

An Evaluation of Interventions Designed to Reduce Ultraviolet Radiation Exposure



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Executive Summary

Ultraviolet radiation from sunlight is the main risk factor for the development of skin cancer. This risk factor can be greatly reduced by following responsible sun protection measures and avoiding artificial ultraviolet radiation. This review was conducted to assess the evidence behind interventions aimed at reducing ultraviolet radiation exposure.

A literature search was conducted using several online databases. The items retrieved included a systematic review and primary intervention studies. To be included in the review, the studies had to focus on interventions and their effect on human exposure to ultraviolet radiation. Several inclusion criteria were identified. Any papers which did not meet the criteria with certainty were assessed by a second reviewer. All studies related to ultraviolet radiation interventions were compiled into Appendix A.

A recent systematic review, identified in the literature search, included 74 studies that targeted specific settings¹. Seven additional studies were identified during the literature review for this report. The studies were grouped by intervention settings. The target settings included primary schools, secondary schools and colleges, childcare, outdoor occupational settings, healthcare systems, and recreational/tourism settings.

One additional study was found in this literature review which evaluated interventions in primary schools. The results of this study, along with those of the systematic review, suggested that educational interventions directed at primary school-age children are effective at increasing covering up behaviour in children. Covering up behaviour included wearing hats, pants, or long-sleeved shirts.

There were too few studies with consistent evidence to evaluate the effectiveness of interventions in childcare, outdoor occupational, secondary schools and colleges, healthcare systems, and recreational/tourism settings. Although there have been many intervention studies conducted in these settings, the lack of standardization in intervention content and implementation, as well as variation in outcome measurements, make reaching a conclusion on intervention effectiveness difficult.

Four additional studies were found which evaluated appearance-focused interventions targeting the sun protection behaviours of college-age students. The results of these studies indicate that appearance-focused interventions may be more effective than health-focused interventions in this age group. This is a new area of research and at this point, evidence is insufficient to make recommendations regarding the effectiveness of appearance-focused interventions in college students.

Based on the available evidence, educational type interventions directly targeting primary schools are effective strategies for decreasing ultraviolet radiation exposure in children. These educational interventions included a wide range of activities such as didactic classroom teachings, didactic teaching using sunscreen samples, interactive and home-based activities, health fairs, educational picture books, teaching by medical students, interactive CD-ROM multimedia programs, and peer education.

Introduction

Exposure to ultraviolet radiation (UVR) is widely recognized as a major risk factor for skin cancer². Chronic, cumulative sun exposure over an extended period of time is a risk factor for basal and squamous cell carcinoma. Intermittent intense exposure, received prior to adulthood, is thought to be a risk factor for malignant melanoma and basal cell carcinoma³. Total avoidance of ultraviolet is not recommended, however, as UVR is an excellent source of Vitamin D, which plays a vital role in muscle and bone health and disease prevention⁴.

Cutaneous malignant melanoma is increasing in incidence in light-skinned populations across the world⁵. In British Columbia, there are approximately 13,000 new cases of non-melanoma skin cancers per year, with an annual average increase of 3.5%⁶.

While skin cancer may be among the most common cancers, it is also one of the most preventable⁷. Risk of skin cancers can be reduced by limiting exposure to sunlight, which is the primary source of UVR. Tanning beds and sunlamps are other sources of UVR. Primary preventive behaviours which limit exposure to UVR offer the best prospect for reducing the incidence of skin cancer.

This review of published studies has been conducted to assess the evidence of effectiveness behind ultraviolet radiation reduction interventions. The purpose of this report is to present a review of the scientific literature that examines the evidence for the effectiveness of interventions which aim to reduce UVR exposure, through minimizing UVR exposure during peak hours, seeking shade, or wearing protective clothing. The effectiveness of interventions on changing knowledge, attitudes, and interventions was discussed in this report, but these outcomes were not considered when drawing a conclusion on intervention effectiveness, as it remains unclear how these intermediate outcomes relate to UVR exposure.

