
739 LIP
25762 BLOCK?
0 LIP(W)BLOCK?
0 LIPBALM?
735 LIP/TI,AB,DE
337 BALM?/TI,AB,DE
0 LIP/TI,AB,DE(W)BALM?/TI,AB,DE
S27 38 SUNSCREEN? OR SUN(W)SCREEN? OR SUNBLOCK? OR SUN(W)BLOCK? OR LIPBLOCK? OR LIP(W)BLOCK? OR LIPBALM? OR LIP(W)BALM?/TI,AB,DE

? s clothing or clothe? or uniform? or hat or hats or pants or sleeve? or sunglasses or sun(w)glasses/ti,ab,de

```
        5830  CLOTHING
         826  CLOTHE?
       33578  UNIFORM?
         514  HAT
         130  HATS
          41  PANTS
        1395  SLEEVE?
          69  SUNGLASSES
        8880  SUN/TI,AB,DE
        4638  GLASSES/TI,AB,DE
           4  SUN/TI,AB,DE(W)GLASSES/TI,AB,DE
   S28  41717  CLOTHING OR CLOTHE? OR UNIFORM? OR HAT OR HATS OR PANTS
               OR SLEEVE? OR SUNGLASSES OR SUN(W)GLASSES/TI,AB,DE
```

? s environment?(3n)(intervention? or chang? or improv? or condition? or safe or safer or safety or protect?)/ti,ab,de

```
      273860  ENVIRONMENT?/TI,AB,DE
        8133  INTERVENTION?/TI,AB,DE
      178123  CHANG?/TI,AB,DE
      191278  IMPROV?/TI,AB,DE
      239589  CONDITION?/TI,AB,DE
       17115  SAFE/TI,AB,DE
        1755  SAFER/TI,AB,DE
      122725  SAFETY/TI,AB,DE
      104246  PROTECT?/TI,AB,DE
   S29  47232  ENVIRONMENT?(3N)(INTERVENTION? OR CHANG? OR IMPROV? OR
               CONDITION? OR SAFE OR SAFER OR SAFETY OR
               PROTECT?)/TI,AB,DE
```

? s environment?(3n)(design? or planning or build or built or structur?)/ti,ab,de

```
      273860  ENVIRONMENT?/TI,AB,DE
      400846  DESIGN?/TI,AB,DE
      138729  PLANNING/TI,AB,DE
       12241  BUILD/TI,AB,DE
       25793  BUILT/TI,AB,DE
      285591  STRUCTUR?/TI,AB,DE
   S30  13245  ENVIRONMENT?(3N)(DESIGN? OR PLANNING OR BUILD OR BUILT OR
               STRUCTUR?)/TI,AB,DE
```

? s physical(3n)(environment? or landscap?)/ti,ab,de

```
       98611  PHYSICAL/TI,AB,DE
      273860  ENVIRONMENT?/TI,AB,DE
        4116  LANDSCAP?/TI,AB,DE
   S31   2533  PHYSICAL(3N)(ENVIRONMENT? OR LANDSCAP?)/TI,AB,DE
```

? s protectiv?(3n)(structur? or build? or built or shelter?)/ti,ab,de

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       20110  PROTECTIV?/TI,AB,DE
      285591  STRUCTUR?/TI,AB,DE
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80428 BUILD?/TI,AB,DE
25793 BUILT/TI,AB,DE
4035 SHELTER?/TI,AB,DE
S32 905 PROTECTIV?(3N)(STRUCTUR? OR BUILD? OR BUILT OR SHELTER?)/TI,AB,DE

? s architectur?(3n)(chang? or improv? or safe or safer or safety or design? or structur? or construct?)/ti,ab,de

28500 ARCHITECTUR?/TI,AB,DE
178123 CHANG?/TI,AB,DE
191278 IMPROV?/TI,AB,DE
17115 SAFE/TI,AB,DE
1755 SAFER/TI,AB,DE
122725 SAFETY/TI,AB,DE
400846 DESIGN?/TI,AB,DE
285591 STRUCTUR?/TI,AB,DE
142696 CONSTRUCT?/TI,AB,DE
S33 4791 ARCHITECTUR?(3N)(CHANG? OR IMPROV? OR SAFE OR SAFER OR SAFETY OR DESIGN? OR STRUCTUR? OR CONSTRUCT?)/TI,AB,DE

? s building?(3n)(chang? or improv? or safe or safer or safety or design? or structur? or construct?)/ti,ab,de

64278 BUILDING?/TI,AB,DE
178123 CHANG?/TI,AB,DE
191278 IMPROV?/TI,AB,DE
17115 SAFE/TI,AB,DE
1755 SAFER/TI,AB,DE
122725 SAFETY/TI,AB,DE
400846 DESIGN?/TI,AB,DE
285591 STRUCTUR?/TI,AB,DE
142696 CONSTRUCT?/TI,AB,DE
S34 13645 BUILDING?(3N)(CHANG? OR IMPROV? OR SAFE OR SAFER OR SAFETY OR DESIGN? OR STRUCTUR? OR CONSTRUCT?)/TI,AB,DE

? s shade or shaded or shady or shelter?/ti,ab,de

521 SHADE
337 SHADED
34 SHADY
4035 SHELTER?/TI,AB,DE
S35 4904 SHADE OR SHADED OR SHADY OR SHELTER?/TI,AB,DE
? s canopy or canopied or canopies or awning?/ti,ab,de

1962 CANOPY
18 CANOPIED
1481 CANOPIES
32 AWNING?/TI,AB,DE
S36 2669 CANOPY OR CANOPIED OR CANOPIES OR AWNING?/TI,AB,DE

? s plant or plants or tree or trees or foliage or vegetation/ti,ab,de

```
        93235  PLANT
       150045  PLANTS
        10634  TREE
        14842  TREES
          935  FOLIAGE
        14065  VEGETATION/TI,AB,DE
   S37  216540  PLANT OR PLANTS OR TREE OR TREES OR FOLIAGE OR
              VEGETATION/TI,AB,DE

? s lunch(w)time or lunchtime or lunch(w)break or midday or noon or (middle(2w)day) or
(time(2w)day) or morning or afternoon/ti,ab,de

          314  LUNCH
       274843  TIME
            2  LUNCH(W)TIME
            6  LUNCHTIME
          314  LUNCH
         6788  BREAK
            8  LUNCH(W)BREAK
          189  MIDDAY
          410  NOON
        11963  MIDDLE
        35980  DAY
           18  MIDDLE(2W)DAY
       274843  TIME