Methodology

A literature search was conducted to identify all published studies and systematic reviews involving UVR interventions, using EbscoHost and PubMed. EbscoHost included the following databases: Academic Search Premier, Biomedical Reference Collection, and the Cochrane Database of Systematic Reviews. The published studies were limited to intervention studies and evidence-based medicine databases. The systematic reviews were limited to reviews of intervention studies.

EbscoHost and PubMed were searched using a combination of the following keywords: ultraviolet radiation OR UV radiation OR UVR AND interventions OR strategies OR programs AND reduction OR education OR prevention OR public health.

Following completion of the literature search and identification of a systematic review, the criteria used to evaluate whether a study qualified for this report were set to the inclusion criteria listed by the systematic review¹. Setting similar criteria for this report and the systematic review identified during the literature search facilitated the comparison between studies included in the systematic review and additional studies identified in this report. To be included in this review, the studies had to:

- evaluate a specified population-based intervention for the prevention of skin cancer;
- be published in English;
- involve primary prevention of skin cancer;
- evaluate effectiveness and assess at least one of the specified primary behavioural outcomes. These include minimizing exposure to the sun during peak hours, seeking shade, or wearing protective clothing.

Studies had to focus on the effects of interventions on UV exposure to be included in this review. Since the relationship between UVR and skin cancer is well established, a reduction in UVR exposure was used as the outcome of interest. Searches were first performed in EbscoHost, followed by PubMed. Any studies previously identified in EbscoHost were discarded in PubMed.

A reduction in UV exposure was defined as minimizing exposure to the sun during peak hours, seeking shade, or wearing protective clothing. Secondary outcomes are discussed in this review, but they are not used to evaluate the effectiveness of interventions as the link between secondary outcomes and UV exposure is not well defined. Secondary outcomes include a change in knowledge, attitudes, intentions, or sunscreen use.

Following the review of all papers retrieved during the literature search, studies were organized according to intervention settings used in the identified systematic review. Six settings were identified, including: 1) Primary schools; 2) Childcare; 3) Recreation and tourism; 4) Outdoor occupational settings; 5) Healthcare systems; and, 6) Secondary schools and colleges. All studies related to UVR intervention strategies that were not included in the systematic review but met the inclusion criteria of this review, were compiled into tables outlining populations, interventions, methodology, comparators, and outcomes.

Results

A total of 263 studies were retrieved during the literature review. The 74 studies that qualified for the systematic review were excluded from review in this report¹. All studies which did not meet the inclusion criteria were also excluded, leaving seven primary studies reviewed in this report. A summary of the number of all primary studies that qualified for the systematic review, and additional studies identified in the current search, is shown in Table 1.

Table 1. *The number of studies which qualified for the systematic review by Saraiya et al. and the number of additional studies identified that qualified for this report*

<i>Intervention setting</i>	<i>Qualifying reports</i>	<i>Additional studies</i>
Primary schools	20	1 ¹⁰
Childcare	11	
Recreation/tourism	11	
Outdoor occupational	8	1 ¹⁴
Healthcare systems	11	
Secondary schools/colleges	13	5 ^{18,20,24-26}

Systematic Review

A systematic review of interventions designed to prevent skin cancer by reducing exposure to UVR was conducted by Saraiya et al¹. The systematic review included 74 studies that conducted interventions in specific settings. Electronic searches for literature were conducted in MEDLINE, PsycINFO, and CINAHL. In order to be included in the review, the identified studies had to:

- evaluate a specified population-based intervention for the prevention of skin cancer;
- be published in English from 1966 to June 2000;
- involve primary prevention of skin cancer;
- evaluate effectiveness and assess at least one of the specified outcomes;
- be conducted in an established market economy as defined by the World Bank;
- be a primary study.