        35980  DAY
         1237  TIME(2W)DAY
         1623  MORNING
          836  AFTERNOON/TI,AB,DE
   S38    3802  LUNCH(W)TIME OR LUNCHTIME OR LUNCH(W)BREAK OR MIDDAY OR
              NOON OR (MIDDLE(2W)DAY) OR (TIME(2W)DAY) OR MORNING OR
              AFTERNOON/TI,AB,DE

? s s21:s38

   S39  335608  S21:S38

? s s20 and s39

        25055  S20
       335608  S39
   S40    3042  S20 AND S39
? s SunWise or SunSmart or Pool Cool or Kidskin/ti,ab,de

            2  SUNWISE
            1  SUNSMART
            0  POOL COOL
            0  KIDSKIN/TI,AB,DE
   S41      3  SUNWISE OR SUNSMART OR POOL COOL OR KIDSKIN/TI,AB,DE

? s s40 or s41
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3042 S40
3 S41
S42 3043 S40 OR S41

? s py=1990:2009

S43 863919 PY=1990:2009

? s s42 and s43

3043 S42
863919 S43
S44 1083 S42 AND S43

PsycINFO <1987 to August Week 4 2009>

Searched via OvidSP

Search date=2nd Sept 2009

Records retrieved=402

Search Strategy:

1 neoplasms/ (12576)

2 (skin adj3 (cancer$ or neoplas$ or oncolog$ or malignan$ or tumo?r$ or carcinoma$ or adenocarcinoma$)).ti,ab. (270)

3 (melanoma$ or nonmelanoma$).ti,ab. (254)

4 (basal cell adj2 (carcinoma$ or cancer$)).ti,ab. (6)

5 (basal cell adj2 epithel$).ti,ab. (0)

6 (squamous cell adj2 (carcinoma$ or cancer$)).ti,ab. (57)

7 (squamous cell adj2 epithel$).ti,ab. (0)

8 (NMSC or BCC or SCC).ti,ab. (125)

9 (nevus or nevi or naevi).ti,ab. (23)

10 (mole or moles).ti,ab. (205)

11 exp Radiation/ (466)

12 (sunburn$ or sun burn$ or tanning or sun tan$ or suntan$).ti,ab. (129)

13 (sun damag$ or sundamag$ or (sun adj2 expos$)).ti,ab. (139)

14 ((solar adj2 damag$) or (solar adj2 expos$)).ti,ab. (7)

15 (photodamag$ or photo damag$).ti,ab. (3)

16 ((ultraviolet adj2 radiat$) or (ultra violet adj2 radiat$) or (uv adj2 radiat$) or (solar adj2 radiat$)).ti,ab. (89)

17 ((ultraviolet adj2 irradiat$) or (ultra violet adj2 irradiat$) or (uv adj2 irradiat$) or (solar adj2 irradiat$)).ti,ab. (20)

18 (ultraviolet ray$ or ultra violet ray$ or uv ray$ or solar ray$).ti,ab. (6)

19 ((ultraviolet adj2 expos$) or (ultra violet adj2 expos$) or (uv adj2 expos$)).ti,ab. (65)

20 or/1-19 (13623)

21 (radiat$ adj2 protect$).ti,ab. (18)

22 (irradiat$ adj2 protect$).ti,ab. (0)

23 ((sun adj2 protect$) or (solar adj2 protect$)).ti,ab. (173)

24 (sunsafe$ or sun safe$).ti,ab. (41)

25 (photoprotect$ or photo protect$).ti,ab. (4)

26 (sunscreen$ or sun screen$ or sunblock$ or sun block$ or lipblock$ or lip block$ or lipbalm$ or lip balm$).ti,ab. (134)

27 (clothing or clothe$ or uniform$ or hat or hats or pants or sleeve$ or sunglasses or sun glasses).ti,ab. (8154)

28 environment/ (7012)

29 built environment/ (95)

30 architecture/ (620)

31 (environment$ adj3 (intervention$ or chang$ or improv$ or condition$ or safe or safer or safety or protect$)).ti,ab. (7883)

32 (environment$ adj3 (design$ or planning or build or built or structur$)).ti,ab. (2940)

33 (physical adj3 (environment$ or landscap$)).ti,ab. (2631)

34 (protectiv$ adj3 (structur$ or build$ or built or shelter$)).ti,ab. (49)

35 (architectur$ adj3 (chang$ or improv$ or safe or safer or safety or design$ or structur$ or construct$)).ti,ab. (500)

36 (building$ adj3 (chang$ or improv$ or safe or safer or safety or design$ or structur$ or construct$)).ti,ab. (869)

37 (shade or shaded or shady).ti,ab. (317)

38 (canopy or canopied or canopies or awning$).ti,ab. (130)

39 (plant or plants or tree or trees or foliage or vegetation).ti,ab. (6846)

40 (lunch time or lunchtime or lunch break or midday or noon or (middle adj2 day) or (time adj2 day) or morning or afternoon).ti,ab. (5978)

41 or/21-40 (41544)

42 41 and 20 (416)

43 limit 42 to yr="1990 -Current" (402)

44 from 43 keep 1-402 (402)

Science Citation index

Searched via Web of Science (ISI) on Web of Knowledge

Search date=7th September 2009

Records retrieved= 1169

Strategy