Studies were excluded from the review if they did not meet the inclusion criteria, if the results were duplicated in another included study, or if they had limited execution quality. Limited execution quality includes not providing basic descriptions of the target populations, interventions, comparator group, or outcomes. Limited execution quality also includes studies that measured different outcomes pre- and post-intervention. The studies identified consisted of randomized controlled trials, time-series designs, and before and after designs.

The behavioural outcomes used to measure the effectiveness of interventions included avoiding the sun during peak hours, seeking shade, or wearing protective clothing. The use of sunscreen alone was not considered to be a primary defense against skin cancer. The authors cited recent research that suggests sunscreen by itself is not an adequate strategy for UVR protection^{8,9}.

Primary studies

Primary schools

Intermittent and cumulative UVR exposure in childhood plays an important role in the subsequent development of skin cancer^{17,18}. Interventions which reduce UVR in the first 18 years of life could reduce the lifetime incidence of skin cancers. The results of the systematic review on interventions in primary

schools are summarized below. One study was found in addition to the studies included in the systematic review on interventions in primary schools¹⁰.

The systematic review team's search identified a total of 33 reports on the effectiveness of educational and policy interventions in primary schools. Five of these reports were excluded due to the low quality of execution, and eight of these reports were already included in another study.

A wide range of intervention activities was used, including classroom teachings, health fairs, interactive and home-based activities, an educational picture book, interactive CD-Rom multimedia programs, teaching by medical students, and peer education. These interventions can be classified as educational interventions.

The review team reported that results from 20 qualifying studies provided sufficient evidence of the effectiveness of interventions in primary schools in improving the use of protective clothing or covering up behaviour. The use of protective clothing was mainly reported by parents, teachers, and caregivers. Covering up behaviour includes wearing hats, pants, or long-sleeved shirts. Inconsistent results prevented a conclusion being formed regarding the effectiveness of interventions in improving other sun protective behaviours, such as avoiding the sun during peak hours or seeking shade.

When the results of the studies were examined, study design was found to markedly affect the effect size of the data. For covering up behaviours, the median relative change ranged from 25% in concurrent comparison studies to 70% in before and after studies (Table 2). Different timelines were used in the before and after studies.

Table 2. *Median and interquartile relative changes in sun-protective behaviours from interventions in primary schools¹*

<i>Outcome behaviours</i>	<i>Relative Change</i>		
	25 th	Median	75 th
<i>Studies with concurrent comparison groups</i>			
Avoid sun	0.92	1.04	1.16
Cover up	1.01	1.25	1.04
Use sunscreen	1.02	1.17	1.32
<i>Before-and-after studies</i>			
Avoid sun	NA	1.16	NA
Cover up	1.42	1.70	2.00
Use sunscreen	NA	1.34	NA

The additional study identified in this literature search reported the results of the evaluation of the Environmental Protection Agency's SunWise school program¹⁰. The SunWise school program was pilot tested in 130 schools during the 1999-2000 school year. National implementation began in the 2000-2001 school year. The classroom component of the intervention consisted of cross-curricular classroom lessons and internet learning. School components included suggestions for infrastructure enhancements and ideas for school-based sun safety activities. Evaluation of the program was carried out through teacher and student surveys. As of 2002, data from over 6000 students' pre-tests and post-tests have been analyzed. The results of the analysis show that student knowledge regarding covering up behaviour, the UV index, and the SPF factor increased pre-test to post-test. Children aged 5-9 years experienced a 10% decrease in the attitude that a tan is healthy. Children in the control schools had no changes in knowledge or attitudes during this comparable period. The responses of surveys completed in 2002 indicated that changes in attitude and knowledge were maintained the following year, and only 55% of children experienced sunburns in 2001 compared to 66% in 2000.

Childcare

Caregivers such as parents, early childhood educators, and other role models are important targets for intervention strategies due to their influence on the sun-protection habits of children under their care. No

additional studies were found other than the studies included in the systematic review on interventions in childcare settings.