# 10	1,169	#9 AND #4 *Databases=SCI-EXPANDED Timespan=1990-2009*
# 9	>100,000	#8 OR #7 OR #6 OR #5 *Databases=SCI-EXPANDED Timespan=1990-2009*
# 8	>100,000	TI=((shade OR shaded OR shady OR shelter* OR canopy OR canopies OR canopied OR awning* OR plant OR plants OR tree OR trees OR foliage OR vegetation OR (lunch time*) OR lunchtime* OR (lunch break*) OR midday OR noon OR (middle SAME day) OR (time SAME day) OR morning* OR afternoon*)) *Databases=SCI-EXPANDED Timespan=1990-2009*
# 7	4,747	TI=((architectur* SAME chang*) OR (architectur* SAME improv*) OR (architectur* SAME safe*) OR (architectur* SAMEdesign*) OR (architectur* SAME structur*) OR (architectur* SAME construct*) OR (building* SAME chang*) OR (building* SAME improv*) OR (building* SAME safe*) OR (building* SAME design*) OR (building* SAME structur*) OR (building* SAME construct*)) *Databases=SCI-EXPANDED Timespan=1990-2009*
# 6	16,299	TI=((environment* SAME intervention*) OR (environment* SAME chang*) OR (environment* SAME improv*) OR (environment* SAME condition*) OR (environment* SAME safe*) OR (environment* SAME protect*) OR (environment* SAME design*) OR (environment* SAME planning) OR (environment* SAME build*) OR (environment* SAME built) OR (environment SAME structur*) OR (physical SAME environment*) OR (physical SAME landscape*) OR(protective SAME structur*) OR (protective SAME build*) OR

(protective SAME built) OR (protective SAME shelter*))

Databases=SCI-EXPANDED Timespan=1990-2009

# 5	26,796	TI=((radiat* SAME protect*) OR (irradiat* SAME protect*) OR (sun SAME protect*) OR (solar SAME protect*) OR sunsafe* OR (sun SAME safe*) OR photoprotect* OR (photo SAME protect*) OR sunscreen* OR (sun SAME screen*) OR sunblock* OR (sun SAME block*) or lipblock* OR (lip SAME block*) OR lipbalm OR (lip SAME balm*) OR clothing OR clothe* OR uniform* OR hat OR hats OR pants OR sleeve* OR sunglasses OR (sun SAME glasses))

Databases=SCI-EXPANDED Timespan=1990-2009

# 4	57,134	#3 OR #2 OR #1

Databases=SCI-EXPANDED Timespan=1990-2009

# 3	71	TI=((ultra violet SAME radiat*) OR (ultra violet SAME irradiat*) OR (ultra violet SAME expos*) OR (ultra violet SAME ray*))

Databases=SCI-EXPANDED Timespan=1990-2009

# 2	51,685	TI=(melanoma OR nonmelanoma OR nevus OR nevi OR naevi OR mole OR moles OR sunburn* OR (sun SAME burn*) OR tanning OR (sun SAME tan*) OR suntan* OR (sun SAME damag*) OR (sundamag*) OR (sun SAME expos*) OR (solar SAME damag*) OR (solar SAME expos*) OR photodamag* or (photo SAME damag*) OR (ultraviolet SAME radiat*) OR (uv SAME radiat*) OR (solar SAME radiat*) OR (ultraviolet SAME irradiat*) OR (uv SAME irradiat*) OR (solar SAME irradiat*) OR (ultraviolet ray*) OR (ultra violet ray*) OR (uv ray*) OR (solar ray*) OR (ultraviolet SAME expos*) OR (uv SAME expos*))

Databases=SCI-EXPANDED Timespan=1990-2009

# 1	6,408	TI=((skin SAME cancer) OR (skin SAME neoplasm*) OR (skin SAME oncolog*) OR (skin SAME malignan*) OR (skin SAME tumor*) OR (skin SAME tumour*) OR (skin SAME carcinoma*) OR (skin SAME adenocarcinoma*))

Databases=SCI-EXPANDED Timespan=1990-2009

Social Science Citation Index

Searched via Web of Science (ISI) on Web of Knowledge

Searched date=27th August 2009

Records retrieved=574

# 10	574	#9 AND #4

Databases=SSCI Timespan=1900-2009

# 9	89,458	#8 OR #7 OR #6 OR #5

Databases=SSCI Timespan=1900-2009

8 33,496 TS=((shade OR shaded OR shady OR shelter* OR canopy OR canopies OR canopied OR awning* OR plant OR plants OR tree OR trees OR foliage OR vegetation OR (lunch time*) OR lunchtime* OR (lunch break*) OR midday OR noon OR (middle SAME day) OR (time SAME day) OR morning* OR afternoon*))

Databases=SSCI Timespan=1900-2009

7 5,827 TS=((architectur* SAME chang*) OR (architectur* SAME improv*) OR (architectur* SAME safe*) OR (architectur* SAMEdesign*) OR (architectur* SAME structur*) OR (architectur* SAME construct*) OR (building* SAME chang*) OR (building* SAME improv*) OR (building* SAME safe*) OR (building* SAME design*) OR (building* SAME structur*) OR (building* SAME construct*))

Databases=SSCI Timespan=1900-2009

6 38,737 TS=((environment* SAME intervention*) OR (environment* SAME chang*) OR (environment* SAME improv*) OR (environment* SAME condition*) OR (environment* SAME safe*) OR (environment* SAME protect*) OR (environment* SAME design*) OR (environment* SAME planning) OR (environment* SAME build*) OR (environment* SAME built) OR (environment SAME structur*) OR (physical SAME environment*) OR (physical SAME landscape*) OR(protective SAME structur*) OR (protective SAME build*) OR (protective SAME built) OR (protective SAME shelter*))

Databases=SSCI Timespan=1900-2009

5 14,353 TS=((radiat* SAME protect*) OR (irradiat* SAME protect*) OR (sun SAME protect*) OR (solar SAME protect*) OR sunsafe* OR (sun SAME safe*) OR photoprotect* OR (photo SAME protect*) OR sunscreen* OR (sun SAME screen*) OR sunblock* OR (sun SAME block*) or lipblock* OR (lip SAME block*) OR lipbalm OR (lip SAME balm*) OR clothing OR clothe* OR uniform* OR hat OR hats OR pants OR sleeve* OR sunglasses OR (sun SAME glasses))

Databases=SSCI Timespan=1900-2009

4 2,397 #3 OR #2 OR #1

Databases=SSCI Timespan=1900-2009

3 7 TS=((ultra violet SAME radiat*) OR (ultra violet SAME irradiat*) OR (ultra violet SAME expos*) OR (ultra violet SAME ray*))

Databases=SSCI Timespan=1900-2009

2 2,116 TS=(melanoma OR nonmelanoma OR nevus OR nevi OR naevi OR mole OR moles OR sunburn* OR (sun SAME burn*) OR tanning OR (sun SAME tan*) OR suntan* OR (sun SAME damag*) OR (sundamag*) OR (sun SAME expos*) OR (solar SAME damag*) OR (solar SAME expos*) OR photodamag* or (photo SAME damag*) OR (ultraviolet SAME radiat*) OR (uv SAME radiat*) OR (solar SAME radiat*) OR (ultraviolet SAME irradiat*) OR (uv SAME irradiat*) OR (solar SAME irradiat*) OR (ultraviolet ray*) OR (ultra violet ray*) OR (uv ray*) OR (solar ray*) OR (ultraviolet SAME expos*) OR (uv SAME expos*))

Databases=SSCI Timespan=1900-2009

# 1	800	ts=((skin SAME cancer) OR (skin SAME neoplasm*) OR (skin SAME oncolog*) OR (skin SAME malignan*) OR (skin SAME tumor*) OR (skin SAME tumour*) OR (skin SAME carcinoma*) OR (skin SAME adenocarcinoma*))

Databases=SSCI Timespan=1900-2009

The Trials Register of Promoting Health Interventions (TRoPHI)

Searched via EPPI website http://eppi.ioe.ac.uk/webdatabases/Intro.aspx?ID=7

Search date=3rd September 2009

Records retrieved=55

Strategy: *Focus of the report: skin cancer*

Appendix 1b: Internet searching

65 websites identified and checked from an initial search of Intute using the search phrase "skin cancer". Websites scanned 19th and 20th August 2009. Relevant references/ publications cut and pasted into word document

1.ActinicKeratosesNet - http://www.skincarephysicians.com/actinickeratosesnet/index.html

No references identified

2.Age page : skin care and aging - http://www.nia.nih.gov/HealthInformation/Publications/skin.htm

No references identified

3. AgingSkinNet

http://www.skincarephysicians.com/agingskinnet/index.html

No references identified

4. American Cancer Society : sun safety - http://www.cancer.org/docroot/PED/PED_7.asp?sitearea=PED

No references identified

5. Anabolic steroid abuse –

http://www.steroidabuse.gov/

No references identified

6. Australasian College of Dermatologists –

http://www.dermcoll.asn.au/

no references identified

7. BASO : the Association for Cancer Surgery

http://www.baso.org/content/default.asp?s=ACS

no references identified

8. BC Cancer Agency : cancer management guidelines

http://www.bccancer.bc.ca/HPI/CancerManagementGuidelines/default.htm

no references identified

9. Burden of occupational cancer in Great Britain, The. (Research Report RR595)

http://www.hse.gov.uk/research/rrhtm/rr595.htm

no references identified

10. Campaign for safe cosmetics

http://www.safecosmetics.org/

no references identified

11. Cancer of the skin

http://cks.library.nhs.uk/patient_information_leaflet/cancer_of_the_skin

no references identified

12. Cancer prevention : a resource to support in delivering the NHS Cancer Plan

http://www.nice.org.uk/aboutnice/whoweare/aboutthehda/hdapublications/cancer_prevention_a_resource_to_support_local_action_in_delivering_the_nhs_cancer_plan.jsp

1 reference identified

13, Cancer Prevention Research Center (The) - http://www.uri.edu/research/cprc/

No references identified

14. Cancer Research UK SunSmart - http://info.cancerresearchuk.org/healthyliving/sunsmart/

No references identified

15. CDC : cancer prevention and control : choose your cover - http://www.cdc.gov/ChooseYourCover/

No references identified

16. Chemotherapy - http://www.nlm.nih.gov/medlineplus/tutorials/chemotherapyintroduction/htm/index.htm

No references identified

17. CKS clinical topic review : palliative care : malignant ulcer of skin - http://www.cks.library.nhs.uk/palliative_care_malignant_ulcer_of_the_skin

No references identified

18. CKS clinical topic review : skin cancer - suspected - http://cks.library.nhs.uk/skin_cancer_suspected

No references identified