The systematic review identified a total of 25 reports that evaluated the effectiveness of interventions in childcare¹. Eleven of these studies qualified for inclusion in the review. Five of the studies were not included due to the limited quality of the study methodology, and nine of the studies were already reported in other papers. Interventions included workshops for staff, an activity packet for parents, role-playing, and activities for children. The reports demonstrated insufficient evidence on the effectiveness of these interventions due to the small number of reports and inconsistent results.

Recreational and tourism settings

Interventions in recreational and tourism settings involve efforts to promote sun-protective behaviours among adults, children, and their parents. UV exposure often occurs during recreational activity, making recreational settings important sites for sun-protection programs. The systematic review identified 18 reports, of which 11 qualified to be included in the review¹.

The interventions listed included interactive activities, poolside curriculums, home-based activities, brochures, posters and peer-leader modeling. Outcomes measures included changes in self-reported sun-protective behaviour, incidence of sunburn, degree of tan, and changes in knowledge, attitudes, and beliefs. Evidence from three studies indicates that interventions were effective in increasing adult covering up behaviour, showing a median relative difference of 11.2% (interquartile range 5.1% to 12.9%). The evidence was inconsistent for adult incidence of sunburn and children's sun-protective behaviours.

Outdoor occupational settings

Outdoor workers are at a high risk for developing non-melanoma skin cancer and possibly melanoma due to extended time spent in the sunlight^{11,12}. Data from a Canadian survey on sun exposure and protective behaviours in outdoor workers show low levels of sun protection among workers¹³. One study was found in addition to the studies included in the systematic review on interventions in outdoor occupational settings¹⁴.

The systematic review identified 14 reports that evaluated the effectiveness of interventions in outdoor occupational settings¹. Three of these reports were excluded from the review, due to the limited quality of study methodology, and three studies were excluded, since the study was already reported in an included paper. Numerous intervention activities were involved in the reports. Intervention activities included sun safety training, education sessions, skin exams by physicians, role-modeling, and educational brochures. A variety of outcomes was measured including changes in sun-protective behaviours, incidence of sunburn, knowledge, beliefs, and attitudes. Too few studies and inconsistent results provide insufficient evidence to determine the effectiveness of the interventions on the measured outcomes.

The additional study identified in this review targeted employees at ski areas, through the campaign labeled Go Sun Smart. Go Sun Smart, a worksite sun safety program, was evaluated in a pair-matched, group randomized, pre-test/post-test controlled design involving employees at 26 ski areas in western North America¹⁴. The worksite safety program included written, visual, electronic, and interpersonal channels of communication to promote sun-safe practices. The two outcome measures assessed were employee awareness of Go Sun Smart and the number of sunburns received while skiing or snowboarding during the winter. Seventy-eight percent of employees at the intervention ski areas reported hearing about Go Sun Smart versus 30% of employees at control ski areas ($p < 0.05$). Employees at the intervention ski areas reported a 14% reduction in sunburns, and this decline was significantly larger than the 8% decline observed in control ski areas ($p < 0.05$). There were no significant effects of the intervention on sun protection behaviours or attitudes towards sun protection. Awareness of Go Sun Smart did not predict being sunburned ($p > 0.05$).

Healthcare systems

Healthcare providers are in a unique position to provide advice and preventative services to the general population, making healthcare providers an important source of health information. No studies in addition to the reports included in the systematic review were found.

The reports included in the systematic review contained interventions aimed at healthcare providers or placed within a healthcare setting¹. The systematic review identified 21 studies, of which 11 qualified for inclusion in the review. Nine studies were excluded due to the limited quality of the study methodology, and one study was excluded because it was included in another report.