19. Department of Plastic Surgery : Queen Victoria Hospital, East Grinstead - http://qvh.nhs.uk/patients_and_services/specialist_care_and_clinical_services/plastic_surgery.html

No references identified

20. Dermatology image bank –

http://library.med.utah.edu/kw/derm/

no references identified

21, DermIS [Dermatology Internet Service] - http://dermis.multimedica.de/dermisroot/en/home/index.htm

no references identified

22. DermNet NZ : the dermatology resource –

http://dermnetnz.org/

no references identified

23. European Society for Dermatological Research –

http://www.esdr.org/

no references identified

24. Guide to community preventive services : skin cancer - http://www.thecommunityguide.org/cancer/skin/default.htm

31 references identified

25. Preventing Skin Cancer: Education and Policy Approaches in Primary School Settings

http://www.thecommunityguide.org/cancer/skin/education-policy/primaryschools.html

28 references identified

26. Preventing skin cancer: Education and Policy Approaches in Outdoor Recreation Settings

http://www.thecommunityguide.org/cancer/skin/education-policy/outdoorrecreation.html

16 references identified

27. Preventing Skin cancer: Education and Policy approaches in Child Care Centers

http://www.thecommunityguide.org/cancer/skin/education-policy/supportingmaterials/ISchildcarecenters.html

9 references identified

28. Preventing Skin cancer: Education and Policy approaches in Secondary Schools and Colleges

http://www.thecommunityguide.org/cancer/skin/education-policy/supportingmaterials/ISsecondaryschools.html

13 references identified

29. Preventing Skin cancer: Education and Policy approaches in outdoor education settings

http://www.thecommunityguide.org/cancer/skin/education-policy/supportingmaterials/ISoutdooroccupations.html

8 references identified

30. Preventing skin cancer: interventions targeting healthcare settings and providers

http://www.thecommunityguide.org/cancer/skin/education-policy/supportingmaterials/IShealthcaresettings.html

12 references identified

31. Head and neck cancer surgeon

http://www.cancer-surgeon.com.au/

Not available 20/08/2009

32. Informed health online : hot topics –

http://www.informedhealthonline.org/index.2.en.html

No references identified

33. Institute of Occupational Medicine (IOM) –

http://www.iom-world.org/

No references identified

34. Look good ... feel better –

http://www.lookgoodfeelbetter.org/

no references identified

35. MEDLINEplus : skin cancer - http://www.nlm.nih.gov/medlineplus/skincancer.html

No references identified

36. Melanoma - http://www.nlm.nih.gov/medlineplus/tutorials/melanoma/htm/index.htm

No references identified

37. Non-melanoma skin cancer - http://www.cancerhelp.org.uk/help/default.asp?page=4310

No references identified

38. Occupational health statistics : causes and kinds of disease - http://www.hse.gov.uk/statistics/causdis/index.htm

No references identified

39. Primary Care Dermatology Society -

http://www.pcds.org.uk/

No references identified

40. Protecting children from ultraviolet radiation –

http://www.who.int/mediacentre/factsheets/fs261/en/

No references identified

41. RAFT –

http://www.raft.ac.uk/

No references identified

42 Referral guidelines for suspected cancer - http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4008746

No references identified

43. Skin (Basal Cell Carcinomas - BCC) - http://www.cancerimprovement.nhs.uk/patinfopath/Pathway.aspx?TumourID=26

No references identified

44. Skin (Malignant Melanoma - MM) - http://www.cancerimprovement.nhs.uk/patinfopath/Pathway.aspx?TumourID=28

No references identified

45. Skin (Squamous Cell Carcinomas - SCC) - http://www.cancerimprovement.nhs.uk/patinfopath/Pathway.aspx?TumourID=27

No references identified

46. Skin cancer –

http://www.cancerhelp.org.uk/help/default.asp?page=276

No references identified

47. Skin cancer - http://www.nlm.nih.gov/medlineplus/tutorials/skincancerandmelanoma/htm/index.htm

No references identified

48. Skin cancer –

http://www.cancer.org/downloads/PRO/SkinCancer.pdf

No references identified

49. Skin cancer and benign tumor image atlas - http://www.meddean.luc.edu/lumen/MedEd/medicine/dermatology/melton/content1.htm

No references identified

50. Skin Cancer Foundation –

http://www.skincancer.org/

15 References identified

51.Skin cancer information centre