The interventions included brief educational sessions for physicians and staff, skin cancer prevention curriculum for medical students, internet training, videotapes, role modeling procedures, and involvement of the community drugstore. Outcome measurements were diverse and inconsistent between studies. Several studies measured intermediate outcomes such as knowledge and attitudes, but not behaviours. The results from two studies did show that interventions increased knowledge among medical students; however, many students still believed that a tanned appearance looked healthy^{15,16}. The lack of measurement of sun-protective behaviours and health outcomes, and lack of consistent results, provided insufficient evidence to determine the effectiveness of interventions in healthcare settings.

Secondary schools and colleges

Despite higher levels of knowledge about the health effects of prolonged UV exposure, adolescents and young adults are less likely than children to practice sun-protective behaviours. High-risk behaviours increase among this age group, and parents have less influence in promoting sun protection¹⁷. Five studies, in addition to those included in the systematic review, were found. Four of the five studies focused on the possible benefits of appearance-focused interventions, compared to health-focused interventions in college students. Appearance-focused interventions are discussed below in a separate subsection.

The systematic review identified 17 articles on the effectiveness of interventions in secondary schools and colleges¹. Thirteen of these reports qualified to be included in the review, with four studies being excluded due to the limited quality of study methodology. The intervention activities included classroom teaching, internet and home-based activities, internet-based activities, and reward-based incentives. Only four reports measured sun-protective behaviours and each report measured a different behaviour. The inconsistency of evaluations undertaken and outcomes measures did not allow the determination of the effectiveness of the interventions.

Adams et al. completed a study which was designed to clarify how skin cancer education affects behaviours, as well as knowledge and attitudes relevant to skin cancer prevention¹⁸. An educational intervention was provided to half of 30 college coeds. Outcomes measures were knowledge and attitudes towards skin cancer and tanning. Skin colour was also measured throughout the intervention, using a spectrophotometer, and sunscreen use was estimated by weighing the sunscreen bottles provided to the participants. The results show that the intervention significantly increased knowledge about skin cancer and skin cancer prevention, but had no effect on behaviour in terms of UV reduction or sunscreen use.

Appearance-focused interventions

Young adults are continuing to receive large amounts of both intentional and unintentional exposure to UVR. This age group is highly motivated to tan due to the perceived appearance-enhancing benefits of tanned skin¹⁹. Improving physical appearance immediately may be more important than the possibility of developing skin cancer in the long term, in college students²⁰. Three studies were included in the systematic review on appearance-focused interventions²¹⁻²³. Four additional studies were found during the literature search for this report^{20, 24-26}.

The interventions ranged from appearance-focused essays to showing participants UV photos of sun-damaged skin. The results of all the interventions indicate that college students may be more influenced to change tanning behaviours due to appearance concerns rather than health concerns.

Mahler et al. completed several studies on the effects of appearance-oriented interventions on sun-protection intentions and self-reported behaviours²⁴. In the first study, 68 college students and 76 beachgoers were randomly assigned to receive or not receive a photoaging information intervention and, separately, to receive or not receive a novel ultraviolet photo intervention. The UV photographs highlighted the skin pigmentation that results from UV exposure. Questionnaires on sunscreen use, attitudes, and intentions towards sunbathing were completed by participants pre- and post-intervention. The UV photo intervention significantly increased the intentions of both college students and beachgoers to use sunscreen in the future ($p < 0.03$). A follow-up conducted with the beach sample indicated that the combination of UV photo and photoaging information resulted in lower self-reported sunbathing ($p < 0.03$).

A second study was conducted which evaluated an appearance-oriented intervention that was used to reduce UV exposure from tanning booth use among college students²⁵. The intervention used a UV photograph to highlight the damage to facial skin caused by previous UV exposure. After controlling for baseline measures, students who viewed their UV photo reported significantly less booth use at a follow-up session 3-4 weeks later than did students not shown a copy of their photograph. At follow-up, 16% of students who viewed their photo reported using tanning booths versus 47% of students who did not view their photo.

Mahler et al. examined the efficacy of UV photographs and information about photoaging for increasing the sun protection intentions and behaviours of young adults²⁰. They also studied whether any effects of this appearance-oriented intervention could be enhanced by providing a non-UV alternative for achieving a tan, such as using sunless tanning lotion. The design involved a randomized control trial with a one month follow-up. The outcomes measures were participants' sun protection intentions and sun protection behaviours. The intervention resulted in significantly stronger sun protection intentions ($p < 0.001$) and greater sun protection behaviours ($p < 0.05$) relative to controls. The groups that also used sunless tanning lotion tended to engage in greater sun protection behaviours than the group that received the intervention alone, however this result was not significant ($p < 0.08$).

An appearance-based skin cancer prevention intervention involving college-age females was implemented in the southeastern United States²⁶. One hundred and forty-seven respondents were randomly assigned to treatment or control groups. Treatment respondents received a short workbook describing the appearance damaging effects of indoor tanning. At the short-term follow-up intervention, participants reported a 45% reduction in times they intended to tan compared to a 10% reduction in control subjects. At the long-term follow-up, participants reported significantly fewer indoor tanning visits (4.16) than the controls (7.48).

Summary

Evidence is sufficient to determine the effectiveness of interventions in primary schools for covering up behaviour, which includes wearing hats, pants, or long-sleeved shirts. These interventions included the provision of information, sun-protection activities, and environmental and policy changes. Inconsistent results prevented the determination of the effectiveness of interventions in primary schools for other behaviours, such as seeking shade or avoiding peak hours. The design of the study greatly influenced the effect size of the data for all behaviours. There was a greater relative change evident in before and after studies relative to concurrent comparison studies. It is possible that the size of the effect would diminish over time in before and after studies, as most post-intervention data was collected only over a short-term period.

Evidence was insufficient to determine effectiveness of interventions on reducing UVR exposure in childcare, outdoor occupational settings, healthcare systems, secondary schools, and colleges. **The results of the many studies evaluated indicated that, while educational interventions may increase the knowledge of people, increased knowledge does not always lead to changed behaviour.** The

effectiveness of these interventions could not be determined due to the variability in interventions and evaluated outcomes.

The systematic review team reported sufficient evidence for the effectiveness of interventions in the recreational and tourism setting. While the results from three studies demonstrated evidence for effectiveness of the intervention on the adult sun-protective behaviour of wearing protective clothing, the interventions targeted different populations and employed varying interventions. The evidence on the effectiveness of interventions on adult incidence of sunburn was inconsistent, as was all evidence for interventions on children.

The success of health-focused interventions to influence intentions but not behaviour among college-age students prompted the design of appearance-focused interventions. Appearance-focused interventions are designed with the hypotheses that individuals' concerns about their own appearance may be more effective than health warnings alone for countering the influences on tanning. To date, there are a small number of studies suggesting that an effective strategy might be to emphasize that UV exposure can have negative consequences for individual appearance. College students who viewed their own UV photo reported less use of tanning booths 3-4 weeks following the intervention²⁰. Other studies showed that college students who viewed their UV photo and were given photoaging information had greater sun-protection behaviours than control subjects^{24,25}.

Despite the completion of a large number of studies involving UVR reduction strategies, there are several research issues that make the evaluation of UVR reduction interventions difficult. One important issue is the lack of standardization in these intervention studies. The interventions, study designs, measures of UVR exposure, and measures of outcomes vary greatly between studies, making the comparison and contrast of studies difficult. Many of the studies contained multi-component interventions. Even if the intervention resulted in a significant change in sun-related behaviour, it was not possible to determine whether it was the combined components of the intervention that resulted in change, or one specific component.

Many of the studies examined outcomes such as knowledge, attitudes, and intentions, rather than sun-protective behaviours. More behavioural outcomes need to be examined as the relationship between knowledge, attitudes, intentions, and behaviour is not clear. The behavioural outcomes that were reported were often self-reported behaviours rather than physical measures by a third party.