http://www.cancerbackup.org.uk/Cancertype/Skin

No references identified

52. Skin deep : a safety assessment of ingredients in personal care products –

http://www.cosmeticsdatabase.com/

No references identified

53. Skin treatment guide –

http://www.skin-treatment-guide.com/

No references identified

54. SkinCarePhysicians.com –

http://www.skincarephysicians.com/

1 reference identified

55. SkinCeuticals –

http://skinceuticals.com/

No references identified

56. State Cancer Legislative Database Program –

http://www.scld-nci.net/index.cfml

No references identified

57. Triangle tattoo and museum –

http://triangletattoo.com/

No references identified

58. Vantage Oncology –

http://www.vantageoncology.com/company.php

No references identified

59. Virtual Pathology at the University of Leeds -

http://www.virtualpathology.leeds.ac.uk/

No references identified

60. What you need to know about skin cancer –

http://www.cancer.gov/cancerinfo/wyntk/skin

No references identified

61. Your pet information leaflets : Animal Health Trust –

http://www.aht.org.uk/sa_leaflets.html

No references identified

62. Health Protection Agency

http://www.hpa.org.uk/servlet/Satellite?c=HPAweb_C&cid=1195733760549&pagename=HPAweb%2FHPAwebStandard

Searched for “sun” and identified 166 records

63. Cancer Council Australia

http://www.cancer.org.au/home.htm

no references identified

64. SunSmart Victoria, Australia

http://www.sunsmart.com.au/

8 references identified

65. SunSmart Victoria Australia

http://www.cancervic.org.au/about-our-research/centre_behavioural_research_cancer/research_projects_and_reports/skin_cancer/journal_pub_skin_cancer.html

48 references identified

Appendix 2: List of OECD countries

Australia	Korea
Austria	Luxembourg
Belgium	Mexico
Canada	Netherlands
Czech Republic	New Zealand
Denmark	Norway
Finland	Poland
France	Portugal
Germany	Slovak Republic
Greece	Spain
Hungary	Sweden
Iceland	Switzerland
Ireland	Turkey
Italy	United Kingdom
Japan	United States

Appendix 3: Criteria for selection of studies from titles and abstracts

GET (if the abstract meets the criteria below or it is unclear whether the criteria are met)	**REJECT (if the abstract clearly meets the criteria below)**	**BACKGROUND (abstracts that provide highly relevant background information on the topic)**
Is about primary prevention of skin cancer attributable to UV exposure (including primary prevention studies that include a small proportion of participants who have had an episode of skin cancer)	Not primary prevention (e.g. secondary prevention aiming to prevent a re-occurrence of skin cancer, screening, diagnosis, treatment or management of skin cancer)	
The intervention is (i) a change to the natural or built environment, such as provision of shade in public spaces or school grounds using built shelters or planting of trees and vegetation or changing the time of day that outdoor activities take place (ii) provision of sun protection resources, such as sunscreen or protective clothing (iii) a combination of both of these or (iv) a combination of either or both of these with provision of information†	The intervention does not contain a change to the natural or built environment, provision of sun protection resources, a combination of both of these or a combination of either or both of these with provision of information (e.g. information or education only, screening) The intervention is a policy, fiscal or legislative change, (for example, raising the minimum age of sunbed use to 18 years, removing unsupervised and coin-operated sunbed facilities, or reducing VAT on sunscreen products)	
The abstract reports (i) a primary study, (ii) a systematic review (iii) a cost-effectiveness study (reports economic/cost data for the intervention)	Is not a primary study, a systematic review, or cost-effectiveness study. The abstract reports a dissertation or thesis	
Publication date 1990 or after	Publication date prior to 1990	
OECD country	Not OECD country (This was not applied)	

† Includes information provided via: one-to-one or group-based advice; mass media campaigns; leaflets and other printed information such as posters and teaching resources; new media such as the internet and text-messaging

Appendix 4: Criteria for selection of studies from full papers