Finally, many of the studies had short-term follow-up periods. This makes it difficult to evaluate the effect of interventions on behaviour change, as short-term behaviour changes may not be indicative of long-term habits. Future studies need to follow participants over a greater time period to determine the effectiveness of interventions on changing long-term sun-protection behaviours.

Conclusion

Based on the available evidence, the following conclusions were made:

- 1) Educational interventions in primary schools are measures that are effective in reducing ultraviolet radiation in children through increasing covering up behaviour. The educational interventions contained many components including classroom teachings, health fairs, interactive and home-based activities, an educational picture book, interactive CD-ROM multimedia programs, teaching by medical students, and peer education. It was not possible to evaluate the effectiveness of specific components or the effectiveness of educational interventions in changing long-term covering up behaviour.
- 2) Educational interventions focused on childcare settings, secondary schools and colleges, outdoor occupational settings, healthcare systems, and recreational and tourism settings may also be effective, but there is no consistent evidence to recommend these interventions.

- 3) The results from appearance-focused interventions indicate that college students may respond better to interventions that address individual appearance concerns rather than health outcomes, however this is a new area of research and there is not enough evidence to recommend appearance-focused interventions at this time.
- 4) Interventions may be effective at changing knowledge in the absence of a change in behaviour. The relationship between knowledge, attitude, intentions, and behaviour is not well defined.
- 5) The inconsistency in intervention content, UV exposure measures, study outcomes, and methodology make the results of studies difficult to compare and evaluate systematically. Standardization among intervention content, methodology, and outcomes would permit a much more systematic evaluation of intervention effectiveness.
- 6) Several of the studies included in this review were randomized control trials. This illustrates that evidence-based data collecting, which leads to evidence-based decision making, is being conducted in public health.
- 7) There were many studies identified during the literature search that implemented interventions without measuring the effectiveness of the intervention on UVR exposure. This was very evident for interventions in outdoor occupational settings. Many regulations, programs, and guidelines have been derived for outdoor occupational settings, yet there is no follow-up to measure the effectiveness of these interventions. In order to collect evidence-based data, researchers must follow up interventions with measures of intervention effectiveness.

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Appendix A Summary table for evidence papers identified in the literature search that were not included in the systematic review by Saraiya et al.

Setting and Reference	Population	Intervention	Methodology	Comparator	Outcome
<i>Primary schools</i>					
USA ¹⁰	Primary schools n=130 schools n>6000 children	•SunWise program •Cross curricular activities, internet learning, community partnerships	•Schools that participated in the SunWise program were the intervention group/schools that did not participate served as the control •Pre-intervention and post-intervention surveys completed	•Control schools and intervention schools •Pre- and post-intervention surveys	<u>Measures</u> •Knowledge variables, attitudes and beliefs about tanning, sunburn frequency, intentions <u>Results</u> •Student knowledge of the need for SPF 15 improved from 50% pre-test to 78% post-test •Knowledge of the UV index improved from 28% pre-test to 57% post-test •Attitudes that tans are healthy decreased in the intervention group •No changes in knowledge or attitudes
<i>Outdoor occupational settings</i>					
Western US and Canada ¹⁴	Ski area employees n=7289	•Sun safety messages disseminated through multiple media and interpersonal channels •Preventative messages were apply sunscreen, wear a hat, and wear protective eyewear	•Effectiveness of program was evaluated in a randomized, pair-matched, nested-cohort, pre-test/post-test controlled design •Unit of randomization was the ski area •Pre-test and post-test surveys were conducted	•Half the ski areas received the intervention •Other ski areas acted as controls	<u>Measures</u> •Awareness of sun safety program and number of sunburns received <u>Results</u> •Employees at interventions ski areas were more aware of the sun safety program and reported less sunburning at post-test than employees at the control areas •Program awareness was not predictive of reduced sunburning

Setting and Reference	Population	Intervention	Methodology	Comparator	Outcome
<i>Colleges</i>					
San Diego, CA ²⁵	College students n=204	•Uses UV photography to highlight facial damage caused by UV	•Randomized controlled study •Participants randomly assigned to either a UV photo or no-UV photo group •Baseline tanning booth reported •Intervention •Four weeks later students were asked again about tanning booth use since intervention	•Intervention group •Control group	<u>Measures</u> •Tanning booth use <u>Results</u> •Students who viewed their UV photo reported less booth use 3-4 weeks later compared to controls •At follow-up, 16% of students who viewed their photo reported using tanning booths, versus 47% of students who did not view their photo
San Diego, CA ²⁴	College students n=68 ages 18-37 Beachgoers n=76 ages 19-57	•In the first experiment, participants were shown a photoaging videotape and UV photo •In the second experiment, participants were given a photoaging brochure and shown a UV photo	•Participants assigned randomly to a 2x2 factorial design •Initial questionnaire given, intervention, and second questionnaire were completed •In experiment 2, participants were followed up with a telephone call	•Intervention group 1: receive photoaging information and UV photo •Intervention group 2: receive photoaging information but no UV photo •Intervention group 3: receive UV photo but no photoaging information •Control group: receive neither photoaging information nor UV photo	<u>Measures</u> •Sunscreen use and sun-protection habits <u>Results</u> •Both experiments indicated that the UV photo significantly increased intentions to use sunscreen (p<0.03) •For beachgoers, the UV photo and photoaging brochure resulted in lower reported sunbathing (p<0.03)

Setting and Reference	Population	Intervention	Methodology	Comparator	Outcome
San Diego and San Marcos, CA ²⁰	Volunteer college students n=146	<ul style="list-style-type: none"> •UV photographs and information about photoaging •Also provided sunless tanning lotion as a non-UV alternative 	<ul style="list-style-type: none"> •Randomized controlled trial •One month surprise follow-up conducted by telephone 	<ul style="list-style-type: none"> •Intervention group 1 •Intervention group 2 •Intervention plus self tanner •Control group 	<u>Measures</u> <ul style="list-style-type: none"> •Sun protection intentions and sun-protection behaviours <u>Results</u> <ul style="list-style-type: none"> •Intervention resulted in significantly stronger sun protection intentions ($p < 0.001$) and behaviours relative to controls ($p < 0.05$); sun protection behaviours included limiting sun exposure during peak hours, wearing sun-protective clothing, and wearing sunscreen
US ¹⁸	College coeds n=30	<ul style="list-style-type: none"> •Health education, sunscreen provided 	<ul style="list-style-type: none"> •Knowledge, attitudes towards sunscreen and tanning were taken before and after intervention •During the first 9 weeks and at week 15, skin colour and sunscreen use were measured 	<ul style="list-style-type: none"> •Intervention group •Control group 	<u>Measures</u> <ul style="list-style-type: none"> •Knowledge, attitudes, and behaviour <u>Results</u> <ul style="list-style-type: none"> •Intervention increased knowledge, but did not affect attitudes or behaviour

Setting and Reference	Population	Intervention	Methodology	Comparator	Outcome
Southeast USA ²⁶	Female university students n=147	<ul style="list-style-type: none"> ·Workbook given to participants in intervention group ·Workbook provided information on the appearance-damaging effects of indoor tanning 	<ul style="list-style-type: none"> ·Respondents were matched following the pre-intervention assessment and randomly assigned to groups ·All respondents were administered a pre-intervention assessment, a 2-week follow-up and 2-month follow-up assessment 	<ul style="list-style-type: none"> ·Intervention group ·Control group 	<u>Measures</u> <ul style="list-style-type: none"> ·Attitudes, beliefs and intentions to indoor tan <u>Results</u> <ul style="list-style-type: none"> ·At the short-term follow-up intervention, participants reported a 45% reduction in times they intended to tan compared to a 10% reduction in control subjects ·At the long-term follow-up, participants reported significantly fewer indoor tanning visits (4.16) than the controls (7.48)

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