1. Population The study address primary prevention† of skin cancer attributable to UV exposure (this includes studies where the main focus of the study is primary prevention but a small proportion of participants have had a previous episode of skin cancer)	No	EXCLUDE
	Yes	
	Unclear	
2. Intervention The intervention is (i) a change to the natural or built environment, such as provision of shade in public spaces or school grounds using built shelters or planting of trees and vegetation or changing the time of day that outdoor activities take place (ii) provision of sun protection resources, such as sunscreen or protective clothing (iii) a combination of both of these or (iv) a combination of either or both of these with provision of information‡	No	EXCLUDE
	Yes	
	Unclear	
3. Outcomes At least one of the following reported: • Reduction in the incidence of mortality from skin cancer • Reduction in the incidence of morbidity from skin cancer, including sunburn. • Change in behaviour or attitudes • Increase in knowledge and awareness of skin cancer, causes of skin cancer (including risks), prevention of skin cancer • Costs or cost-effectiveness • Process and implementation outcomes • Adverse or unintended effects	No	EXCLUDE
	Yes	
	Unclear	
4. Study design The paper reports a primary evaluation study (any design) or is a full economic evaluation§	No	EXCLUDE
	Yes	
	Unclear	
5. Publication date The study was published 1990 or after	No	EXCLUDE
	Yes	
6. Country The setting is an OECD country (This criterion was not applied due to the limited number of studies identified)	No	EXCLUDE
	Yes	
	Unclear	

† i.e. not secondary prevention (aiming to prevent a re-occurrence of skin cancer), screening programmes (which solely aim to detect the occurrence of skin cancer or activities to assess its incidence among specific groups of people), diagnosis, treatment or management of skin cancer.

‡ i.e. not policy, legislative or fiscal changes, for example, raising the minimum age of sunbed use to 18 years, removing unsupervised and coin-operated sunbed facilities or reducing VAT on sunscreen products.
§Full economic evaluations of relevant types of interventions or schemes will be included. Costs of illness studies or studies which do not involve assessing the costs and related benefits/effectiveness of relevant interventions will be excluded.

Appendix 5: Example of a completed quality assessment form

Dobbinson et al 2009 [6]

1	Is the source population or source area well described?	+
2	Is the eligible population or area representative of the source area or population?	+ + Randomly selected from the source population
3	Do the selected participants or areas represent the eligible population or area?	+
4	Allocation to intervention – how was selection bias minimised?	+ + Randomisation undertaken by a statistician, although details of methods were not provided
5	Were interventions and comparisons well described and appropriate?	+ +
6	Was the allocation concealed?	+ + Randomisation was conducted blind, and allocation was concealed from other researchers and the schools until randomisation had occurred
7	Were the participants and/or investigators blind to exposure and comparison?	NA
8	Was the exposure to the intervention and comparison adequate?	+
9	Was contamination acceptably low?	+ The risk of contamination was low but contamination may have occurred due to the following: (1) two intervention schools

		did not build shaded areas, which means that the intention to treat analysis may have underestimated the effect, (2) two control schools did build shaded areas, and (3) one intervention school used portable shade umbrellas.
10	Were other interventions similar in both groups?	NR
11	Were all participants accounted for at study conclusion?	+ Schools were accounted for at the end of the study period, with none of the schools dropping out. For one intervention school it was not possible to make observations at the alternative site.
12	Did the setting reflect usual UK practice?	+
13	Did the intervention or control comparison reflect usual UK practice?	+ Opportunities to spend most of the lunchtime outdoors and eating lunch outside may be more limited in the UK
14	Were outcome measures reliable?	+ Video of randomly chosen time periods and coders were trained to achieve total agreement before starting coding.
15	Were all outcome measures complete?	+
16	Were all important outcomes assessed?	+ Use of shade was assessed, although long term clinical effects were not.
17	Were outcomes relevant?	+
18	Were there similar follow-up times in exposure and comparison groups?	+

19	Was follow-up time meaningful?	+
20	Were groups similar at baseline? If not were these adjusted?	+ Groups were similar in terms of size of the student population and shade development sites, but sites were not matched due to the potential differences between study sites.
21	Was ITT analysis conducted?	+
22	Was the study sufficiently powered to detect an intervention effect?	+
23	Were the estimates of effect size given or calculable?	+
24	Were the analytical methods appropriate?	+
25	Was the precision of intervention effects given or calculable? Were they meaningful?	+ Confidence intervals provided
26	Summary internal validity	+ + No significant flaws or sources of bias
27	Summary external validity	+

Appendix 6a: Excluded effectiveness studies

Excluded potential comparative papers	Reason for exclusion
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Harrison SL, Buettner PG, Maclennan R. The North Queensland "Sun-Safe Clothing" study: design and baseline results of a randomized trial to determine the effectiveness of sun-protective clothing in preventing melanocytic nevi. Am J Epidemiol. 2005 Mar 15;161(6):536-45.	Only baseline data available

Appendix 6b: Excluded economic studies

	Reason for exclusion
Cancer Council Australia, Australasian College of Dermatologists. Skin cancer prevention: a blue chip investment in health. Cancer Council Victoria 2009 Carter R, Marks R, Hill D. Could a national skin cancer primary prevention campaign in Australia be worthwhile?: An economic perspective. Health Promot Int. 1999;14(1):73-82. Carter R, Stone C, Vos T, Hocking J, Mihalopoulos C, Peacock S, et al. Trial of program budgeting and marginal analysis (PBMA) to assist cancer control planning in Australia. West Heidelberg, Australia: Centre for Health Program Evaluation; 2000. Carter R, Vos T, Moodie M, Haby M, Magnus A, Mihalopoulos C. Priority setting in health: origins, description and application of the Australian Assessing Cost-Effectiveness initiative. Expert Rev Pharmacoeconomics Outcomes Res. 2008;8(6):593-617. - , M., editor. Skin cancer and UV radiation: Springer; 1997. p. 902-08. Hocking B. Economic aspects of skin cancer prevention. J Occup Health Safety Auz N Z. 1991;7(6):473-6. Holman CDJ, Donovan RJ, Corti B, Jalleh G, Frizzell SK, Carroll AM. Evaluating projects funded by the Western Australian Health Promotion Foundation: first results. Health Promot Int. 1996;11(2):75-88. Kyle JW, Hammitt JK, Lim HW, Geller AC, Hall-Jordan LH, Maibach EW, et al. Economic evaluation of the US Environmental Protection Agency's SunWise program: sun protection education for young children. Pediatrics. 2008 May;121(5):e1074-84. Moatti J, Bouscary M. Some economists thoughts about prevention of skin cancer. Causes and prevention of skin diseases. In: Grob JJS, R. S.; McKie, R., editor. Epidemiology, Causes and Prevention of Skin Diseases: Causes and Prevention of Skin Diseases. Blackwell Science; 1997. Roy CR, Gies HP. Protective measures against solar UV exposures. Radiat Prot Dosimetry. 1997;72(3-4):231-40. Shih S, Carter R, Sinclair C, Mihalopoulos C, Vos T. Economic evaluation of skin cancer prevention in Australia. Prev Med. 2009. Sunsmart, Cancer Council Victoria. Skin cancer prevention: a blue chip investment in Victoria Cancer Council Victoria; 2008.	Is not a full economic evaluation of a relevant intervention

Appendix 6c: Unobtainable studies

Excluded potential comparative papers	Reason for exclusion
Fork HE, Wagner Jr RF, Wagner KD. The Texas peer education sun awareness project for children: primary prevention of malignant melanoma and nonmelanocytic skin cancers. Cutis. 1992;50(5):363-4. Health Education Authority. Public Health Division Research. Skin cancer campaign evaluation. 1990. Jackson KM. Psychosocial model and intervention to encourage sun protective behavior: Jackson, Kristina Melia: Arizona State U, US; 1997. Labat K, DeLong M, Gahring S. Evaluation of a skin cancer intervention program for youth. J Family Consumer Sci. 1996;88:3-10. Lescano CM. Promoting sun protective behaviors through a school-plus-home intervention: Lescano, Celia Maria: U Florida, US; 1999. Shani E, Rosenberg L, Bahar-Fuchs A, Friger Mea. Longitudinal improvements in skin cancer preventive behavior (SCPB) of outdoor workers in response to a two-phase intervention. Final Research Report presented to the Committee for Research and Prevention in Occupational Safety and Health. Israel: Final Research Report presented to the Committee for Research and Prevention in Occupational Safety and Health; 2000.	Unobtainable